Pulelehua

A New Traditional Community

FINAL ENVIRONMENTAL IMPACT STATEMENT

Volume 2 of 2: Appendices

PREPARED BY:

PBR HAWAII

PREPARED FOR:
ACCEPTING AUTHORITY,
STATE OF HAWAII LAND USE COMMISSION
DOCKET NO. A04-751

MAUI LAND & PINEAPPLE COMPANY INC.

TOWN PLAN
PREPARED BY:
DOVER, KOHL & PARTNERS

AUGUST 2005

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A

Market Study & Economic Impact Analysis

THE HALLSTROM GROUP INC.
REAL ESTATE
CONSULTANTS
& APPRAISERS

Market Study and Economic Impact Analysis of the Proposed

PULELEHUA COMMUNITY

to be located at

Mahinahina, West Maui, Hawaii

Prepared for

Mr. Robert McNatt
Maui Land & Pineapple Company

March 2005

ARBITRATION
VALUATION AND
MARKET STUDIES

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March 1, 2005

Mr. Robert M. McNatt
Maui Land & Pineapple Company, Inc.
120 Kane Street
Kahului, Maui, Hawaii 96732

Market Study and Economic Impact Analysis of the Proposed Pulelehua Community Mahinahina, West Maui, Hawaii

Dear Mr. McNatt:

At your request, we have completed a series of studies quantifying the probable market standing of, and anticipated regional economic impacts resulting from, the proposed Pulelehua community, a master-planned, local resident-oriented development to be located on 312 acres mauka of Honoapiilani Highway, abutting the Kapalua/West Maui Airport, approximately six miles north of Lahaina Town, West Maui, Hawaii.

As currently envisioned, the project will contain 895 total residential units, including 151 apartments, 299 townhouse and flats, and 445 cottages and single-family homes. The community will also have approximately 96,475 square feet of retail/commercial and 78,000 square feet of mixed-use floor space on some 15 acres of project-serving "neighborhood" business sites. The master plan also provides for a variety of public/civic uses, and open space/parklands. The intent is to develop a series of interconnected neighborhoods providing complete, quality lifestyle opportunities in close proximity to West Maui employment, service providers and civic/recreational amenities. At least half of the units will be priced according to county affordability guidelines, and approximately 310 of the house lots will have the potential for future ohana units.

The development goal is to help address the acute need for full-time residential units in West Maui. Although the study region is the focal point of the island's visitor industry and a vital component of the Maui economy, there has not been a major residential inventory addition in years, and it remains one of the tightest housing markets in the nation.

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The Pulelehua site, identified on State of Hawaii Tax Maps as a portion of Second Division Tax Map Key 4-3-01, Parcel 31, is a moderately sloping site extending mauka from Honoapiilani Highway, above the Kahana and Mahinahina shoreline vacation villages, to the makai side of the Kapalua/West Maui Airport. The terrain in the area is generally regular (although there are two gulches bisecting the property), offers many superior ocean and mountain panoramas, and has a desirable moderate climate.

The focus of our assignment was eight-fold:

1. To quantify the demand for residential inventory in the West Maui study area using a variety of demographic, economic and other analytical techniques.

2. To identify recent residential inventory additions in the regional market and their construction, pricing, and absorption histories.

3. To identify approved and proposed competitive residential inventory additions, with concern given to timing, likelihood of actualization, anticipated characteristics and other relevant traits.

4. To quantify the pricing "affordability" ratios/levels for West Maui housing units given household income trends and governmental/conventional mortgage qualifying criteria, and identify the number of households needing such units.

5. To estimate the demand for neighborhood light industrial and commercial space within Pulelehua based on potential consumer population forecasts.

6. To assess the appropriateness of the subject holding for the proposed uses, and ascertain whether it has sufficient attributes to obtain a competitive market share.

7. To identify the most probable purchasers for the subject inventory and estimate the speed of product absorption.

8. To estimate the direct and indirect, on and off-site benefits flowing to the local economy as a result of undertaking the subject development, including job and wage creation, business profits and discretionary expenditures.

The pertinent results from our study are contained in the following summary report, focusing on tabular presentation with brief narrative conclusions.

In completing this assignment, we visited the Pulelehua site, environs, and competitive projects in the study area; interviewed knowledgeable developers, brokers and other parties regarding current sales and market conditions; utilized published and on-line databases; reviewed governmental land use designations, entitlements and policies in the region; and identified proposed competitive developments for each subject use type and their attributes.

This study was prepared for Maui Land & Pineapple Company, Inc. (ML&P), with Robert McNatt of ML&P and Tom Schnell of PBR Hawaii (project entitlement planners) being the primary client contacts. The purpose of this assignment is to provide market analysis and conclusions regarding the proposed Pulelehua community for use in land use entitlement petitions for the property, and for internal planning purposes. The publication date of the report is March 2005. The initial investigation and analysis was completed in spring/summer 2004, with nominal revisions and updating prior to this edition.

All conclusions presented herein are subject to the identified limiting conditions, assumptions and certifications of The Hallstrom Group, Inc., in addition to any others set forth in the text or tables. All work has been completed in conformance with the Code of Professional Ethics and Standards of Professional Appraisal Practice of the Appraisal Institute, and the Uniform Standards of Professional Appraisal Practice (USPAP).

Based on our investigation and analysis we conclude:

- There is significant market support for the proposed Pulelehua housing units, with strong current and projected demand and scarce supply throughout West Maui. Community consumers and airport-related uses will support the secondary neighborhood light industrial and commercial components.

- The property is centrally located, with good access, climate and view characteristics, and is well-suited for the proposed development. The master plan will achieve market acceptance by providing desirable residential and neighborhood business opportunities for local residents.

- Full absorption of the 895 residential units and the 15 gross acres of mixed-use/ commercial sites comprising the Pulelehua project is estimated to require approximately six years.

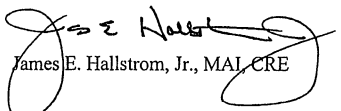
- The construction of the project will bring $301.5 million in development capital into the Maui economy and create 8,399 worker years of employment and $278.8 million in wages during the initial 10-year build-out and use period. The on-site operating businesses and building maintenance will have 705 permanent full-time equivalent positions with $17.7 million in annual wages, and generate another 254 off-site/support jobs.

- The 895 units will have a de facto population of 2,669 persons, including 2,492 permanent residents, of which some 623 will be of school age and circa 411 will be public school attendees. The discretionary expenditures of the community into the Maui economy will be about $30.9 million annually.

We appreciate the opportunity to be of service in regard to this holding. Please contact us if further detail or discussion in the matter covered herein is required.

Respectfully submitted,

THE HALLSTROM GROUP, INC



James E. Hallstrom, Jr., MAI, CRE

/as

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Qualifications of The Hallstrom Group, Inc.

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Introduction

The proposed Pulelehua community will encompass approximately 312 acres in the mauka/northerly area of the Lahaina to Kapalua coastal corridor, adjacent to the Kapalua West Maui Airport, upslope from the Mahinahina and Kahana beachfront communities, and abutting the existing Kahana Ridge subdivision. The holding has a viable location for moderate intensity urban uses: being proximate to major employment centers, supporting businesses and services; offering desirable view/climate amenities and nearby recreational areas; and ready access onto a major island thoroughfare. It is a natural expansion area for the growing Kahana area.

The subject site possesses sufficient attributes to provide competitive development in service of fundamental regional housing needs. The goal of the Pulelehua master plan is to maximize real property resources through creation of a reasonably self-contained, local-oriented community of inter-connected neighborhoods offering affordable-priced and market-level residential inventory with sufficient commercial and mixed-uses to support a quality, integrated lifestyle.

Maui's on-going transformation from an agrarian to urban economy has created strong demand for a variety of land uses over the past thirty-plus years, a trend which will continue during the next two decades. In order to support this growth, an expanding urban land base is required to provide the residential, industrial, retail, business, service, office and other uses vital for a healthy, modern island economy.

Market-driven development since statehood has been generally focused in relatively defined single-use districts, which are efficient in many respects, but can result in logistic/movement issues and a failure to capitalize on the natural synergy possible between residents and providers of goods and services.

The restoration of intimacy between residential uses and commercial uses, and between neighborhood patrons and neighborhood businesses, within a small mixed-use community is considered a leading-edge concept and a solution to urban sprawl. Yet, in many ways it harkens back to Old Maui when residents and businesses enjoyed immediate proximity, common architectural types, and a more pedestrian-oriented experience.

Pulelehua will offer a variety of housing oriented towards the local buyer, ranging in type from long-term rental apartments and lofts above ground floor businesses, to single-family homes, and in price from "affordable" to market levels. The focus will be on models meeting the needs of overcrowded West Maui households, young families seeking entry-level housing, seniors, low to moderate income families and regional/ML&P workers. The project is consistent with nearby existing uses (Kahana Village and Kahana Ridge).

Pulelehua will specifically address the shortfall of residential units in West Maui during the near to mid-term, contribute to the regional urban land base, enhance the island's economy, provide hundreds of housing units and employment opportunities, and strengthen the state and county tax base.

The purpose of our assignment has been to analyze the proposed Pulelehua community in light of competitive, regional, prevailing and forecast economic/market conditions in order to answer six primary study questions:

- What is the forecast demand for additional residential uses in Lahaina/West Maui over the next two decades?
- How much competitive residential supply is currently available and proposed in the study area?
- Will additional development be required to meet demand forecasts?
- How much supporting neighborhood commercial and light industrial space demand will be created by Pulelehua residents and the project location.
- Is the Pulelehua master plan an appropriate and competitive site and concept capable of successfully achieving absorption during a reasonable exposure period?
- What are the regional economic impacts which will result from the Pulelehua community during its construction and long-term use and projected community population levels?

These issues were addressed through a comprehensive research and inquiry process utilizing data from market investigation, governmental

agencies, various Hawaii-based media, industry spokespersons/ sources, on-line databases, and published public and private documents.

The pertinent results from our study are contained in the following summary report. Supporting materials contributing to these conclusions are on file. The narrative presentation is divided into seven sections:

1. **Primary Study Conclusions**
2. **The Subject Property and the Proposed Project**
3. **Overview of the West Maui Region**
4. **The West Maui Residential Sector**
5. **Analysis of Subject Neighborhood Commercial and Light Industrial Demand**
6. **Appropriateness of the Subject for the Planned Uses**
7. **Economic Impacts of the Proposed Subject Development**

The primary source information regarding the subject were maps, plans, descriptions, and background materials provided by Maui Land & Pineapple Company, Dover Kohl & Partners, and PBR Hawaii. We have also employed some findings from the *Maui County Community Plan Update Program Socio-Economic Forecast (Phase I Report)*, June 14, 2002, prepared by SMS for the Planning Department of Maui County, which is to form the statistical foundation for the ongoing community plan update process. Numerous other public and private data sources, as cited, were also used. The initial study was completed in spring/summer 2004, with limited updating prior to final publication in March 2005.

Primary Study Conclusions

We have reached the following conclusions regarding the West Maui market and the probable standing of the Pulelehua inventory therein:

The Residential Market

- The West Maui housing sector is currently undersupplied by some 470 to 1,168 units and will require some 3,447 to 5,440 new units over the next 17 years (through 2020) in order to adequately service demand. Approximately 31 percent of the unit demand during the next two decades will be at prices (or rental equivalents) of under $205,000 in current dollars, 25 percent of the demand will be for units priced between $205,000 and $380,000, 25 percent for homes ranging from $380,000 to $550,000, and 19 percent for homes above $550,000.

- At present, single-family homes and lots comprise over 60 percent of the offered inventory; however, projections are for multi-family units to become a moderately increasing fraction of the resident housing sector, reaching about 48 percent of the total new product by 2020. Current prices for single-family homes in the study area generally range from about $300,000 to $8 million, multi-family units at $200,000 to $3.5 million, and vacant house lots at $250,000 and up.

- Based on HUD and Maui County guidelines, the 2004 "affordable" housing price range for "Low Income" households, those earning 80 percent or less of the current median Maui household income of $60,700, is at $205,000 (rounded). For "Low-Moderate" income households, those earning 80 to 100 percent of the county median, affordable prices can reach as high as $258,000; and for "Moderate Income" households, with income at 100 to 140 percent of median, affordability runs to $378,000.(1)

- Virtually all new "residential" product recently offered in West Maui has been either resort-oriented (within Kapalua or Kaanapali Beach), estate-sized agricultural lots (Launiupoko), or homesites beyond the affordability of most local households (Kahana Ridge). Even so, all offered product has been rapidly absorbed, with most projects having application/waiting lists.

- While there have been discussions regarding 10,664 potential additional units (including Pulelehua) within major proposed West Maui projects, few have been approved to date, with only

(1) The terms and criteria for "low", "low-moderate", and "moderate" in regards to income levels are the traditional divisions made by public planning and housing agencies in Hawaii. Usage may vary between jurisdiction over time.

a fraction (some 1,265, excluding Pulelehua) having a likely chance of being built in the near to mid-term. And, of these, more than half will be within the upper-end Kapalua Mauka project. The other 8,502 non-subject units are in projects which are only in the earliest planning stages, face meaningful community opposition, are for native Hawaiians only, or are bogged down by interminable litigation, and are unlikely to reach fruition within the next ten to fifteen years. The 1,265 approved and likely units are insufficient by upwards of 2,300 units to meet minimal demand levels, and are short of maximum demand requirements by more than 4,300 units.

- There is currently strong market support for the proposed Pulelehua residential inventory.

The Neighborhood Commercial/Light Industrial Component

- The residents of the Pulelehua community will generate the need for some 96,000 square feet of "neighborhood" and supporting commercial and light industrial floor space. These are uses appropriate for a residential project and needed if the comprehensive lifestyle envisioned by the master plan is to be achieved.

- Secondary consumer groups, including Pulelehua guests, workers in the community, passers-by, specialty shoppers and airport users, are anticipated to create (or support) demand for an additional 40,300 square feet of space.

- Additional demand will be generated by airport-related businesses, estimated at 39,000 square feet of floor area.

- The total direct demand for neighborhood and airport-oriented commercial/mixed-use uses at Pulelehua will be approximately 175,000 square feet of finished floor space. This magnitude of consumer requirements is supportive of the master plan, which calls for up to 174,475 square feet of commercial/mixed-use floor area in the project.

- Retail uses will generally be limited and oriented towards meeting the direct, daily consumer demands of the community and nearby residents, including restaurants/food outlets, small grocery/convenience, video rental, banks, storefront professional/financial, gas station, and other services.

- Other business uses in the community may include health and medical providers, financial and professional services, self-storage, garden/nursery, Artisan workspace, local suppliers, offices for resident entrepreneurs, and other services. Airport-related uses could include base yards, freight forwarders and other businesses.

- Given traffic issues in West Maui, the time constraints of a modern family, the limitations of nearby support commercial opportunities, the income demographics of project residents, airport proximity, and the desire to develop a competitive community offering a comprehensive lifestyle, we consider the commercial/mixed-use component of the Pulelehua master plan to be essential.

The Subject Project

- The subject property presents a reasonable opportunity to meet some of the existing and projected shortfall in urban real estate in West Maui; specifically addressing the community needs for local resident housing and quality lifestyle opportunities during the next two decades. It has:

  1. The necessary physical characteristics (size, shape topography) to support residential neighborhood development.

  2. Ready access to a primary highway.

  3. Proximity to, but is outside, the congested Lahaina/Kaanapali core.

  4. Nearby existing utility systems.

  5. Proximity to major employment facilities in the region.

  6. A location within the urbanizing coastal corridor stretching from Lahaina to Kapalua.

  Owing to its "interior" location (non-resort with no direct major thoroughfare frontage) and resident-orientation, the housing component should not be subject to extreme demand pressures from second home/vacation purchasers as is experienced within makai or up-scale regional projects, and the commercial/mixed-use component will not attract major "big box"/intensive

retailers which are better suited to other areas of the island. Rather it presents a local-serving development opportunity converting feral, and excess agricultural lands into a modern fully-serviced residential community.

- The proposed Pulelehua master plan embodies characteristics that will prove amenable to a wide range of residential uses within a mixed-use concept consistent with leading edge urban land use trends. Among the primary attractions of the master-planned "neighborhood" from a market perspective:

  1. It maximizes the utilization of urban potential lands by combining uses, permitting varying densities, and implementing planning and architectural guidelines.

  2. Residents will be within walking distance of a wide-range of needed supporting services, goods and employment opportunities. This is particularly important for the low to moderate income households and young families which will comprise a significant portion of the community; and a needed attribute given the current limitations of public transportation.

  3. The increased carrying capacity and greater efficiencies resulting from, including the commercial and mixed-use components, means less land is required to service community needs, thereby limiting urban sprawl.

  4. The mixed-use development concept being oriented to local residents and businesses (non-resort) is new for Maui, and will provide additional opportunities to creatively meet the demands of the residential and business sectors.

  5. The ability to incorporate mixed-use concepts and associated densities will allow the builders of the business spaces to ameliorate costs and risks by incorporating residential units, which in turn help meet regional housing needs.

Subject Absorption Estimates

- We estimate the developed Pulelehua inventory will require about six years to achieve full absorption once product is offered following completion of the entitlement process and

emplacement of community infrastructure, which will collectively require about 18 months. If the market continues in its current up-cycle (or another occurs during sales), the proposed competitive product is not actualized in a timely manner, and the mixed-use concept achieves rapid acceptance, the absorption could be faster. If the economy slows, all of the planned competitive supply is quickly approved and built-out, and no benefits are realized from mixed-use potentials, the absorption period could be longer.

- Table A displays our mid-point absorption and pricing estimates for the proposed Pulelehua community.

- At least 51 percent of the subject housing units will meet affordability pricing criteria for affordable housing projects as defined in Section 2.86.140 of the Maui County code.

Subject Economic Impacts

- The construction of the Pulelehua community components (infrastructure, finished units and businesses) and their on-going use will bring some $301.5 million in direct real property capital investment and create some 8,399 "worker years" of employment on Maui, generating $278.8 million in total wages, over the initial ten-year build-out and usage period of the project.[2] Profits to local contractors and suppliers resulting from the development are estimated to be $47.4 million.

- The on-going commercial and mixed-use businesses in the community will create the equivalent of 634 permanent full-time jobs having annual wages of $16 million (in current dollars). The maintenance, landscaping and upgrading of the project homes and buildings will create about 71 permanent jobs in the regional economy with annual wages of $1.7 million.

- The average de facto population of the community at full-absorption is forecast at 2,669 persons, of which 2,492 will be full-time residents, 118 will be second-home users (or part-time residents); and the rest, guests of homeowners. There will be

(2) Our analysis assumes a time line with some 18 months of entitlement and infrastructure, and the first units coming on line by the end of year two. Full build-out will take another five years followed by three years of stabilized use/operations.

TABLE A

SUMMARY OF ABSORPTION ESTIMATES BY PRODUCT TYPE
Market Study of the Proposed Pulelehua Community
Mahinahina, West Maui, Hawaii
Using Rounded Mid-Point Demand Estimates

Sales Year (1)	Residential Inventory (Units)		Retail & Business (2) (Square Feet)	Mixed-Use (2) (Square Feet)
1	250	(3)	12,500	25,000
2	125		15,000	20,000
3	130		17,500	15,000
4	130		17,500	15,000
5	130		17,500	3,000
6	130		16,475	
Totals	**895**		**96,475**	**78,000**
	6.0 Years		**5.9 years**	**4.2 years**

(1) Assumes first products are available for rent/sale in 2007.
(2) Based on single-use applications. The mixed-use potentials for some of the sites (with businesses on first floor and residences above) could stimulate demand above projected levels.
(3) Includes 125 low/moderate income rental apartments and 125 for sale units.

Source: The Hallstrom Group, Inc.

an estimated 623 school age children, of which 411 are likely to attend public institutions. The stabilized discretionary expenditures of the neighborhood population are estimated at $30.9 million annually, and the household income of full-time residents at $52.2 million per year.

- The total base economic impact on Maui from the community for the first ten years of development, construction and use is projected at $996.3 million, with a stabilized base impact of $132.2 million per year thereafter. The total overall economic impact during the first decade will be in excess of $1.9 billion and some $264.4 million annually over the long-term.

The Property and Proposed Pulelehua Community

The Pulelehua Property

The proposed Pulelehua community will be located on an irregularly shaped site of approximately 312 acres (out of a larger 1,746-acre parcel) stretching upslope from the mauka frontage of Honoapiilani Highway to the makai side of the Kapalua West Maui Airport property, above the shoreline villages of Kahana and Mahinahina. The holding varies in depth (mauka/makai) from 700 to 2,900 feet and in width (north/south) from 4,500 to 6,900 feet.

The site has 4,800 lineal feet of highway frontage and runs in elevation from approximately 80 feet above sea level along the right-of-way to 260 feet southerly adjacent to the airport. The topography is generally consistent and moderately sloping; however, one large and one minor gulch bisect the property, dividing the site into three distinct project areas.

The property is identified on State of Hawaii Tax Maps as Second Division, Tax Map Key 4-3-01, Parcel 31 (portion). A full range of utilities are available in the area, but will require significant extension and some enhancements in order to service the proposed community.

Superior view panoramas are available from most areas of the site, makai across beachfront vacation areas and the Pailolo Channel towards Lanai and Molokai, and mauka up the forested westerly flanks of the West Maui Mountains. The northerly leeward climate is very desirable among local residents; warm, low humidity, generally dry, with occasional showers, and typically gentle breezes.

At present primary access to the property is available directly from Honoapiilani Highway, a four-lane, high-speed, macadam surfaced thoroughfare which is the primary arterial for West Maui. The Kapalua West Maui Airport access road (Akahele Street) extends from the highway (at a signalized intersection) through the center of the subject to the airport terminal. Additional access points from Honoapiilani Highway are planned as part of the community.

The surrounding neighborhood has a mix of use types. Immediately mauka of the property is the airport, with agricultural fields and open/forest lands beyond. On the northerly/makai side of the subject are the Kahana Ridge (240 house lots) and Kahana Hui (16 agricultural lots) subdivisions. The highway is along the central and southerly makai portions of the site, with the oceanfront vacation communities beyond. The lands north of the holding are in agricultural uses or undeveloped, and the Department of Hawaiian Home Lands Honokowai parcel (in-planning for homestead subdivision) lies to the south.

The Proposed Community

The Pulelehua master plan calls for a total of 895 residential units, up to 174,475 square feet of commercial/mixed-use floor space, roadways, greenbelts, and recreational/civic uses. The primary residential and business components in the land use design can be summarized as follows:

PULELEHUA UNIT COUNT

Unit Type	Total Units/Area	
Main Street	20	
Live/Work	60	
Apartment	151	
Terrace/Row House	219	
Sideyard/Cottage House	122	
Front Lanai House	297	
Estate House	26	
Total Housing	**895**	**Units**
Neighborhood Retail	21,475	
Specialty Retail/Office	75,000	
Mixed-Use	78,000	
Total Commercial	**174,475**	**Sq. Ft.**
Civic/Community	**7**	**Lots**

Note: Some of the larger residential lots will have the potential to have an "ohana" (or secondary) dwelling unit. Under the current master plan, up to 323 lots would have this potential.

Although not specifically analyzed herein, some of the larger house lots in the community will have the potential to have an ohana unit, which are typically studio or one bedroom cottages or additions intended for extended households and multi-generational families.

The development team has described the master plan concept as follows:

> The site chosen for the Pulelehua community presents many unique opportunities. The gentle slope of the land provides exceptional views from many vantage points; remarkable gulches form natural divisions, and can be preserved as amenities for future residents; natural features such as the topography, wind direction, and the sun angle can be used to inform the designers of ways to organize the orientation of new buildings and streets.
>
> Pulelehua will contain three distinct neighborhoods proposed, each with its own individual character. The central neighborhood, anchored by Akahele Street, will be a complete neighborhood unit with a mix of uses including Pulelehua-serving retail, public uses including an elementary school and Wellness Center, open park and recreation spaces, and a variety of residential options. The uses and building types are to be organized with the most intense and closely spaced uses (commercial and higher density) in the central Crossroads area, with less intense uses (single family homes and less density) as you move toward the edges.
>
> The central Crossroads is to include a main street area, consisting of shopfront buildings with apartments above, and live/work units. At one end of the main street will be a Wellness Center overlooking a long terracing green that leads back to the highway. At the other end of the main street is the proposed site for the elementary school – healthy living and education will provide the anchors for the neighborhood. Near the airport, a light industrial, "workplace edge" area will be located – this area can accommodate airport-serving uses such as an air courier or car rental shop, and will serve as a buffer for residential units below. A range of housing types will complete this area; attached units modeled after Pacific terrace homes

would be found near the neighborhood center, allowing privacy and homeownership in a compact, affordable form. Single family homes in the form of island cottages or bungalows, duplexes, or courtyard apartment buildings are some of the building types that would be found in the "neighborhood general" area – between the center and edge. Larger single family lots would be found along the outer edge, completing a variety of housing types and price options. All of the buildings in the neighborhood will reflect traditional Hawaiian architecture; inspiration in their design was drawn from the work of architect Charles Dickey and from traditional Hawaiian settlements such as Lanai City. Houses located along streets that run mauka-makai will frame vistas to the water and the islands of Molokai and Lanai. These views can be enjoyed by pedestrians, bicyclists, and motorists on the streets, as well as residents on their front lanais.

Other proposed new neighborhoods are to be located to the north and south, separated from the central neighborhood by preserved gulches; these are to have a different, predominantly residential character. The north neighborhood is an opportunity to complete the Kahana Ridge neighborhood, providing shared park space and a network of walkable streets and trails to connect residents to other areas of Pulelehua town. Near the airport a green buffer area is to be created, including a large parcel for community gardens. The south neighborhood will contain new houses and parks that are intended to eventually become an interconnected part of a complete neighborhood, when linked to development on the Department of Hawaiian Homelands property.

Circulation through the new neighborhoods was an important consideration during the design process. Vehicular circulation is to occur along a network of interconnected streets to disperse traffic throughout the neighborhood. There are to be multiple connections to Honoapiilani Highway to allow a series of options to enter and exit. Not all of these connections would have traffic signals, and those that do would have synchronized lights, to keep traffic flowing along the highway.

Pedestrian circulation, as well as vehicular circulation, was given a high priority by the designers. Neighborhood streets will be designed for lower vehicle speeds, with appropriately narrow lanes, sidewalks, street trees, and buildings close to the street. A second circulation system of linked paths and trails will allow pedestrians and bicyclists to have another option for movement through the neighborhood. These paths and trails will run through a strategically located network of green spaces and exterior greenbelt that will make the neighborhoods livable for residents.

Overview of the West Maui Region

General Description - Island of Maui

Maui, the second largest island in the Hawaiian chain, lies midway between Oahu and Hawaii. The island is often called the "Valley Island," because of its valley-like central isthmus stretching between two mountain masses. The island measures 25 miles from north to south, a maximum 38 miles from east to west, and contains 728 total square miles. The western shores of the island of Maui include approximately 20 miles of clean, accessible, sandy beaches.

The Pulelehua site is located in the northwesterly quadrant of the volcanic-created island, within the coastal corridor of the West Maui mountains, approximately 28 miles from the county seat, airport and harbor facilities at Wailuku/Kahului. The area is generally referred to as "West Maui," or the Lahaina vacation community. The region historically was used for sugar cane and pineapple cultivation. Over the past three decades, the coastal corridor has evolved into a major vacation and commercial community, and one of the most extensively developed tourism locales in the state outside of Waikiki. The primary draws of the area to tourists are the numerous picturesque bays and beaches along the shoreline, and a superior climate--among the most favorable in the islands.

Wailuku, the historical hub of island business, is the seat of government for Maui County, which includes the islands of Maui, Molokai, Lanai, and Kahoolawe. Adjacent is Kahului, the headquarters for HC&S, the world's largest sugar plantation (and only major surviving Hawaii sugar operation), and the site of the primary transshipment facilities at Kahului Harbor and Kahului Airport. The Wailuku/Kahului central windward area of the island is the focus for Maui industrial activity, and the employment and resident population

centers of the county outside the destination resorts. Sugar production has traditionally been the island's base industry; however, with the closure of Wailuku Mill and Pioneer Mill (Lahaina), alternative agricultural, commercial, and residential opportunities for the land are being pursued, with the tourism-oriented businesses of the leeward side of the island (West and South Maui) coming to dominate the economy and job market.

According to the Year 2000 U.S. census, the county has a resident population of some 128,094 persons, more than double the 1980 total of 62,823, and equating to a compounded annual growth rate of 3.67 percent over the past two decades. Outside the Wailuku/Kahului urban enclave, Kihei and Lahaina are the largest settlements, both of which have undergone dramatic growth in recent decades due to tourism economic and land use demands.

Population projections completed as part of the most recent Maui Community Plan Update call for the present island population of circa 123,000 (year end 2003) to increase by more than 12 percent during the next seven years, reaching 138,665 persons, by the Year 2010 under the SMS "baseline" alternative. Such expansion equates to a compounded annual growth rate of 1.73 percent.

Most of this growth is forecast to occur in the three "major" *Community Plan* regions of the island: Wailuku-Kahului, Kihei-Makena, and West Maui (which includes Pulelehua).

Attracted by a thriving tourism plant, some 45,000 non-residents additionally populate the island each day--about 40 percent (18,000) in West Maui. The capital expenditures associated with the development and operation of visitor-oriented facilities and services, and their secondary effects, now comprise more than two-thirds of the total island economy, and has a ripple effect throughout all governmental and private finances.

Notwithstanding a few minor stagnant periods focused in several submarkets during the early 1980s and from 1991 through late 1994, the Maui economy has generally "boomed" over the last two decades, growing at a long-term rate which places it among the more vibrant regions in the country. As Oahu before it, the island has successfully been transformed from a simple agrarian-based structure to a diversified service model founded on a widely recognized and well-established tourism industry.

From the mid-1980s through summer 1990, the demand for real property development had been near or at record levels in all sectors. Beginning at the end of that year, the market became subdued due to looming recession and war concerns. This downturn, which affected virtually every sector in the statewide real estate market lasted until the fourth quarter of 1994, at which time tourism and residential markets began showing the most initial signs of recovery. Regardless of the extended economic setback, which affected Maui to a far lesser degree than the other islands, the most sensitive community real property issue remains how to manage long-term growth while encouraging economic vitality.

Despite a surge of preliminary development approvals for projects in central and southerly/leeward Maui during the last years of the economic expansion period ending in 1990-91, the final approvals and construction process for many projects proposed in the late-1980s were slowed during the 1990s by recessionary concerns and elected officials stressing "reasonable growth" planning viewpoints.

With the onset of widespread economic recovery on the island since 1997 there been a resurgent effort to actualize several major projects. Kehalani and Maui Lani, have each offered multiple developments which have been immediately absorbed, and the Makena Resort, Wailea 670 and Kapalua Mauka developments are again being pursued. New subdivisions have also been undertaken within the Wailea and Kaanapali resorts, and in Makena and Kihei; however, many of these are primarily oriented toward resort/second home buyers.

Apart from cyclical market trends, the primary brake on long-term general urban development on the island continues to be a lack of fully approved lands and sufficient in-place supporting infrastructure. Politically and financially stressed governmental agencies are under pressure to require developer-financed improvements, collective contributions and other community benefits as a function of the approval process.

Vast potentially habitable areas of the island and significant water resources have historically been devoted to sugar cane cultivation. Until the past decade, the long-term viability of the sugar industry was unquestioned, and the business remained a major employer and tax payer. As a result, cane land was re-classified for alternative (urban)

uses only after lengthy public agency reviews and negotiation with unions.

The impact of this policy, in the face of unmet resident housing needs and off-island capital driven, visitor-oriented land use demands, was large-scale appreciation in real estate prices (due to limited supply) and major dysfunction in the residential sector since the early 1970s.

Maui boasts the world's largest sugar plantation, which apparently remains economically productive and viable. However, there has been a shrinking of the Maui sugar industry over the past 15 years, with the closure of Pioneer Mill and associated plantation (Lahaina) and the Paia Mill, indicative of the industry's collapse. Alternative agricultural versus mixed-urban uses for large tracts of land are the source of public debate. Diversified crops (macadamia nut, coffee, cocoa, floral products and others) are viewed as potential sources of agricultural land use and employment. Yet, developing consistent yields, secure markets and product acceptance requires many years; and absorption of sugar lands by other crops has proceeded slowly. Over the long term on a per acre basis, diversified crops offer significantly more employment and return potentials than sugar, benefit more from the Hawaii "name," and are less prone to outside destabilization. But it will take generations to absorb the vast plantation lands by alternative agricultural products.

Overall, we remain optimistic as to the extended prospects for the Maui economy and resident population base, with a generally sustained growth forecast over the next two decades (though moderate by historic standards).

The investment value represented by the existing resort, industrial, commercial and residential components of the real estate market is many billions of dollars, and serves as a strong foundation for the island's economy far exceeding the other neighbor islands and most tropical resort locales around the world. Maui has had the highest visitor satisfaction index of any major destination worldwide in recent years, and has been voted "America's favorite island" by numerous surveys. The island is continuing to be successful in its transition from an agrarian to urban economy and land use structure, and is attracting large numbers of entrepreneurs and new investment capital.

Base historical indicators support long-term conclusions favoring a vital and growing Maui economy, founded on a superior natural appearance and attraction which portends well for future growth.

Regional Description - The Lahaina District (West Maui)

Historically acclaimed as the playground of Hawaiian Alii (royalty), and westernized during the boisterous whaling days of the 1880s, the leeward coast of Maui is once again undergoing significant change. During the past three decades, the 40 mile oceanfront corridor stretching from Makena to Kapalua, encompassing Lahaina and the Kapalua, Kaanapali Beach, Wailea and Makena resorts, has been transformed from sleepy villages surrounded by sugarcane fields and livestock range to one of the world's most successful vacation areas--all resulting from the influx of tourist and investor capital.

The Pulelehua property is located in the northerly area of this corridor.

The Lahaina District, comprising West Maui, is among the more heavily urbanized neighbor island communities. As shown on the chart below, the resident population of the study area has tripled during the last 30 years, and residential numbers would be significantly higher were sufficient product made available.

RESIDENT POPULATION OF LAHAINA DISTRICT (1)
1970 to 2003

Year	Residents	% Change (2)
1970	5,524	--
1980	10,284	6.41
1990	14,574	3.55
2000	17,798	2.02
2003	19,050	2.29

(1) U.S. Census Bureau data. Lahaina District is comprised of Lahaina, Napali-Honokowai, Kaanapali and Kapalua CDPs.
(2) Compounded annual growth rate.

Over the past 33 years, the compounded annual growth rate of the district has been at 3.82 percent.

Surveys have estimated that upwards of an additional 3,000 to 4,500 Maui residents would readily relocate to West Maui if housing, traffic and infrastructure problems were addressed.

The ten mile urban strand stretching close by the coastline from Puamana through Kapalua has been the economic engine which changed Maui from an isolated agrarian community to a world renown vacation destination boasting the finest in tourism infrastructure. While extensive quality development in the Kihei-Makena corridor in the 1980s placed that region in a competitive position with greater Lahaina, the South Maui area lacks the history and charm of West Maui.

Despite having very limited lands designated for urban uses, with agricultural and conservation holdings still dominating the land base, the subject region houses some 28 percent of all Maui jobs, generates upwards of $3.2 billion in economic activity annually, represents almost 30 percent of the island tax base, and more than 20 percent of countywide assessed real property value. While there are some urban lands in the district which remain undeveloped, older infrastructure systems, traffic issues and Hawaiian ownership claims have limited inventory development.

With the sugar industry in the region now defunct, after years of declining importance, tourism dollars have made the entire Lahaina District virtually a single integrated destination project. The region has inescapably moved further away from its historical standing as an outlying plantation community.

This conflict between visitor and resident uses over a very limited available land base has created a dysfunctional real estate market, with tourist-oriented dollars overwhelming the local population. Property and finished unit prices have escalated over the past two decades with development and infrastructure priorities being dictated by off-shore investment; currently dominated by mainland (primarily West Coast) interests.

There is nō doubt, the resident population in West Maui would be higher were it not for the competition in residential housing units between full-time resident and transient visitor demand. However, for a variety of reasons, including land costs, lack of infrastructure and community concerns, previous county administrations have restrained

Lahaina growth in favor of increasing Wailuku, Kahului and Kihei populations.

Yet, the additional numbers of workers West Maui will require during the next two decades as tourism fully matures in the region, the demise of the sugar industry, and a heavily over-burdened transportation system leading into the area, require a change of planning directions. State, county and private planners now call for housing demands created by regional economic activity in West Maui to be met "in-district" instead of moving demand elsewhere on the island and generating further traffic congestion.

While extensive plans have been forwarded by major private and public landowners over the past two decades years, as at Puukolii Villages, the Villages at Leialii (DHHL), and on other public and private holdings mauka of Lahaina, they have yet to provide inventory to meet demand. Given the lack of activity in these large-scale proposed developments, they are unlikely to provide meaningful product in the near to mid-term. The concentration of land ownership has resulted in a dearth of smaller subdivisions and projects which could have relieved some of the housing pressures. Fundamentally, there have been no major additions to the resident-oriented (non-resort) regional housing inventory in many years.

The proposed expansion areas of the Kaanapali Beach and Kapalua resorts will create upwards of 4,000 new permanent employment opportunities. Most all of these jobs will be primarily filled by existing trade workers and island residents coming of working age.

As part of the periodic West Maui Community Plan Update analyses undertaken by SMS in 2002, development and employment models were constructed for use in projecting land use needs in the Lahaina District from 2005 to 2020. Their "baseline" estimates call for 25,431 residents, 29,709 total jobs and 11,114 visitor units in the region by 2020.

Private estimates prepared based on maximum potential scenarios project the resident Lahaina District population could reach upwards of 30,000 by the Year 2020, if unencumbered by infrastructure and land use shortages.

The West Maui region has among the most extensive visitor plant among the non-Waikiki locales, and is developed with quality

restaurant, retail, recreational, and resort facilities. The anchor destination developments are the Kaanapali Beach and Kapalua Resorts, two of the state's more desirable master-planned vacation communities. Freestanding condominium and single-family units line the six mile coastal strip between the projects.

Currently, more than 5,300 Maui residents are employed at Kaanapali Beach hotels, shops, restaurants, and service centers. The Kapalua Resort presently has about 1,400 employees.

In summary, the Lahaina District is within the second generational phase of urbanization; continuing its transition from an agricultural-based economy into an intensive destination/residential community. Foundational economic assets are in place to support demand, and the historically tight leash on mauka land development will likely be loosened over the long term.

Large agricultural/rural lots are being subdivided from the mauka feral cane lands at Launiupoko, and are being considered elsewhere. While regional diversified agriculture is still in its infancy and has questionable near- to mid-term viability, such rural developments do provide potentials for future cultivation and a limited agricultural resurgence unless they are converted into "gentlemen estates" for non-resident owners.

The West Maui real estate market is in a generally positive condition, with highly favorable long-term prospects regardless of near-term infrastructure and land use concerns. It is widely considered as one of the world's foremost vacation areas, achieving exceptionally high room rates and occupancy levels, and would be a favored residential location were inventory made available. Demand for commercial, industrial, resort and residential land has shown substantial recovery after the early to mid-1990s downturn. Recently introduced light industrial/business lots in north Lahaina have been well received and all available new "residential" inventory (primarily resort and agricultural lots) has been fully absorbed. The indicators achieved over the past two decades must be considered as indicative of the favorable long-term supply/demand quotient for real estate in the district.

The actual and perceived desirability of West Maui among visitors, residents and investors is strong, leading to a more intensive and stable

economy than any other neighbor island district; approached only by West Hawaii.

The West Maui Residential Sector

The focus of the Pulelehua community is three residential neighborhoods (Crossroads, Kohanaiki and Mahinahina) containing a total of 895 apartment, multi-family and single family units. The design concept classifies the proposed housing model types into seven categories, ranging from apartment for long-term rentals to estate homes, and includes several atypical types (terrace homes, lofts over work space) which will be new to the regional market.

Most of the units will be affordable to moderate-market priced buyers, and are intended to service the housing needs of local resident working-class families. A moderate density residential development is in keeping with the overall scale and scope of the master plan, and will provide synergistic lifestyle and operational benefits to subject residents and businesses.

Historically, the West Maui residential sector has been dominated by condominium projects to makai (in the shoreline vacation villages) with single-family subdivisions in the mauka areas. The oceanfront multi-family projects are generally devoted to vacation/second home use, with limited numbers of full-time residents, while the off-water projects are more commonly used for resident housing.

The large majority of purchasers in single family subdivisions within the destination resort communities are non-residents, with the regional "neighborhoods" generally being largely composed of local households. Yet, the movement of non-resident buyers into non-resort subdivisions is an increasing trend, as evidenced at Kahana Ridge, and in Lahaina and Launiupoko.

Were it not for the scarcity of available units (and nagging transportation issues), West Maui would be a focal point of residential development on the island. Studies over the past two decades, including by HUD and Locations, Inc, have concluded the study area is "one of the tightest housing markets in the nation" with high demand and low supply, and that as many as 7,000 Mauians would relocate into the area if sufficient housing was available. Among the primary attractions of the area for residents are:

- proximity to major employment centers (Kaanapali Beach, Lahaina Town, Kapalua and within the shoreline villages).
- a superior warm, relatively dry, and northerly leeward climate.
- excellent mountain and ocean view panoramas.
- an expanding commercial (goods & services) and infrastructure base.
- modern, well-kept public facilities extensive beach parks, and civic support.
- a highly desirable lifestyle.

The supply of housing in West Maui has failed to keep pace with demand as the bulk lands are concentrated in few ownerships, traffic and community concerns have slowed the entitlement process, infrastructure capacities need to be addressed, and developers have pursued higher-return resort opportunities and residential projects elsewhere on the island.

Projecting the probable demand for the subject residential units is a three-step process:

1. **Quantification of West Maui Housing Unit Demand** -- Estimating the need for additional housing units in the study area based on population, vacancy and income characteristics.
2. **Identification of Current and Proposed Projects** -- Overview of recent/in-sales and proposed/potential residential development in the study area units in regards to unit types, sales activity and pricing.
3. **Assessment of Subject Demand** -- Correlation of demand and supply indicators in conjunction with the competitive attributes of the subject to estimate probable pricing and absorption factors.

We have assumed that the large majority of subject units would be affordable to moderate market-priced buyers with purchasers across a broad local resident demographic, including first time/entry level "buyers", residents relocating from other areas of Maui, young married

couples (typically with less than two children), empty nesters, and seniors. Although there may be substantial demand for the units by non-resident buyers, ML&P is proposing to "qualify" purchasers according to a rating system favoring their employees, other West Maui workers, and Mauians. We anticipate there will be only a limited number of investors or second-home/vacation purchasers in the subject project; all within the market-priced segment.

However, the demand for non-resort housing units by non-residents is an increasing trend in the study area, and most developments will not have as stringent purchaser criteria as Pulelehua, meaning greater numbers of general housing units are being absorbed by off-island buyers and being effectively removed from the local housing inventory.

This condition is intractable in West Maui given its wide recognition as a highly desirable vacation area, and any forecasts of residential unit demand must account for this significant market influence. Failure to do so will result in a dramatic under-assessment of the total numbers of units actually required to adequately service the sector, as these non-resident purchasers (who typically have higher incomes than local households) can more readily absorb appreciating prices, are intent on buying their "dream house", and invariably result in resident purchasers being marginalized.

All competing demand segments in a given market sector must be adequately accounted for if a reasonable demand/supply balance it to be achieved.

Quantification of Lahaina/West Maui Housing Unit Demand

We have projected the demand for residential units in the Lahaina Community Plan area using standardized formulae employing population forecasts, household size trends, and other market-based factors as follows:

RP/AHS = TRUR X (1 + (VA + NRPA)) = TMUD

Where:

RP is the Resident Population
AHS is the Average Household Size
TRUR is the Total Resident Units Required
VA is a Vacancy Allowance
NRPA is a Non-Resident Purchaser Allowance
TMUD is a Total Market Unit Demand

Each of the variables in the formula is based on historic statistics compiled by the Federal Home Loan Bank, U.S. Census Bureau, State of Hawaii DBEDT, other recognized governmental sources, and researched market data.

These past and current indicators were translated into estimates based on temperate trending interpretations. Our emphasis was on letting the data "speak for itself" through our projections, as opposed to making large-scale adjustments for subjectively anticipated lifestyle or market evolutions.

In this regard, our forecasts are representative of moderate future housing requirements, and could be understated if some movements continue as strongly as in recent years; such as the trend toward smaller household sizes and an increasing influx of non-resident purchasers into the market.

We have also included the "baseline" housing demand projections for the study area completed by SMS as part of their *Maui Community Plan Update Program: Socio-Economic Forecast* (June 2002).

The "Total Market Unit Demand" conclusions resulting from equation application are intended to quantify the total number of residences which will be needed in the study region over a 17-year projection period (2004 through 2020) in order to manifest a reasonably stable market with all purchaser/tenant demand segments served.

Currently, the Lahaina/West Maui housing market is in a moderately to strongly undersupplied condition on a basic level, with very low vacancy rates and rapidly appreciating prices over the last several years. Were all the households desirous of moving to the study area included in the accounting, the effective undersupply would be dramatically higher.

Stated governmental policy is to alleviate the unit shortage through actualizing long-proposed projects, increasing densities of urban lands, solving transportation problems, and development of feral lands at as rapid a pace as the infrastructure and community will bear.

The factors comprising our housing demand equation can be summarized as follows:

Resident Population (RP) -- This variable utilizes population forecasts made by SMS, and ourselves based on analysis of past state (Series 2020), county, and district forecasts.

Average Household Size (AHS) -- This factor was calculated using the data as provided by the above-cited sources and census figures. Extrapolating the 2000 census indications and SMS figures, we have estimated the current AHS in the study area was at 2.92 persons. This is at the middle to lower-end of the range for Maui regions.

Most Hawaii-oriented sociologists contend the movement to smaller household sizes will continue into the future, assuming enough units are built, until stabilizing at circa 2.6 to 2.9 persons. These forecasts factor in longer life-spans, the influx of single persons attracted to the climate and employment opportunities, and the tendency toward fewer children.

We project the average household size level in the study area will stabilize by the Year 2020 at about 2.68 persons, down meaningfully from current levels but consistent most island locales. SMS baseline forecasts show a 2.72 average household size in Lahaina/West Maui by 2020.

Total Resident Units Required (TRUR) -- This figure is arrived at by dividing the subject area resident population (RP) by the average household size (AHS). It is indicative of the minimum number of residences which would be required to meet basic market needs, assuming there were no vacant units, none uninhabitable due to on-going repair or deleterious conditions, and none occupied by non-resident persons.

For a market to be considered stable (and nominally operative) with acceptable appreciation rates and quality lifestyle opportunities, allowances for such factors must be made.

Vacancy Allowance (VA) -- Federal, state, and local governments have gone on record during the past 20 years calling Maui one of the tightest residential market sectors in the nation, and expressing fears of a deteriorating economy and community structure unless major steps are taken over the long-term to address the shortage. The undersupply condition

TABLE 1

QUANTIFICATION OF HOUSING UNIT DEMAND FOR THE WEST MAUI STUDY AREA 2003 to 2020 (1)
Market Study of the Proposed Pulelehua Community
Mahinahina, West Maui, Hawaii

	Year-End 2003	2005	2010	2015	2020	Additional Units Required by 2020 (2)
Scenario One: SMS Lahaina "Baseline" Projections (Rounded)						
Resident Population	19,050	19,779	21,663	23,564	25,431	
Average Household Size	2.92	2.87	2.81	2.76	2.72	
Total Resident Units Required	6,524	6,892	7,709	8,538	9,350	
Vacancy Allowance (circa 5% of resident unit demand)	346	367	407	438	497	
Non-Resident Purchaser Allowance (0% of resident unit demand)	0	0	0	0	0	
TOTAL MARKET UNIT DEMAND	6,870	7,259	8,116	8,976	9,847	3,447
Scenario Two: Maximum Projections Using High Population Growth and Market Allowance Factors						
Resident Population (3)	19,050	20,003	22,403	24,867	27,354	
Average Household Size	2.92	2.86	2.79	2.73	2.68	
Total Resident Units Required	6,524	6,994	8,030	9,109	10,207	
Vacancy Allowance (4% of resident unit demand)	261	280	321	364	408	
Non-Resident Purchaser Allowance (12% of resident unit demand)	783	839	964	1,093	1,225	
TOTAL MARKET UNIT DEMAND	7,568	8,113	9,314	10,566	11,840	5,440

CONCLUDED HOUSING UNIT DEMAND RANGE

	Existing	2004-2005	2006-2010	2011-2015	2016-2020	Totals
MINIMUM DEMAND						
Periodic	470	389	857	860	871	3,447
Cumulative	470	445	1,440	2,438	3,447	
Average Annual Demand (4)		222	199	200	202	
MAXIMUM DEMAND						
Periodic	1,168	545	1,202	1,252	1,273	5,440
Cumulative	1,168	682	2,227	3,823	5,440	
Average Annual Demand (4)		341	309	319	323	
MID-POINT DEMAND						
Periodic	819	467	1,029	1,056	1,072	4,443
Cumulative	819	564	1,834	3,130	4,443	
Average Annual Demand (4)		282	254	259	263	

(1) The study region is the West Maui/Lahaina Community Plan area.
(2) There are an estimated 6,400 housing units in the Lahaina community planning study area as of year-end 2003 (extrapolated from 2000 census figure of 5,951 units).
(3) Population growth equivalent to 2.15 percent compounded annually during projection period. Declines from rate averaging 2.5 percent annually in 2004-05 to 2.0 percent per year (simple) growth from 2016 through 2020.
(4) Existing (or latent) demand is assumed absorbed evenly throughout study period.

Source: SMS "Maui Community Plan Update Program", Various and The Hallstrom Group, Inc.

is a primary reason Maui housing prices are on average among the highest of any locale in the country.

According to HUD, the Urban Institute, and other sources, a "healthy" market has a minimum vacancy level of five to six percent of the total number of units in the inventory. This allows for uninhabitable units, units under repair, seasonal fluctuations, a transitional housing margin, a degree of mobility potential, and the ability to service periodic unanticipated population increases. A "slack" in unit occupancy also serves as a margin to cushion against hyper-appreciation during strong demand periods.

Given the history of the Maui housing market and its inability to keep an acceptable vacancy pool available, we believe it will be exceptionally difficult for the desirable vacancy allowance of five percent or more to be achieved on the island during the foreseeable future.

In our demand formula, we have tested vacancy rate allowances of four percent of the Total Resident Units Required figure. The SMS projections assume a vacancy allowance of circa five percent.

Non-Resident Purchaser Allowance (NRPA) -- While most investors strongly desire to rent purchased units to residents in an effort to minimize debt service obligations, there are those who buy a Hawaii home or condominium for personal use, business reasons, or for periodic rental to non-resident "visitors."

These units are not available to meet resident housing demands and are effectively withdrawn from the inventory pool. An allowance must be made for these residences in the general community, which are not to be confused with those specifically intended for tourist-oriented transient rentals (i.e., within a condominium/hotel project in a vacation area).

On the neighbor islands and in Waikiki, there are many units in complexes or subdivisions designed for general residential use, which often sit vacant the vast majority of the time.

Conversion of this estimate of gross demand into pricing equivalents was completed using available data from the U.S. Census, Maui Board of Realtors, and the U.S. Dept. of HUD.

Table 2 illustrates this striation of Lahaina/West Maui regional housing demand to 2020 into probable percentile demand by sales prices at current dollar levels (note that total unit demand figures are slightly different due to rounding) . The figures correlate both historic actual buying trends and theoretical "affordability" quotients derived using government pricing criteria.

Table 3 displays the calculations of housing price affordability for Maui residents based on HUD/Maui County and conventional financing guidelines.

Using the governmental criteria, households in the "Low Income" grouping, earning 80 percent or less of the island median income, can afford a sales price, or rental equivalent, of $205,000 (rounded) or less. "Low to Moderate Income" households, earning 80 to 100 percent of median income, can afford home prices up to $258,000. And, "Moderate-Gap Group Income" households, earning 100 to 140 percent of median, can afford prices up to $378,000. Above this level, prices are considered "market".

Inherently, a large portion of the demand is generated by lower- to middle-income groups who can have difficulty competing in the high-priced Maui marketplace. Upper-middle and above income households have more meaningful purchase alternatives.

About 31 percent of the regional units required through 2020 will need to be priced below a current level of $205,000 (affordable to the "low income" group); 25 percent of demand will have price limits between $206,000 and $380,000 (affordable to "low-moderate" and "moderate-gap group" categories); 25 percent of demand will be oriented toward homes having prices of $380,000 to $550,000 (moderate market pricing); and, 19 percent will seek properties having a price above $550,000.

The substantial majority of the Pulelehua inventory will be oriented toward the 81 percent of the purchasers seeking homes at or below the moderate market price level (less than $550,000), with many of units priced at less than $380,000, or within the affordable price ranges for

TABLE 2

STRIATED PROJECTIONS OF HOUSING UNIT DEMAND
BY SELLING PRICE IN LAHAINA/WEST MAUI 2003 TO 2020
Market Study of the Proposed Pulelehua Community
Mahinahina, West Maui, Hawaii

Period	Periodic Demand (1) 2004 to 2005	2006 to 2010	2011 to 2015	2016 to 2020	Total Demand 2004-2020
1. Using SMS Demand Forecasts					
Less Than $205,000 (1)	**147**	**318**	**310**	**303**	**1,078**
Percent of Total Demand	33.00%	32.00%	31.00%	30.00%	31.25%
$206,000 to $380,000 (2)	**102**	**239**	**250**	**263**	**854**
Percent of Total Demand	23.00%	24.00%	25.00%	26.00%	24.75%
$380,000 to $550,000	**111**	**249**	**250**	**253**	**862**
Percent of Total Demand	25.00%	25.00%	25.00%	25.00%	25.00%
$550,000 to $800,000	**49**	**109**	**110**	**111**	**379**
Percent of Total Demand	11.00%	11.00%	11.00%	11.00%	11.00%
Over $800,000	**36**	**80**	**80**	**81**	**276**
Percent of Total Demand	8.00%	8.00%	8.00%	8.00%	8.00%
Total Market Demand	**444**	**995**	**1,000**	**1,010**	**3,449**
	100.00%	100.00%	100.00%	100.00%	100.00%
2. Using Maximum Demand Forecasts					
Less Than $205,000 (1)	**225**	**494**	**494**	**485**	**1,698**
Percent of Total Demand	33.00%	32.00%	31.00%	30.00%	31.24%
$206,000 to $380,000 (2)	**157**	**371**	**399**	**420**	**1,346**
Percent of Total Demand	23.00%	24.00%	25.00%	26.00%	24.76%
$380,000 to $550,000	**171**	**386**	**399**	**404**	**1,359**
Percent of Total Demand	25.00%	25.00%	25.00%	25.00%	25.00%
$550,000 to $800,000	**75**	**170**	**175**	**178**	**598**
Percent of Total Demand	11.00%	11.00%	11.00%	11.00%	11.00%
Over $800,000	**55**	**124**	**128**	**129**	**435**
Percent of Total Demand	8.00%	8.00%	8.00%	8.00%	8.00%
Total Market Demand	**682**	**1,545**	**1,595**	**1,615**	**5,437**
	100.00%	100.00%	100.00%	100.00%	100.00%

Note: The median household income for Maui for 2003-04 is estimated at $60,700 (HUD & Maui County sources).

(1) This price is considered "affordable" for households earning 80% of the median county household income ("Low Income").
(2) This price is considered "affordable" for households earning from 80% to 140% of county median (includes "Low-Median" to "Gap Group" categories).

Source: SMS, Various and The Hallstrom Group, Inc.

the 56 percent of the market comprised by low to gap group income households.

Given land, subdivision and construction costs, it will be difficult to meet anticipated regional housing demands solely through single-family development. Multi-family projects must be vigorously pursued in the mauka areas of the region during the next two decades in order to keep the West Maui housing sector in balance.

Between half and 60 percent of the housing inventory built in the study area during the past 20 years is comprised of single-family homes (finished houses or lots), with less than half being multi-family. As shown on Table 4, we forecast that multi-family units will increase in proportion to single-family homes in new projects over the next 17 years, moving upwards from the current level to 48 percent of market additions by 2020.

The total mid-point demand for multi-family development in Lahaina/West Maui over the next two decades is estimated at 1,972 units. For single-family types the demand will be for 1,737 houses and 734 building lots.

Identification of Lahaina/West Maui Residential Projects

Existing and Recent/In-Sales Supply

Based on 2000 census data, we estimate the total number of habitable housing units in the West Maui Community Plan area as of year-end 2003 was approximately 6,400 units. This represents an increase of nearly 25 percent over the number of units in place in 1990 and equates to a compounded annual inventory growth rate of 1.73 percent. However, inventory additions in recent years have been limited.

There have been eight major projects offering some form of residential-potential product in the study area in the past four years. The developments, which contain a total of 759 potential homes, are summarized on Table 5.

The 117 units at the Villas at Kahana Ridge, 90 units at West Maui Breakers, the 45 lots at Kapua Village (an affordably-priced subdivision for ML&P employees) and the 240 lots at Kahana Ridge (many of which were purchased by non-residents) can be considered as

TABLE 3

ESTIMATE OF HOUSING PRICE AFFORDABILITY FOR MAUI RESIDENTS
Market Study of the Proposed Pulelehua Community
Mahinahina, West Maui, Hawaii

1. Based on HUD/Maui County Criteria

Grouping	**Low Income**	**Low-Moderate Income**	**Moderate-Gap Group Income**
Household Income as a Percent of County Median	**80% or less**	**80% to 100%**	**100% to 140%**
Gross Household Monthly Income	$4,047	$5,058	$7,082
Maximum Allowable Housing Expense (1)	$1,335	$1,669	$2,337
Less Tax and Insurance Reserve (2)	($150)	($150)	($150)
Less Mortgage Insurance Payment (2)	($50)	($90)	($90)
Net Amount Available for Debt Service	$1,135	$1,429	$2,097
Maximum Mortgage Amount (3)	$194,491	$244,871	$359,338
Downpayment at 5% of Sales Price (2)	$10,236	$12,888	$18,913
Total Affordable Purchase Price	**$204,727**	**$257,759**	**$378,251**

2. Based on Conventional Financing Criteria

Grouping	**Low Income**	**Low-Moderate Income**	**Moderate-Gap Group Income**
Gross Household Monthly Income	$4,047	$5,058	$7,082
Maximum Allowable Housing Expense (4)	$1,133	$1,416	$1,983
Maximum Mortgage Amount (5)	$194,149	$242,643	$339,080
Downpayment at 20% of Sales Price (5)	$48,537	$60,661	$84,770
Total Affordable Purchase Price	**$242,686**	**$303,304**	**$423,850**

(1) Based on HUD/Maui County affordability criteria at 33%.
(2) As established by Maui County Department of Housing and Human Concerns for housing affordability formula.
(3) Assuming 5.75% annual interest and 30 year mortgage (Hula Mae rate), per Maui County Department of Housing and Human Concerns.
(4) Conventional financing with maximum monthly mortgage payment at 28% of gross income. No reserves of mortgage insurance required.
(5) Assuming 5.75% annual interest and 30 year mortgage.
(6) Conventional financing standard.

Source: State of Hawaii, Maui County and The Hallstrom Group, Inc.

TABLE 4

DIVISION OF PROJECTED DEMAND BY UNIT TYPE
FOR HOUSING UNITS IN LAHAINA/WEST MAUI 2004 TO 2020
Market Study of the Proposed Pulelehua Community
Mahinahina, West Maui, Hawaii

	Periodic Demand (1)				Total	
	2004 to 2005	2006 to 2010	2011 to 2015	2016 to 2020	Demand 2004-2020	Comments
1. Using SMS Demand Projections						
Single Family Homes	155	378	400	414	1,348	Historic primary demand type, with increasing rate of non-resident buyers in recent years. Escalating land costs and scarcity have limited new non-resort inventory during past decade. Home prices range from $300,000 to $4 M-plus.
Percent of Total	35%	38%	40%	41%	39%	
Single Family Lots	111	199	150	111	571	Comprises most of recent inventory additions at Kahana Ridge, Kaanapali, Kapalua and elsewhere. Oriented to high end of market with inventory at $175,00 to $800,000+plus
Percent of Total	25%	20%	15%	11%	16%	
Multifamily Units	178	418	450	485	1,530	Makai multifamily development oriented towards non-resident owners, although there has been some building and conversion of resident units in recent years. Current prices range from $225,000 to more than $3 million. Only feasible option for many low income households.
Percent of Total	40%	42%	45%	48%	44%	
Total	**444**	**995**	**1,000**	**1,010**	**3,449**	
	100%	100%	100%	100%	99%	
2. Using Maximum Demand Projections						
Single Family Homes	239	587	638	662	2,126	
Percent of Total	35%	38%	40%	41%	39%	
Single Family Lots	171	309	239	178	896	
Percent of Total	25%	20%	15%	11%	16%	
Multifamily Units	273	649	718	775	2,415	
Percent of Total	40%	42%	45%	48%	44%	
Total	**682**	**1,545**	**1,595**	**1,615**	**5,437**	
	100%	100%	100%	100%	100%	
Mid-Point						
Single Family Homes	197	483	519	538	1,737	
Single Family Lots	141	254	195	144	734	
Multifamily Units	225	533	584	630	1,972	
Total	**563**	**1,270**	**1,298**	**1,313**	**4,443**	

Source: The Hallstrom Group, Inc.

TABLE 5

SUMMARY OF IN-SALES/RECENT MAJOR WEST MAUI "RESIDENTIAL" DEVELOPMENTS
Market Study of the Proposed Pulelehua Community
Mahinahina, West Maui, Hawaii

Development/Project	No. of Units	Type	Original Price Range	Status	Comments
Kahana Ridge	240	SF Lots of 6,000 to to 11,145 Sq. Ft.	$149,000 to $191,000	Sold-Out in 2000, most lots now built-out.	Current lot prices at $429,000 to $465,000, homes to $1.4 M.
Villas at Kahana Ridge	117	Multifamily units, 1, 2 and 3 bedroom	$269,000 to $380,000	Sold-out in 2004 via list of applicants.	Under-construction, first units to close early 2005.
West Maui Breakers	90	Studio, 1, 2 &3 BR MF units. 52 affordable.	$232,750 to $525,000	28 mkt. units and 29 aff. units reserved	Construction scheduled to commence in Feb. 2005.
Mahanalua Nui	150	Ag. Lots between 2.0 and 6.8 acres.	$225,000 to $600,000	Sold-Out in 2003, homes now being built.	Current lot prices at $350,000 to $648,000, homes to $2.4 M.
Kapua Village	45	SF w/ lots at 6,102 to 9,583 Sq. Ft.	$92,000 to $97,000	Sold-Out in 2002, homes now being built.	Limited to Maui Land & Pineapple employees. Prices well below mkt.
The Summit at Kaanapali	53	SF Lots at 10,000 to 12,000 SF, and units at 2,100 to 2,400 SF.	Lots at $485,000 to $595,000. Units at $989,000 to $1,500,000.	Sold-Out in 2003, homes now being built on vacant lots.	Rapid absorption of final lots. Many purchased by Hawaii residents. Re-sale prices up 10 to 20 percent over original prices.
The Pinnacle at Kaanapali	33	SF w/lots at 18,014 to 28,354 Sq. Ft.	$575,000 to $735,000	Sold-Out in 2002, homes now being built.	High demand during pre-sales. Most purchased by non-residents.
Pineapple Hill Estates	31	SF w/lots at 19,000 to 25,000 Sq. Ft.	$560,000 to $795,000	Sold-Out in 2003, homes now being built.	Current lot prices at $894,500 to $1.5 M, homes to $7.9 M.

Note: Table does not include Lokahi Pacific 15 unit project in Lahaina scheduled to begin construction in December 2004, or the 26 units in the West Maui Resource Center (phase II) which are to begin construction in early 2005. Both are specialized (affordable, special needs, transitional) housing providers who will offer units at below-market levels to lower income households from existing applicant lists.

Source: Development websites, project brokers, and The Hallstrom Group, Inc.

TABLE 6

SUMMARY OF MAJOR PROPOSED WEST MAUI RESIDENTIAL DEVELOPMENTS
Market Study of the Proposed Pulelehua Community
Mahinahina, West Maui, Hawaii
Excluding Agricultural Lot Subdivisions, 49 or more units

Development/Project (2)	Proposed Units (1) Single Family	Multi-Family	Total	Type	Timing	Comments
Kaanapali 2020	1,257	1,553	2,810	Mixed Densities of SF & MF. Includes mixed-use units.	Forecast approvals by 2008 with total development over following 20 to 30 years	Majority of land to be used for local resident communities, w/rest as resort expansion. Will include affordable units.
Kapalua Mauka	390	300	690	Mixed Densities of SF and MF	In County approvals, constr. expected to begin by 2007 absorption over 12 years.	Upscale resort-oriented project is expansion phase of existing resort. Mauka of Highway.
Palisades at Kaanapali	132	0	132	SF "resort quality" lots & homes.	In early approval process, build-out expected by 2010.	Upscale project in Kaanapali mauka of highway.
Honolua Ridge	49	0	49	SF Ag. Estate lots & homes.	Phase I Reservations being taken, build-out by 2014.	Upscale agricultural estates north of Kapalua.
Pulelehua (Subject Property)	445	450	895	Mixed Densities of SF & MF, may allow up to 446 addl. Ohana units.	In planning and approval process. Development forecast to start in 2007.	Mixed-use community for local residents (ML&P workers), more than half the units to be affordable.
Wainee (Kaanapali Development Corp.)	400	175	575	Moderate density single family subdivision.	In initial planning and community input phase. Not likely until late decade.	Will include market and affordable units.
Puunoa (Smith Development)	254	0	254	SF lot & house pkg.	Rejected by County after initial State approval. Development now uncertain/ unlikely.	Strong County & community opposition to date. To include at least 1/2 "affordable" units, many for "low" and "very low" income.
DHHL Honokowai	411	0	411	SF homestead lots.	In planning, but recently placed on indefinite hold.	In response to extensive waiting lists. For Native Hawaiians only.
Villages at Leialii	2,006	2,840	4,846	Mixed Densities of SF and MF	DHHL to build homes using infrastructure for initial 104 homes finished in 1994. Rest of project stalled by lawsuit.	60 percent to be affordable priced, remainder at market. Unknown when/if project will be resumed.
TOTALS						
Pending Near-Term or Likely	1,235	777	2,160			
Pending Mid-Term or Somewhat Problematic	1,438	1,728	2,991			
Pending Long-Term or Unlikely	2,671	2,840	5,511			
Total	5,344	5,345	10,662			

(1) Unit counts are estimates based on discussions with developers, brokers and County agencies and website data.
(2) Includes Puu Kahana (25 SF homes), West Maui Resource Center Phase II (26 MF units), Kiahuna (20 units), Land Tech-Kaanapali (18 units), Makila (40 homes), Olowalu (20 homes), and Lokahi Pacific (12 homes).

Source: County of Maui Department of Housing and Human Concerns, Development websites, project brokers, and The Hallstrom Group, Inc.

"standard" residential product. This is 65 percent of the regional development in recent years.

The others units are either in destination resort communities, 117 units are at Kaanapali Beach and Kapalua, or in agricultural "estate" subdivisions (Mahanalua Nui).

All were well-received by the market and are now fully absorbed despite the generally high prices. This demonstrates the strength of the current upcycle and the shortage of units. All of the projects had significantly more interest than the total number of available units.

Proposed Supply

There are nine major projects approved, proposed or being discussed in the general study area at this time. The projects are summarized on Table 6. Most are in the initial entitlement phase.

There have been some entitlements granted for the Kaanapali lands (such as Pukuolii Village), but the approval process associated with the Kaanapali 2020 master plan will take many more years, mitigating the usefulness of any past approvals.

The 690 units in Kapalua Mauka, to be upper-end and resort-oriented, and the 575 units at Wainee, to include affordable and market product, are the only two projects which are likely to achieve approvals and begin construction during the near-term; with the Kaanapali 2020 units likely to gain substantial approvals thereafter.

Puunoa, a proposed 254 home affordable and market-priced subdivision, garnered initial state support and was resubmitted to the County Council after being re-designed. It was subsequently rejected again by the county. Given the degree of community opposition to the original master plan and the developer's upslope agricultural subdivisions, approvals for this development are not likely in the foreseeable future.

Two major projects comprising 5,100 total units, or about half the proposed supply in the study region, are currently on-hold pending the resolution of land ownership and financing disputes.

The 4,846 unit Villages at Leialii development, a State HCDC undertaking which was to forcefully address the need for affordable and moderate-priced homes in West Maui, has been on hold since the completion of the first phase of 104 lots in 1994. A dispute over the

use of Native Hawaiian ceded lands for the project resulted in a lawsuit that is still in progress, resulting in the abandonment of the first phase (the subdivided lots and infrastructure are now overgrown) and the placing of the project on indefinite hold. HCDC spokespersons do not expect any inventory will be built on the site for another decade (or so). Negotiations have been completed with the Office of Hawaiian Affairs and the Department of Hawaiian Home Lands to remove the Phase I lands from the lawsuit and allow native Hawaiians to purchase the existing homesites by 2006.

Because of these negotiations, development commitments in East Maui, and strong beneficiary demand for homes in Central Maui, DHHL has placed its proposed 411 units Honokowai project on indefinite hold as well. While the house lots would be restricted to native Hawaiian "purchasers", the addition to regional supply is still relevant.

If all these proposed projects were built-out in a timely manner to maximum densities as presently envisioned they would contain up to 10,000 additional residential units; enough to service forecast regional demand. But we consider it highly improbable that many of these homes will ever be built, and certainly not within the parameters of the study time-frame.

Based on our investigation, we estimate the maximum potential supply of new housing in the study area over the next 17 years, assuming a favorable planning and entitlement process, will be about 4,300 total units apart from Pulelehua. Of these, about 1,300 are fully-approved, in development, or are judged to be somewhat likely in the near to mid-term, and 1,300 have a potential to be actualized over the mid to long-term.

On a minimum basis, assuming the Villages at Leialii lawsuit is not favorably resolved, DHHL concerns continue to stymie development, and given the rejection of the project, there will be far fewer units built during the projection time-frame.

If the maximum supply potential is achieved, upwards of 40 percent of the units would likely fall into affordable pricing categories, and the product would begin to address the overall demand spectrum. However, under the minimum scenario the large majority of the units would be within destination resort projects and fail to make

meaningful inroads into the demand for affordable and moderate-priced homes.

Assessment of Subject Demand

On a general basis, there is reasonable market support for the Pulelehua residential units: the current demand for inventory is strong and increasing; the amount and construction pace of competitive supply is limited; and, there are concerns on the timing and ultimate scope of alternative development-potential sites.

The Pulelehua inventory will have sufficient characteristics to be competitive in the Lahaina/West Maui market. The probable price ranges would be below that for most other developments in the study area and the Pulelehua community will offer lifestyle benefits not available in other projects. The sites will be within modern, moderate density mixed-use neighborhoods, having easy access to the primary thoroughfare, adjacent to parks, open spaces and civic uses, and controlled through well-designed master planned development.

Even if the proposed/potential inventory was actualized at maximum levels during the projection period, the Pulelehua units could still anticipate achieving a reasonably rapid absorption. This is illustrated by correlating statistical regional housing "needs" and subjective competitive insights using three analytical methods discussed below. In our demand assessment, we have assumed the 125 units of affordable rental apartments would be immediately absorbed upon offering. There is substantial latent demand for this product type, and it would not detract from (or be competitive with) the other inventory offered in the subject community.

- The Gross Analysis Method -- This is both the simplest and most fundamentally insightful technique. It is a mere comparison between demand for additional units and probable unit supply. If there is more potential demand than potential units during the project period, it can be reasonably asserted there will be sufficient demand to absorb all of the proposed subject units.

  The estimated demand for residential development over the next 17 years in West Maui is between 3,447 and 5,400 new units, with a mid-point of 4,444 units.

  Under the "maximum" construction scenario, the total number of units built would be 4,300, only enough to cover the mid- to

low-end of the demand forecast (which is based on SMS projections that exclude non-resident demand for units), and meaningfully insufficient to meet the mid- to upper-end demand forecasts we consider much more probable. The anticipated gross shortfall would be upwards of 1,100 units, or several hundred units beyond the inventory proposed for Pulelehua.

In the "minimum" scenario, the total shortfall in the number of units needed would be more than 1,600 units, about twice the level of inventory proposed for Pulelehua.

Further, few of the units (under either scenario) are expected to be built during the near term, most being late in the decade or beyond. This creates a major hole in supply during the next four to six years.

This method indicates the Pulelehua units could be readily absorbed within the projected development time frame of circa four to ten years, apart from any competitive advantage the Pulelehua inventory may have.

- The Residual Method -- In this technique, the identified proposed and potential projects are placed on a time-line depicting the sales absorption anticipated by the developers, as evidenced by our market survey, or as can be reasonably assumed through historic activity. The analysis is applied in five-year increments. To the extent these projects fall short of the forecast periodic demand for units in the study region, or exceed the total demand, an undersupply or oversupply situation respectively exists.

  By accounting for the total of the known/possible units likely to be built in the competitive market over the 17 years, it can be reasonably asserted the subject development will "capture" a significant portion of any residual demand. This approach is generally conservative, as it assumes the subject will capture only what is leftover after the other projects garner their anticipated share.

  The tabular presentation of this method for the proposed subject units under the "maximum" supply scenario is shown

on Table 7. The "minimum" supply scenario is shown on Table 8.

In both models the forecast supply fails to fully service the demand, and while there are periods of excess supply later in the model based on the assumption that several projects get approvals and difficulties resolved, there are exceptional shortfalls during the near to mid-term. As all of the identified potential competitive units are accounted for in the model, and an allowance is made for minor projects and in-fill is provided, the subject units should achieve a high capture rate of the residual demand.

According to the residual method, the 895 Pulelehua residential units should be absorbed within a five to ten-plus year marketing period.

Should the total number of units developed at competitive projects be less than the intensities identified (which is highly likely) or require greater approval time, the residual demand for the subject units will be greater and their absorption period shorter.

- The Market Shares Method accounts for the probable competitiveness of the subject product regardless of the total level of other inventory being offered. In essence, it is an estimate of how much of the total new unit demand in West Maui the subject could expect to achieve on an annual basis in light of its locational, pricing, and amenity characteristics.

  This pure competitiveness technique is generally moderate to optimistic in application and requires some subjective variables, but is perhaps the most appropriate and classic approach.

  Given the type, location and amenities of the proposed subject product, and the probable size of the competitive market, we believe the Pulelehua subject residential component could readily achieve a maximum annual market share of 50 percent of the total demand for housing units in Lahaina/West Maui following a brief market exposure and ramp-up period. The estimated average market capture rate over the entire sell-out period would be in the upper-40s percentile.

TABLE 7

PROJECTION OF SUBJECT UNIT ABSORPTION USING THE RESIDUAL METHOD BASED ON TOTAL DEMAND FOR RESIDENTIAL HOUSING IN THE LAHAINA/WEST MAUI STUDY AREA
"MAXIMUM SUPPLY" SCENARIO
Market Study of the Proposed Pulelehua Community
Mahinahina, West Maui, Hawaii
Includes All Proposed and Announced Units, Assuming Mid-Point Demand Trends

Major Projects (1)	TOTAL UNITS	UNITS LIKELY TO BE DEVELOPED/ABSORBED 2004-2005	2006-2010	2011-2015	2016-2020
Maui Breakers	90	90			
Market Share Percentage		32%			
Lanikeha	132		132		
Market Share Percentage			15%		
Villas at Kahana Ridge		117			
Market Share Percentage		42%			
Wainee	575		150	300	125
Market Share Percentage			17%	22%	15%
Kaanapali 2020 *	2,810		200	500	500
Market Share Percentage			23%	36%	61%
Kapalua Mauka	690		235	385	70
Market Share Percentage			27%	28%	9%
DHHL Honokowai *	411			100	100
Market Share Percentage				7%	12%
Villages at Leialii (2) *	4,846		104		
Market Share Percentage			12%		
Other Minor Projects/In-Fill (3)	260	70	59	110	21
Market Share Percentage		25%	7%	8%	3%
Totals	9,814	277	880	1,395	816
Regional Housing Unit Demand	4,444	564	1,270	1,295	1,315
Shortage or (Excess) Supply		287	390	(100)	499
Potential Pulelehua Residual Subject Demand					
at 100% Capture Rate	1,081	287	390	(95)	499
at 97.5% Capture Rate	1,057	280	380	(90)	487
at 95% Capture Rate	1,037	273	371	(80)	474

* : Indicates project is not fully absorbed during projection period.

(1) Proposed projects having 50 or more units. Smaller developments included in the "other minor projects/in-fill" category.
(2) 104 lot subdivision infrastructure in place and to be "sold" by 2006. Remaining units unlikely to be built during study time-frame due to legal issues.
(3) Includes Puu Kahana (25 SF homes), West Maui Resource Center Phase II (26 MF units), Kiahuna (20 units), Land Tech-Kaanapali (18 units), Makila (40 hon Olowalu (20 homes), Lokahi Pacific (12 homes), Honolua Ridge (49 homes) and allowance or 50 in-fill homes.

Source: Maui County, Developers/Agents, & The Hallstrom Group, Inc.

TABLE 8

PROJECTION OF SUBJECT UNIT ABSORPTION USING THE RESIDUAL METHOD BASED ON TOTAL DEMAND FOR RESIDENTIAL HOUSING IN THE LAHAINA/WEST MAUI STUDY AREA
"MINIMUM SUPPLY" SCENARIO
Market Study of the Proposed Pulelehua Community
Mahinahina, West Maui, Hawaii
Includes Approved and Probable Units Only, Assuming Mid-Point Demand Trends

Major Projects (1)	TOTAL UNITS	UNITS LIKELY TO BE DEVELOPED/ABSORBED 2004-2005	2006-2010	2011-2015	2016-2020
Maui Breakers	90	90			
Market Share Percentage		32%			
Lanikeha	132		132		
Market Share Percentage			15%		
Villas at Kahana Ridge		117			
Market Share Percentage		42%			
Wainee	575		150	300	125
Market Share Percentage			17%	21%	15%
Kaanapali 2020 *	2,810		200	500	500
Market Share Percentage			23%	35%	61%
Kapalua Mauka	690		235	385	70
Market Share Percentage			27%	27%	9%
Puunoa	254			150	104
Market Share Percentage				10%	13%
Villages at Leialii			104		
Market Share Percentage			12%		
Other Minor Projects/In-Fill (2)	260	70	59	110	21
Market Share Percentage		25%	7%	8%	3%
Totals	4,811	277	880	1,445	820
Regional Housing Unit Demand	4,444	564	1,270	1,295	1,315
Shortage or (Excess) Supply		287	390	(150)	495
Potential Pulelehua Residual Subject Demand					
at 100% Capture Rate	1,022	287	390	(150)	495
at 97.5% Capture Rate	996	280	380	(146)	483
at 95% Capture Rate	971	273	371	(143)	470

* : Indicates project is not fully absorbed during projection period.

(1) Proposed projects having 50 or more units. Smaller developments included in the "other minor projects/in-fill" category.
(2) 104 lot subdivision infrastructure in place and to be "sold" by 2006. Remaining units unlikely to be built during study time-frame due to legal issues.
(3) Includes Puu Kahana (25 SF homes), West Maui Resource Center Phase II (26 MF units), Kihune (20 units), Land Tech-Kaanapali (18 units), Makila (40 home Olowalu (20 homes), Lokahi Pacific (12 homes), Honolua Ridge (49 homes) and allowance or 50 in-fill homes.

Source: Maui County, Developers/Agents, & The Hallstrom Group, Inc.

The mid-point capture rate, which is reasonable given the competitiveness analysis and the limited alternatives, would equate to a 48.8 percent share of the total study area housing sector during a mid-point 6.9-year sell-out period. This equates to an average absorption of 130 units annually.

Table 9 displays the Pulelehua unit absorption forecasts. It is anticipated full sell-out will take from 5.5 to 8.3 years.

Based on our correlated analysis, we forecast the 895 residential units at Pulelehua will be absorbed in about a five to seven-year time-frame from initial offering.

Quantification of Pulelehua Neighborhood Commercial/Light Industrial Demand

The successful implementation of the integrated residential lifestyle concept envisioned at Pulelehua requires the provision of an appropriate mix of retail, restaurant, office, mixed-use and other supporting "commercial" land uses suitable for inclusion in a neighborhood setting. The goal is to have housing, goods and services, and employment opportunities in close proximity within a design-controlled community allowing for a more intimate daily life that reduces the impact on regional traffic and off-site systems.

The current master plan calls for three basic types of commercial/mixed-use uses within Pulelehua:

1. **"Main Street"**, general retail, restaurant and service/commercial uses located along the frontage of the core streets in each neighborhood, totaling a maximum of 21,475 square feet of floor space;

2. **"Specialty Retail/Office"**, ground floor shops, boutiques, and storefront offices, with living units above, in the areas adjacent to the neighborhood centers, totaling a maximum of 75,000 square feet of space; and,

3. **"Workplace Edge"**, workshop, storage, showroom, and neighborhood-oriented mixed uses in loft buildings and warehouses located along the mauka borders of the neighborhoods near the airport, totaling a maximum of 78,000 square feet.

TABLE 9

SUMMARY OF PULELEHUA PROJECTED UNIT DEMAND LEVELS
USING THE MARKET SHARES METHOD
Market Study of the Proposed Pulelehua Community
Mahinahina, West Maui, Hawaii
Assuming 895 New Housing Units, With 125 Affordable Apartment Units in Year 1
With Sales to Begin in 2007

Scenario One: Using Conservative (SMS Baseline) Assumptions

Sales Year		Total Regional Housing Demand	Effective Subject Share	Indicated Total Subject Absorption
1	(1)	199	35.00%	195
2		199	40.00%	80
3		199	45.00%	90
4		199	50.00%	100
5		200	50.00%	100
6		200	50.00%	100
7		200	50.00%	100
8		200	50.00%	100
9		200	50.00%	32
Totals	8.3 years	1,796	49.85%	895

Scenario Two: Using Optimistic Assumptions

Sales Year		Total Regional Housing Demand	Effective Subject Share	Indicated Total Subject Absorption
1	(1)	309	35.00%	233
2		309	40.00%	124
3		309	45.00%	139
4		309	50.00%	155
5		319	50.00%	160
6		319	50.00%	85
Totals	5.5 years	1,874	47.75%	895

ANALYSIS MID-POINT			
6.9 years	1,835	48.78%	895

(1) First year inventory includes 125 affordable rental apartments for which there are significant waiting lists. These units, meeting long unmet demands, will be rapidly absorbed, and are effectively outside the standard market demand stream. Thus, they are shown as being absorbed in addition to the other subject units.

Source: The Hallstrom Group, Inc.

Given the interior location of these components (having no highway frontage or visibility) their viability will be a direct function of consumer demand created by the Pulelehua community members, guests and users for the finished product or service. As the neighborhoods build-out, population levels in the project will increase, and the need for additional services is proportionately created.

The most appropriate method to determine the neighborhood-oriented floor space needs at Pulelehua is one based on the size of the proximate potential consumer population. We have therefore quantified the level of in-community commercial/light industrial spatial needs using a per capita spatial demand trends analysis.

By ascertaining appropriate *"per square foot of light industrial and commercial development per person"* allowances, determining the proportion applicable to neighborhood use-types, and applying these ratios against forecast Pulelehua population levels, the demand for light industrial/business and retail/service commercial uses in the subject project can be estimated.

Additional contributors to floor space demand will be created by guests of Pulelehua residents, passer-bys and use-types specifically drawn to the near-airport location (such as freight delivery, base yards, and tour and express services).

Consumer Population Levels

At build-out the base consumer population at Pulelehua is estimated as follows:

Number of Dwelling Units	895
Average Household Size (persons)	2.90
Total Community Base Consumer Population[3]	**2,595**

Per Capita Spatial Demand Trends

The best indicators of appropriate mixed-use and commercial demand requirements for an urban island economy can best be drawn from the experience of Oahu, which provides useful insight into the probable growth trends of the neighbor islands. The total estimated developed light industrial space on the island was 35,250,000 square feet at year-end 2003, this equates to a per resident ratio of 39.05 square feet as of the end of last year, as shown on Table 10.

[3] For purposes of this calculation, it is assumed all of the units at Pulelehua contain full-time resident households. As presented in a subsequent section, the effective de facto population will be slightly different to account for non-resident owners, guests and vacancies.

While the Pulelehua mixed-use lands will not be "true" light industrial sites, as allowable uses and improvements will be restricted at Pulelehua, the available data is categorized as such. For analytical purposes, the terms light industrial and mixed-use are considered interchangeable in this section of the report.

This compares with nationwide estimates by the Urban Institute and others which indicate a range of 25 to 40-plus square feet per person is appropriate for an urban economy. The overall national range represents the lower end of the spectrum for Hawaii. Unlike the mainland, where shared service between communities is possible for some businesses, a more comprehensive range is required in the islands, and hence, more space.

A summary of Oahu retail/service space per capita development is shown on Table 11. At year-end 2003, there was 18,100,000 square feet of finished competitive floor space, equating to 20.05 square feet per resident of the island. This is at the middle to upper end of the standard range of 15 to 22 square feet per person for a modern market of over 100,000 people.

A summary of estimated light industrial and retail/service commercial development and per capita rates for selected neighbor island locales is shown on Table 12. The industrial space per capita figures range from 17.52 square feet per person in the undersupplied Lahaina market to 41.13 square feet in the oversupplied Hilo sector, bracketing the Oahu indicator. All of the communities have higher per capital retail/service development levels than Oahu ranging from 20.58 to 33.33 per square foot per capita. The combined development ranges from 49.18 square feet per capita on Kauai to 68.26 square feet in Kona, with Oahu at 59.10 square feet per resident.

At present, Maui has approximately 6.5 million square feet of conforming, market-based, light industrial and retail/service commercial floor space, or about 52.0 square feet per resident. This is moderately below standard market levels for a freestanding economic community of this size, and reflects the historic concentration of businesses and services in a single region (Wailuku/Kahului). A gradual move upwards to 60-plus square feet per person is likely.

TABLE 10

SUMMARY OF INDUSTRIAL SPACE DEVELOPMENT
ON OAHU 1977 TO 2003
Market Study of the Proposed Pulelehua Community
Mahinahina, West Maui, Hawaii

Year	Industrial Floor Space Area (Leaseable Sq. Ft.)	Resident Population of Island	Ratio of Industrial Space Per Person (Sq. Ft.)
1977	22,819,000	737,000	30.96
1978	23,412,000	742,600	31.53
1979	23,976,000	756,000	31.71
1980	24,780,000	764,600	32.41
1981	25,645,000	767,573	33.41
1982	---	776,075	---
1983	---	789,097	---
1984	---	797,791	---
1985	28,929,999	804,294	35.97
1986	28,159,000	810,444	34.75
1987	28,644,000	818,447	35.00
1988	29,714,000	824,072	36.06
1989	30,582,000	831,337	36.79
1990	31,261,000	838,107	37.30
1991	32,444,000	846,568	38.32
1992	33,280,000	858,543	38.76
1993	33,600,000	864,366	38.87
1994	33,820,000	871,362	38.81
1995	33,960,000	873,027	38.90
1996	34,120,000	873,131	39.08
1997	34,270,000	874,449	39.19
1998	34,400,000	872,478	39.43
1999	34,580,000	874,321	39.55
2000	34,675,000	876,156	39.58
2001	34,730,000	881,295	39.41
2002	34,810,000	885,700	39.30
2003	**35,250,000**	**902,704**	**39.05**
Compounded Annual Growth Rate for 1977 through 2003	**1.39%**	**0.81%**	**0.93%**
Average Annual Addition for 1977 through 2003	**478,115**	**6,373**	**0.31**

Note: Complete data not available for all study years.

Source: DBEDT, CB Commercial, Hawaii Real Estate, and The Hallstrom Group, Inc.

TABLE 11

SUMMARY OF RETAIL, SHOPPING CENTER AND SERVICE
SPACE ON OAHU 1977 TO 2003
Market Study of the Proposed Pulelehua Community
Mahinahina, West Maui, Hawaii

Year	Gross Leaseable Floor Space in Sq. Ft.			Resident Population of Island	Ratio of Gross Retail/Service Space Per Person (Sq. Ft.)
	Retail, Restaurant and Center (1)	Service (2)	Total		
1977	7,422,000	2,911,000	10,333,000	737,000	14.02
1978	7,492,000	2,944,000	10,436,000	742,600	14.05
1979	7,806,000	3,002,000	10,808,000	756,000	14.30
1980	7,953,000	3,021,000	10,974,000	764,600	14.35
1981	8,537,000	3,052,000	11,589,000	767,573	15.10
1982	---	---	---	776,075	---
1983	---	---	---	789,097	---
1984	---	---	---	797,791	---
1985	9,014,000	3,242,000	12,256,000	804,294	15.24
1986	9,180,000	3,308,000	12,488,000	810,444	15.41
1987	9,280,000	3,384,000	12,664,000	818,447	15.47
1988	9,460,000	3,488,000	12,948,000	824,072	15.71
1989	9,612,000	3,621,000	13,233,000	831,337	15.92
1990	9,850,500	3,720,000	13,570,500	838,107	16.19
1991	10,000,000	3,800,000	13,800,000	846,568	16.30
1992	10,206,000	3,830,000	14,036,000	858,543	16.35
1993	11,636,000	3,950,000	15,586,000	864,366	18.03
1994	11,975,000	4,080,000	16,055,000	871,362	18.43
1995	12,198,600	4,120,000	16,318,600	873,027	18.69
1996	12,267,600	4,167,500	16,435,100	873,131	18.82
1997	12,470,000	4,200,000	16,670,000	874,449	19.06
1998	12,769,000	4,243,000	17,012,000	872,478	19.50
1999	13,140,000	4,295,000	17,435,000	874,321	19.94
2000	13,280,000	4,325,000	17,605,000	876,156	20.09
2001	13,372,000	4,348,000	17,720,000	881,295	20.11
2002	13,445,000	4,375,000	17,820,000	885,700	20.12
2003	**13,600,000**	**4,500,000**	**18,100,000**	**902,704**	**20.05**
Compounded Annual Growth Rate for 1977 through 2003		**2.27%**	**0.81%**		**1.44%**
Average Annual Addition for 1977 through 2003		**298,731**	**6,373**		**0.23**

Note: Complete data not available for all study years.
(1) Includes all significant neighborhood, strip, specialty, community, regional and super-regional malls and centers. Excludes hotels.
(2) Includes all significant business and health services. Excludes hotels.

Source: DBEDT, CB Commercial, Hawaii Real Estate, and The Hallstrom Group, Inc.

TABLE 12

ESTIMATED FINISHED LIGHT INDUSTRIAL AND RETAIL/SERVICE COMMERCIAL FLOOR SPACE IN SELECTED NEIGHBOR ISLAND LOCATIONS
Market Study of the Proposed Pulelehua Community
Mahinahina, West Maui, Hawaii
As of Year-End 2003

Region	Big Island		Maui		Kauai
	Kona	Hilo	Lahaina	Kihei	
Estimated Resident Population	60,100	48,800	18,750	26,500	61,000
Light Industrial Development					
Gross Leaseable Sq. Ft. of Industrial Space (1)	2,400,000	2,007,000	328,500	585,000	1,600,000
Sq. Ft. Per Capita Ratio	**39.93**	**41.13**	**17.52**	**22.08**	**26.23**
Market Status	Stable	Oversupplied	Strongly Undersupplied	Undersupplied	Stable to Undersupplied
Retail/Service Commercial Development					
Gross Leaseable Sq. Ft. of Commercial Space (1)	1,702,500	1,004,500	625,000	775,000	1,400,000
Sq. Ft. Per Capita Ratio	**28.33**	**20.58**	**33.33**	**29.25**	**22.95**
Market Status	Mildly Oversupplied	Stable	Stable	Mildly Oversupplied	Stable
Combined Development					
Gross Leaseable Sq. Ft. of Industrial/Commercial Space (1)	4,102,500	3,011,500	953,500	1,360,000	3,000,000
Sq. Ft. Per Capita Ratio	**68.26**	**61.71**	**50.85**	**51.32**	**49.18**

Source: CB Hawaii, Hawaii Business and The Hallstrom Group, Inc.

We conclude an appropriate full-service objective in per capita light industrial and retail/service commercial finished spatial allowance for Maui would be circa 59 to 64 per square feet per person in the resident population, or a rounded mid-point of 62 square feet per potential consumer.

Of this total, approximately 50-plus to 60 percent is attributable to "neighborhood" type uses, suitable and appropriate for inclusion within a mixed-use residential development. The remainder of demand flows to regional retail centers, centralized industrial services and suppliers, big box outlets, specialty businesses, and uses that do not mix well with proximate residences. Owing to the location of Pulelehua, well-removed from the Wailuku/Kahului industrial and commercial districts, and the limitations of the Lahaina sectors, we conclude a ratio at the upper-end of the "neighborhood" range is appropriate.

The net per capita demand for light industrial and commercial floor space within the subject community is therefore estimated at 37 square feet, with an additional 25 square feet of demand flowing to off-site businesses.

Correlation of Demand Factors

The total base resident consumer demand for neighborhood light industrial and commercial floor space in Pulelehua can be calculated as follows:

Resident Population at Build-Out	2,595
Per Square Foot Per Capita Floor Space Demand	37
Total Base Consumer Demand in Square Feet	**96,015**
Rounded	**96,000**

To this base consumer total must be added allowances for several secondary demand factors:

- Guests of Pulelehua residents, both daily and overnight, are estimated to generate an additional 10 percent of the base consumer demand total.

- Passer-bys, including airport users and travelers along Honoapiilani Highway who drive into Pulelehua are estimate to contribute another six percent of consumer figures.

- Workers in the community are estimated to total 705 permanent full-time-equivalent positions (see the Economic Impact section). These persons will patronize food outlets, banks, mini-marts, some shops and service providers in the community where they work. An allowance of 15 square feet of floor space per worker position equates to about a 12 percent addition to the base resident consumer demand totals.

- Specialty shoppers, are consumers who will be attracted from off-site to specific subject mixed-use/commercial businesses as a result of specialty products or services being offered, or patronage relationships, not available elsewhere in the region. This demand component is estimated at 15 percent of the base requirements.

- Airport-related uses will include rental base yard/pick-up facilities, tour providers, freight forwarders, and other businesses which require space close to the airport facility. Currently, there are no mixed-use lands near the airport to support these needed uses, and the developer has received interest in such lots. We have conservatively estimated the demand for these uses at about three acres of net lot area, or the equivalent of some 39,000 square feet of floor based upon an average "floor area ratio" of .30. This is equal to 40 percent of the base resident consumer floor space demand.

The correlation of the various estimated demand components for the mixed-use/commercial space at Pulelehua is as follows:

Consumer Type	In Square Feet
Base Resident Consumer Demand	96,000
Pulelehua Guests (10% of Base)	9,600
Passer-Bys (6%)	5,800
Community Workers (12%)	10,600
Specialty Shoppers (15%)	14,400
Airport-Related Uses (40%)	39,000
TOTAL COMMUNITY DEMAND	**175,400**

The current master plan calls for a total of 174,475 square feet of finished light industrial/commercial floor space throughout the Pulelehua neighborhoods. This closely corresponds with the quantified level of demand, indicating the proposed components are appropriately sized and designed for the community and its location.

We conclude there is sufficient market support to fully absorb the mixed-use and commercial sites in the subject project during the sell-out period for the residential units.

Appropriateness of Pulelehua for the Planned Use

The proposed Pulelehua community is an appropriate use of the subject property from a market perspective. Given the expressed need for additional residential and neighborhood-supporting lands in West Maui over the coming decades, the site has a variety of traits in support of development, most notably:

Residential Component

- *It is adjacent to and nearby existing residential neighborhoods.* The market acceptance and desirability of Kahana is well-established, as demonstrated by the success of the Kahana Ridge lots.

- *It is a readily accessible housing location for workers.* The site has close proximity and relatively easy access to Kapalua, Kaanapali and Lahaina employment centers.

- *It is a natural expansion area for West Maui housing opportunities.* Residential project sites are limited in West Maui by the ocean, mountains, gulches, forest lands, and concentrated ownerships. The near-coastal corridor stretching northerly from Lahaina to Kapalua fronting Honoapiilani Highway, along the northerly/leeward flanks of the West Maui Mountains (encompassing the subject site), represents the prime potential housing area for the West Maui community plan region.

- *The location has desirable climatic and scenic traits.* The area has favorable residential climatic conditions, being northerly leeward. It is cooler and wetter than South Maui, dryer and less windy than most windward areas, and warmer than Upcountry. Many areas of the property have superior view

panoramas across the channel to Molokai and Lanai, and/or towards the upper slopes of the West Maui Mountains.

- *It is proximate to the goods and services available in Lahaina.* While there are limitations to the extent and diversity of retail opportunities in West Maui (much of the non-neighborhood inventory is in Kahului), there are numerous restaurants, shops and services in Lahaina, and more will open as the Lahaina Business Park is built out.

- *It has ready access onto the major regional thoroughfare.* Honoapiilani Highway is the primary arterial in West Maui leading from the study region into Wailuku/Kahului and the expanding South Maui community.

- *It is a defined in-fill area.* With the airport in the State Urban District, along with the lands makai of Honoapiilani Highway and at neighboring Kahana Ridge, Pulelehua would merely be an in-filling of acreage already abutting established urban uses.

Economic Impact of the Proposed Subject Development

The development of the Pulelehua will generate significant efforts and expenditures that will favorably impact the Maui economy on both a direct and indirect basis, increasing the level of capital investment, capital growth and capital flow in the region. The project will pump millions of dollars into Maui, expanding the economy, widening the tax base and creating stable long-term employment opportunities.

Further, it will help address the acute need for housing opportunities among Maui residents. Natural household formation is quickly outpacing unit development throughout Maui, due to a lack of sufficient new supply. The shortfall is exacerbated by non-resident purchasers and a strong real estate market.

From a direct perspective, the proposed 895 residential units and 174,475 square feet of commercial/mixed-use space comprising Pulelehua will create numerous construction, equipment operator and specialty trade jobs on- and off-site during the planning and emplacement of the infrastructure, building of the homes, and commercial structures. After completion, over an estimated seven-year development period, there will be a number of continuing employment positions in the on-going retail, service and other

businesses in the community, and created by the use of the residential and commercial improvements, including landscape, service, maintenance, and renovation needs.

Numerous local businesses will enjoy meaningful profit opportunities arising for contracting companies constructing the improvements, and for local businesses which would supply a substantial portion of the materials needed in the building efforts.

The general island economy also will benefit from the Pulelehua community, as construction, on-going business and maintenance employees, and neighborhood residents and guests, spend large amounts of wages and household incomes in Maui shops, restaurants, and service establishments, and in purchasing goods and services.

Indirectly, as these wages, profits, and expenditures move through the regional economy, they will have a ripple, or "multiplier," effect--increasing the amount of capital flowing to the entire island as a result of the community.

Construction, business employees, and maintenance/supply workers earning wages from Pulelehua development and uses will spend the majority of their income on living and entertainment expenses while supporting and patronizing other island businesses, as will the residents of the subdivision. Much of this spending would then be re-directed by these businesses to other island industries, with significant portions of these secondary profits in turn being put back through the region's economic and tax structure.

These substantial direct and indirect economic impacts associated with the proposed Pulelehua community, as quantified in the following sections, are all the result of the capital investment and entrepreneurship necessary to convert feral and/or economically unrequired agricultural lands into a needed, established residential and mixed use community.

Capital Investment and Construction Costs

The Pulelehua community will bring an estimated $301.5 million in direct construction capital into Maui over the seven-year model build-out period assumed for the project. Following entitlement approvals, final engineering/survey and infrastructure emplacement (on- and off-site) will require an estimated 18 months, with the initial home and construction commencing immediately thereafter; the first units being completed and occupied toward the end of year 2. Full build-out will

take an additional five years, being finished by the end of the seventh model year. This is consistent with our market analysis showing a five to seven-year absorption period.

Our ten-year economic modeling time-line is as follows:

Activity	Years
Entitlement and Infrastructure	1 and 2
Inventory Development and Sales	2 through 7
Stabilized Use/Operation	8 through 10

A breakdown of the basic expense items, their respective costs and expenditure over time is summarized on Table 13. Also shown are anticipated contractor and supplier profits flowing to local businesses as a result of the project. Infrastructure and site work costs were taken from estimates provided by Goodfellows Bros., Inc., as cited on the table. This excludes construction loan financing and other indirect costs.

The average residential unit construction cost was estimated at $225,317, based on a compilation of per square foot sizes and costs for the three main unit types. Apartment units were assumed to average 700 square feet and cost $130 per square foot, townhouse/flat units at 1,300 square feet and costs of $140 per square foot, and cottage/single family homes at an average of 2,000 square feet and costs of $150 per square foot.

Mixed-use/commercial space was estimated to have an average construction cost of $200 per square foot "all in" including tenant improvements and finish.

Infrastructure site work costs (on- and off-site) were estimated at 60 percent ($39.0 million) in year 1, and 40 percent ($26.0 million) in year 2. Home construction costs were estimated at an average total of $33.1 million annually in current dollars during the seven-year structure build-out period.

We have made an allowance for "soft/indirect" costs including engineering/architectural, overhead/administration, marketing, mobilization, and contingency, totaling an additional 25 percent of the "direct" cost expenditures.

TABLE 13

CONSTRUCTION COSTS AND CONTRACTOR AND SUPPLIER PROFIT ESTIMATES
Economic Impact Analysis of the Proposed Pulelehua Community
Mahinahina, West Maui, Hawaii
In Constant Year 2004 Dollars

Development Year	1	2	3	4	5	5	7	8	9	10	Totals
Construction Costs											
Infrastructure/Sitework (1)	$39,000,000	$26,000,000									$65,000,000
Residential Unit Construction (2)		$39,917,600	$30,445,440	$32,823,990	$32,823,990	$32,823,990	$32,823,990				$201,659,000
Industrial/Commercial Construction			$6,979,000	$6,979,000	$6,979,000	$6,979,000	$6,979,000				$34,895,000
TOTAL CONSTRUCTION COSTS	$39,000,000	$65,917,600	$37,424,440	$39,802,990	$39,802,990	$39,802,990	$39,802,990	$0	$0	$0	$301,554,000
CONTRACTOR'S PROFIT	$7,800,000	$9,191,760	$3,742,444	$3,980,299	$3,980,299	$3,980,299	$3,980,299	$0	$0	$0	$36,655,400
SUPPLIER'S PROFIT	$780,000	$2,116,704	$1,496,978	$1,593,120	$1,592,120	$1,592,120	$1,592,120	$0	$0	$0	$10,762,160

(1) From May 12, 2004 memo to Bob McNatt (M,L&P) from Goodfellow Bros., Inc. Additional 25 percent added for A&E, landscaping, survey, contingency and primary indirect costs. Subdivision infrastructure period estimated at 18 months, commencing at beginning of model and completed by middle of Year 2.

(2) Molded figure assuming 151 apartment units averaging 700 square feet with construction cost at $130 per square foot; 399 townhouse/flats units averaging 1,300 square feet with a construction cost of $140 per square foot; and 445 cottage and single family homes averaging 2,000 square feet with a construction cost of $150 per square foot. Construction assumed at consistent pace.

(3) Industrial/commercial space cost estimated at $200 per square foot "all in" including tenant improvements and finish. Construction assumed at consistent pace.

Source: Maui Land & Pineapple Company and The Hallstrom Group, Inc.

TABLE 14

EMPLOYEE JOB COUNT AND WAGE ESTIMATES
Economic Impact Analysis of the Proposed Pulelehua Community
Mahinahina, West Maui, Hawaii
In Constant Year 2004 Dollars

Development Year	1	2	3	4	5	6	7	8	9	10	Total 1 Through 10	Stabilized
Worker Requirements (1)												
Infrastructure/Sitework (2)	186	124									310	
Residential Construction (3)		266	203	219	219	219	219				1,344	
Industrial/Commercial Construction (3)			47	47	47	47	47				233	
Industrial/Commercial Operations (4)			127	254	381	508	634	634	634	634	3,807	634
Building Maintenance (5)			14	29	43	57	71	71	71	71	429	71
Off-Site Employees (6)	74	156	151	208	258	309	360	254	254	254	2,277	254
TOTAL EMPLOYMENT CREATED	260	546	541	755	947	1,139	1,331	960	960	960	8,399	960
Worker Wages												
Infrastructure/Sitework (7)	$10,715,714	$7,143,810									$17,859,524	
Residential Construction (7)		$15,354,970	$11,711,346	$12,626,295	$12,626,295	$12,626,295	$12,626,295				$77,571,495	
Industrial/Commercial Construction (7)			$2,684,589	$2,684,589	$2,684,589	$2,684,589	$2,684,589				$13,422,943	
Industrial/Commercial Operations (8)			$3,197,651	$6,395,302	$9,592,953	$12,790,604	$15,988,255	$15,988,255	$15,988,255	$15,988,255	$95,929,527	$15,988,255
Building Maintenance (9)			$342,872	$685,744	$1,028,616	$1,371,488	$1,714,360	$1,714,360	$1,714,360	$1,714,360	$10,286,160	$1,714,360
Off-Site Employees (10)	$2,080,000	$4,367,181	$4,215,536	$5,814,313	$7,235,491	$8,656,669	$10,077,847	$7,105,891	$7,105,891	$7,105,891	$63,764,711	$7,105,891
TOTAL ANNUAL WAGES PAID	$12,795,714	$26,865,960	$22,151,994	$28,206,242	$33,167,943	$38,129,644	$43,091,346	$24,808,505	$24,808,505	$24,808,505	$278,834,361	$24,808,505

(1) All job counts expressed as "full-time" equivalent positions.
(2) Estimated at one worker/year per $210,000 in infrastructure emplacement spending..
(3) Estimated at one worker/year per $150,000 in construction spending.
(4) Estimated at one worker for every 275 square feet of finished floor space.
(5) Estimated at one worker/year for each 15 residential units and one for every 15,000 square feet of industrial/commercial floor space.
(6) Includes all off-site jobs created by work efforts at the project; direct and indirect. Estimated at 0.4 off-site positions per on-site position.
(7) Average annual wage of $57,700/worker year.
(8) Average annual wage of $25,200/worker year.
(9) Average annual wage of $24,000/worker year.
(10) Average annual wage of $28,000/worker year.

Source: Various, and The Hallstrom Group, Inc.

We have assumed the initial increment of home construction would include 125 affordable rental apartments and 125 for sale units, which would be available by the end of the second development year.

Pulelehua direct costs will infuse an anticipated $43.1 million annually into the Maui building industry on average over the build-out period. This is the equivalent of about a 14 percent boost over recent yearly islandwide construction levels.

Employment Opportunities Created

Based on indicators provided by the construction of comparable sized projects and Hawaii industry averages, we have estimated the demand for on- and off-site, full-time equivalent employment positions associated with laying of initial infrastructure systems, building of the finished improvements, operating the light industrial and commercial businesses, and in providing continuing services to the occupied structures.

The employment opportunities created by the construction and use of the Pulelehua community will not all be "new" jobs, many will be enhanced opportunities for resident construction trade workers, youths reaching employment age, and existing local businesses. The varied and mixed use nature of the buildings insures the employment positions will be spread among a variety of contractors and local suppliers, providing proximate work opportunities for West Maui tradesmen.

It is assumed the off-site/indirect work created will be steered toward existing Maui supply, equipment providers, and other service companies, which despite the upward movement in the county economy over the past several years remain in a recovering period following the massive development upcycle of the late 1980s. Commercial contractors (as opposed to residential) are particularly in need of new building opportunities.

Our employment estimates on are based on full-time equivalent "worker/years," although one worker/year (or circa 2,000 working hours) may be comprised of many employees involved in specialized tasks of a much shorter duration.

Estimates are based on a 10-year modeling period of project construction, build out and community stabilization. The associated number of employment opportunities created are displayed on the top of Table 14, as divided into six categories. Included in our projections

on the table are the full-time equivalent (FTE) off-site/support employment opportunities which will be provided to Maui businesses as a result of the project.

The projections are founded on examples provided by various residential and light industrial/commercial developments undertaken on the neighbor islands over the past decade, and via formulae expressing relationships between total worker wages/benefits and construction/ operating tasks and costs. All amounts are expressed in constant mid-year 2004 dollars with no inflation from current levels.

We have not included the overhead/administration and sales/marketing positions created by the construction and sales program which would be associated with the disposal of the saleable (or leaseable) components of the development model. Project administration will require a staff of two to three persons for about a nine-year period. The sales program will generate numerous part-time agent opportunities, with perhaps two or three full-time sales office employees. We estimate that as much as $10 million in commissions and wages could be paid to the marketing staff.

Infrastructure, home construction and industrial/commercial construction employment forecasts are taken from discussions with developers, review of project records and ratios of direct costs to job creation (assuming an average wage of $57,700/year plus benefits equal to 25 percent of wages). Our analysis assumes one worker/year per $210,000 in contract spending for infrastructure positions (which are heavily oriented towards equipment and materials), and one worker/year per $150,000 in contracts for residential and industrial/commercial home construction.

Mixed-use/commercial operations in the business sections of the subject community are estimated at one worker per 275 square feet of finished floor space. It will be slightly higher for the commercial-oriented uses, and slightly less (on average) for industrial uses. The average wage of these workers is estimated at $25,200 per year.

The finished residential and business improvements and sites will require maintenance, service and repair workers which will, in total, equal some 71 worker/years annually on a stabilized basis, or one worker/year for 15,000 square feet of finished floor space and one worker/year for every 15 residential units. These workers are estimated to be paid on average $24,000 per year.

Home operations are forecast to require the equivalent of five full-time workers upon build-out and stabilized use levels; reached in the sixth year of the project lifespan. This is equal to one maintenance/landscape/service worker year for each ten houses.

Off-site employees were estimated at 40 percent of on-site workers, and are comprised of three groups:

- Numerous off-site building industry positions will also be enhanced by the Pulelehua development, including such jobs as administration, office help, material providers, equipment maintenance and specialty tasks. Analysis of Maui County labor trends from 1980 through 2003 demonstrate a linkage equal to about 30 percent between the creation of on-site construction positions and direct off-site employment.

- Off-site support businesses, including contractor/retail/counter sales, fuel providers, shipping, storage and professional services will also benefit. A conservative job creation relationship of five to ten percent relative to on-site positions was used (or, one off-site support worker/year for each ten to 20 on-site worker/years).

- Extrapolation of state Department of Business Economic Development and Tourism (DBEDT) data, along with indicators provided by other state agencies and First Hawaiian Bank studies, demonstrate that each Hawaii worker creates demand for services (and related employment) during and directly attributable to the work day at up to a 15 percent ratio. These positions include food businesses, providers of tools and trade goods, payroll/financial and insurance businesses, medical requirements and other secondary indirect/off-site employment.

During the 10-year building and use modeling period of Pulelehua, the number of worker/years created on- and off-site by the development varies from 260 to 1,331 positions annually, totaling 8,399 worker/years over the entire projection timeframe. Of this total, 1,654 worker/years (an annual average of 236 positions during the 7-year construction period) are direct construction-oriented, 3,807 are in on-going industrial/commercial businesses, 429 are resident and business building servicing positions; and 2,277 are off-site worker requirements.

On a stabilized basis after the modeling timeframe, the community will generate some 960 permanent full-time equivalent and/or enhanced employment opportunities--705 directly related to on-site activities, and 254 indirect positions throughout the island.

The average annual on-site job count during the 10-year subject study period of 840 positions represents a 1.34 percent increase from the total jobs presently available in Maui County (840 additional jobs per year to the average 2003 job count of 62,700). This number can be readily absorbed by the currently available employment pool. The job creation impact is minor and spread over a decade, and will not create a strain on current employee resources on Maui.

Our job creation estimates do not include forecasts for self-employed and other "at home" workers which will undoubtedly be present in the community. According to statistics compiled by the state and SMS, circa 22 percent of the jobs in Maui County are self-employed, and it is the fastest growing category, expanding more than four-fold from 1990 to 2000.

These jobs are typically entrepreneur-driven, generate higher than average wages, and lead to additional business and employment opportunities throughout the island. Based on prevailing ratios, upwards of 200 self-employed jobs will be created in Pulelehua on a stabilized basis. More specific projections are not possible at this time.

Additional secondary and/or supplementary employment will be created by the operating business within the community. Much of the capital and cash flow of the mixed-use and commercial businesses will be re-spent in the Maui economy, and are forecast to reach $74.1 million per year on a stabilized basis (quantified in a subsequent section). Based on DBEDT data stating each $100,000 to $150,000 spent creates one employee position, an additional 494 to 741 secondary jobs will be supported on the island as a result of the subject property businesses.

However, any mid- to long-term supplementation of the Maui job pool (particularly in the commercial construction trades sector) is desirable despite the currently low unemployment levels. This is because according to the 2000 U.S. census, some 25.5 percent of Maui County's population is under 18 years of age. Therefore, even if no new workers move to the island, the Maui economy will have to

generate sufficient jobs to absorb up to 34,000 new workers by the year 2020, an average of 1,889 per year. Or, more Maui children will have to be exported in search of work.

Wage Income Generated

In accordance with data compiled by the state Department of Labor and Industry Relations, we have estimated the personal income (in the form of wages) which will flow to Maui workers as a result of the Pulelehua community.

The average wage of a full-time infrastructure construction worker is estimated at $57,700 per year based on DLNR data for year-end 2003. For residential and industrial/commercial construction workers, the average annual pay will also be about $57,700. Tenant business operating personnel are assumed to be paid $25,200 per year on average ($12.60 per hour). Building and house maintenance, servicing, and landscaping personnel are forecast to be paid an average of $24,000 per year on average ($12.00 per hour). Off-site building and support industry jobs were estimated to receive an average pay of $28,000 annually.

Overall Pulelehua average wages are equal to $35,459 per worker/year created during the model period, and $26,046 on a stabilized basis.

Application of these wage estimates to the employment forecasts generates personal income (wage) projections directly resulting from subject development, which were shown at the bottom of Table 14. The wage figures are all presented in constant 2004 dollars, and will undoubtedly escalate over time in accordance with inflationary pressures.

In the first year of development, the "Total Annual Wages Generated" by the Pulelehua development effort would be $12.8 million, increasing to a high of $43.1 million, as the number of construction, business operations and building service workers peak in year 7. Following completion of all construction, the on-going businesses, building maintenance, off-site/indirect and other employment would result in average annual wages of $24.8 million thereafter.

Over the first 10 years of the development and use period, on- and off-site, direct and indirect worker wages would total $278.8 million.

Development Costs as Profit Income

While the significant majority of the materials needed to build the residences and businesses must be imported to Maui, a portion of the

TABLE 15

DE FACTO POPULATION, DISCRETIONARY EXPENDITURES AND RESIDENT HOUSEHOLD INCOMES
Economic Impact Analysis of the Proposed Pulelehua Community
Mahinahina, West Maui, Hawaii
In Constant Year 2004 Dollars

Development Year	2	3	4	5	6	Stabilized 7
Cumulative Residential Development						
Residential Construction	250	125	130	130	130	130
Total Finished Units	250	375	505	635	765	895
Average Daily Resident/Guest Population						
Full-Time Residents (1)	696	1,044	1,406	1,768	2,130	2,492
Part-Time Residents (2)	33	50	67	84	101	118
Guests (3)	17	25	34	42	51	60
Total De Facto Population	746	1,119	1,506	1,894	2,282	2,669
Total Full-Time Resident Population	696	1,044	1,406	1,768	2,130	2,492
Estimated School Age Children (4)	174	261	351	442	532	623
Estimated Public School Children (5)	115	172	232	292	351	411
RESIDENT DISCRETIONARY (TAXABLE) EXPENDITURES (6)	$8,643,625	$12,965,438	$17,460,123	$21,954,808	$26,449,493	$30,944,178
Total Years 1 -10	$118,417,663					
FULL-TIME RESIDENT INCOME (7)	$14,568,000	$21,852,000	$29,427,360	$37,002,720	$44,578,080	$52,153,440
Total Years 1 -10	$199,581,600					

(1) 96 percent of homes estimated to be used as full-time residences, with average household size of 2.9 persons.
(2) 4 percent of homes estimated to be used as part-time (second home) residences, occupied 20% of time with average party size of 3.3 persons.
(3) Estimated average guest population (not included in full-time or part-time categories) of 1 guest per15 finished homes.
(4) Persons between the ages of three and 19 enrolled in public and private schools, estimated at 25% of total full-time resident population.
(5) Persons enrolled in public schools, estimated at 16.5 percent of the full-time resident population.
(6) Estimated at 50% of full-time resident household income, and at $75 per capita daily for part-time residents and guest populations.
(7) Estimated at $60,700 annually per full-time resident household, the current Maui county average for a family of four.

Source: Various, and The Hallstrom Group, Inc.

construction costs spent in the development will flow to local businesses in the form of contractor profits and supplier profits.

Typically, within the industry net contractor profit margins are expected to be at 8 to 20 percent of total construction costs. We have used a conservative ten percent figure. Supplier profits were extrapolated at four percent of total costs; generally supplies/materials equate to 50 to 60 percent of total cost, with a profit margin for the supplier of six to eight percent.

Application of these estimates to the forecast development parameters of the Pulelehua community was shown on Table 13.

The total Contractor's Profit ranges from $3.9 to $9.2 million per year, with a cumulative profit of $36.6 million over the ten-year construction period. The total annual Supplier's Profit ranges from a low of $780,000 to a high of $1.6 million, and equates to $10.8 million over the development time-frame.

Population, Income and Expenditures

The 895 residential units will be marketed as finished rental apartments (151 units), as finished fee simple condominiums and houses, and as single-family or mixed-use building lots. It is expected the large majority of purchasers will be relocating, full-time Maui residents. Despite any qualifying criteria set forth by ML&P for the affordable units, some non-residents will end up purchasing the market-priced homes regardless of best efforts of the developer. We estimate that 96 percent of the total number of buyers in the project will be permanent residents with the remaining four percent being second home (part-time/vacation) buyers. This mix is more oriented towards local buyers than most projects on the island and in West Maui. Together these groups and their guests will contribute to the Maui economy during the use of the subject residences in the form of discretionary expenditures and (for full-time residents) household income levels.

Table 15 displays our population, discretionary expenditures, and household income estimates for the community.

The Pulelehua homes will be of varied sizes, but are anticipated to have average household sizes (in numbers of members).

For the 96 percent full-time resident families, the average household size is forecast at 2.9 persons, about the expected regional averages

during the development period, so that by project build-out there will be 2,492 permanent residents. For the four percent of the Pulelehua units used as second vacation homes, the average party size is estimated at 3.3 persons, with the house occupied about 20 percent of the time. By completion of development, this will create a daily average of 118 second-home users and their guests in the community.

Additionally, the full-time households will have occasional guests, estimated at one guest per 15 finished homes on average. The total "guest" population at built-out will be 60 persons.

The total average daily de facto resident population of the Pulelehua neighborhoods upon build-out will be 2,669 persons. Of the full-time residents, it is estimated approximately 623 (or 25 percent) will be in the juvenile school age group (three through 19). Of these, it would be expected that 411 would be enrolled in public educational institutions based on State of Hawaii Department of Education figures, with about 75 percent (308 children) attending grades K-8, and 25 percent (103 teens) attending high school.

The population of Pulelehua will place significant discretionary expenditure dollars into the Maui economy. We estimate that full-time resident households will spend about 50 percent of their total income on local discretionary items based on the most recent data. The daily per capita spending by second-home users and guests into the Maui economy will be on average $75, which is moderately below what the typical Maui visitor spends daily on non-lodging purchases. This pays for all food, entertainment, household goods, locally purchased fixtures and furnishings, utilities, clothing and other daily items.

By build-out, the total resident (full and part-time) and discretionary expenditures made by subject project users in the local market will be at $30.9 million annually on a stabilized basis, in 2004 dollars. During the 10-year development and operation model period, the total sum of these expenditures will be $211.3 million.

The total full-time resident income amount was estimated at $60,700 per full-time resident household; the current Maui County average for a family of four. We recognize this amount could range widely upwards, and consider this projection conservative.

On a stabilized basis after build-out, the annual full-time taxable resident income at the subject would be some $52.2 million, totaling $199.6 million during the ten-year model time frame.

Summary of Direct, Local Economic Impacts

The various direct, local economic impacts which will flow to the subject region as a result of the subject development are summarized on Table 16. The wages, profits and expenditures figures are taken from previously presented tables.

Industrial and commercial business operations at build-out and stabilization will generate some $74.2 million in gross sales activity based on an estimate of $425 of "sales" per square foot of finished floor area. The figure is likely to be higher, $500-plus per square foot, for commercial uses and lower, $250 to $400 per square foot, for mixed uses. Building maintenance, repairs and upgrades were estimated at $2,000 per finished home per year for residential units and $3 per square foot per year for industrial/commercial space.

The annual Total Base Economic Impact increases from $21.4 million in year 1 of the development effort to a high of $156.1 million in year 7 (in 2004 dollars). Over the decade long development and use modeling period, the total is $996.3 million. The estimated stabilized annual base impact thereafter is $132.2 million.

These dollars will be spent, then re-spent, on goods and services on the island, diminishing in impact on the local economy with each turnover as a portion flows off Maui for goods, services and financing commitments. First Hawaiian Bank studies have concluded the appropriate economic multiplier rates in Hawaii are from 1.2 to 3.5 times (or 20 to 250 percent) of the base impact amount. Mainland studies (by the Urban Institute and others) tend toward the upper end of this range, and reach multipliers as high as 4.0.

Due to the need to import more than 85-plus percent of supplies/goods used on Maui, the multiplier impact for the island is not as great as for mainland locales, particularly for construction-based expenditures. We have therefore tested multiplier rates at the mid-point of the market spectrum, ranging from 1.5 to 3.5 times.

On a conservative basis, using a relatively low-end multiplier effect ratio of 2.0, the total overall direct impact on the Maui island economy resulting from the Pulelehua community would be $1.99 billion over the 10-year projection period (in constant 2004 dollars). On a

stabilized annual basis thereafter, the overall impact would be at $264.4 million.

CERTIFICATION

The undersigned do hereby certify that, to the best of our knowledge and belief, the statements of fact contained in this report are true and correct. It is further certified that the reported analyses, opinions, and conclusions are limited only by the reported assumptions and limiting conditions, and are our personal, impartial, and unbiased professional analyses, opinions, and conclusions. We further certify that we have no present or prospective interest in the property that is the subject of this report, and have no personal interest with respect to the parties involved. We have no bias with respect to the property that is the subject of this report or the parties involved with this assignment. Our engagement in this assignment was not contingent upon developing or reporting predetermined results. Our compensation for completing this assignment is not contingent upon the development or reporting of a predetermined value or direction in value that favors the cause of the client, the amount of the value opinion, the attainment of a stipulated result, or the occurrence of a subsequent event directly related to the intended use of this appraisal. The appraisal analyses, opinions, and conclusions were developed, and this report has been prepared, in conformity with the requirements of the Code of Professional Ethics and Standards of Professional Appraisal Practice of the Appraisal Institute, and the Uniform Standards of Professional Appraisal Practice. The use of this report is subject to the requirements of the Appraisal Institute relating to review by duly authorized representatives. The undersigned certify that they have made personal inspections of the property that is the subject of this report. No other persons provided significant real property appraisal assistance other than the undersigned.

TABLE 16

SUMMARY OF ECONOMIC IMPACTS ASSOCIATED WITH DEVELOPMENT
Economic Impact Analysis of the Proposed Pulelehua Community
Mahinahina, West Maui, Hawaii
In Constant Year 2004 Dollars

Development Year	1	2	3	4	5	6	7	8	9	10	Total Years 1 Through 10	Stabilized
ANNUAL WAGES GENERATED	$12,795,714	$26,865,960	$22,151,994	$28,206,242	$33,167,943	$38,129,644	$43,091,346	$24,808,505	$24,808,505	$24,808,505	$278,834,361	$24,808,505
CONTRACTOR'S PROFIT	$7,800,000	$9,191,760	$3,742,444	$3,980,299	$3,980,299	$3,980,299	$3,980,299				$36,655,400	
SUPPLIER'S PROFIT	$780,000	$2,116,704	$1,496,978	$1,592,120	$1,592,120	$1,592,120	$1,592,120				$10,762,160	
INDUSTRIAL AND COMMERCIAL BUSINESS OPERATIONS (1)			$14,830,375	$29,660,750	$44,491,125	$59,321,500	$74,151,875	$74,151,875	$74,151,875	$74,151,875	$444,911,250	$74,151,875
BUILDING MAINTENANCE, REPAIRS AND UPGRADES (2)			$462,685	$925,370	$1,388,055	$1,850,740	$2,313,425	$2,313,425	$2,313,425	$2,313,425	$13,880,550	$2,313,425
DISCRETIONARY EXPENDITURES		$8,643,625	$12,965,438	$17,460,123	$21,954,808	$26,449,493	$30,944,178	$30,944,178	$30,944,178	$30,944,178	$211,250,195	$30,944,178
TOTAL BASE ECONOMIC IMPACT	$21,375,714	$46,818,049	$55,649,913	$81,824,903	$106,574,349	$131,323,796	$156,073,242	$132,217,983	$132,217,983	$132,217,983	$996,293,916	$132,217,983
Multiplier Effect Ratio	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
TOTAL OVERALL IMPACT	$42,751,429	$93,636,099	$111,299,826	$163,649,807	$213,148,699	$262,647,591	$312,146,483	$264,435,966	$264,435,966	$264,435,966	$1,992,587,831	$264,435,966

(1) Estimated at $425 per square foot of floor space annually.

(2) Estimated at $2,000 per house per year and $3 per square foot of industrial/commercial floor space per year.

Source: Various, and The Hallstrom Group, Inc.

The Appraisal Institute conducts programs of continuing education for their designated members. As of the date of this report, James E. Hallstrom, Jr. has completed the requirements of the continuing education program of the Appraisal Institute.

James E. Hallstrom, Jr., MAI, CRE
Hawaii State Certified
General Appraiser, CGA-178
Exp. Date December 31, 2005

Tom W. Holliday

/as

4521AR01

THE HALLSTROM GROUP INC.
REAL ESTATE
CONSULTANTS
& APPRAISERS

PROFESSIONAL BACKGROUND AND SERVICES

The Hallstrom Group, Inc. is a Honolulu based independent professional organization that provides a wide scope of real estate consulting services throughout the State of Hawaii with particular emphasis on valuation studies. The purpose of the firm is to assist clients in formulating realistic real estate decisions. It provides solutions to complex issues by delivering thoroughly researched, objective analyses in a timely manner. Focusing on specific client problems and needs, and employing a broad range of tools including after-tax cash flow simulations and feasibility analyses, the firm minimizes the financial risks inherent in the real estate decision making process.

The principals and associates of the firm have been professionally trained, are experienced in Hawaiian real estate, and are actively associated with the Appraisal Institute and the Counselors of Real Estate, nationally recognized real estate appraisal and counseling organizations.

The real estate appraisals prepared by The Hallstrom Group accomplish a variety of needs and function to provide professional value opinions for such purposes as mortgage loans, investment decisions, lease negotiations and arbitrations, condemnations, assessment appeals, and the formation of policy decisions. Valuation assignments cover a spectrum of property types including existing and proposed resort and residential developments, industrial properties, high-rise office buildings and condominiums, shopping centers, subdivisions, apartments, residential leased fee conversions, special purpose properties, and vacant acreage, as well as property assemblages and portfolio reviews.

Market studies are research-intensive, analytical tools oriented to provide insight into investment opportunities and development challenges, and range in focus from highest and best use determinations for a specific site or improved property, to an evaluation of multiple (present and future) demand and supply characteristics for long-term, mixed-use projects. Market studies are commissioned for a variety of purposes where timely market information, insightful trends analyses, and perceptive conceptual conclusions or recommendations are critical. Uses include the formation of development strategies, bases for capital commitment decisions, evidence of appropriateness for state and county land use classification petitions, fiscal and social impact evaluations, and the identification of alternative economic use/conversion opportunities.

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PROFESSIONAL QUALIFICATIONS OF JAMES E. HALLSTROM, JR., MAI, CRE

Business Background

President	The Hallstrom Group, Inc. Honolulu, Hawaii (1980 - Present)
Former Senior Vice President and Treasurer	Hastings, Martin, Hallstrom and Chew, Ltd., Honolulu, Hawaii (1972-1980)
Former Real Property Appraiser and Analyst	Administration, Inc., a subsidiary of C. Brewer and Company, Limited Honolulu, Hawaii (1971-1972)
Former Senior Real Property Appraiser and Analyst	Opitz Realty, Madison, Wisconsin (1969-1971)

National Designations and Memberships

- CRE Designation (1998) - The Counselors of Real Estate
- MAI Designation (1976) - American Institute of Real Estate Appraisers
- SRPA Designation (1975) - Society of Real Estate Appraisers

The American Institute of Real Estate Appraisers (AIREA) and the Society of Real Estate Appraisers (SREA) consolidated in 1991, forming the Appraisal Institute (AI).

Education

- M.S. (Real Estate Appraisal and Investment Analysis) 1971, University of Wisconsin at Madison
- B.A. (Economics) 1969, Brigham Young University at Provo
- Additional numerous specialized real estate studies in connection with qualifying for national professional designations, and uninterrupted Continuing Education.
- Completed Continuing Education requirements with the Appraisal Institute through 2004.

Professional Involvement

- Former President and Officer for Hawaii AIREA and SREA Chapters
- Instructor for Society of Real Estate Appraisers Course 101, "Introduction to Appraising Real Property" and Course 201, "Principles of Income Property Appraising"
- Contributing author to the "Hawaii Real Estate Investor"
- Lecturer at many professional seminars and clinics.
- Appointed numerous times as an Arbitrator and Mediator.

Qualified Expert Witness

Federal and State Courts
State Land Use and County Hearings
Arbitration Proceedings

State of Hawaii Certification

Certified General Appraiser, License Number CGA-178, Exp. Date December 31, 2005

Community Service

Active registered member of the Boy Scouts of America; former Director of Le Jardin Academy; former Advisory Board Member of the School of Business, Brigham Young University, Hawaii Campus; Director of Hawaii Reserves, Inc.

PROFESSIONAL QUALIFICATIONS OF THOMAS W. HOLLIDAY

Business Background

Supervisor/ Senior Analyst	The Hallstrom Group, Inc. Honolulu, Hawaii
Former Staff Appraiser	Davis-Baker Appraisal Co. Avalon, Santa Catalina Island, California

Education

- B.A. (Communications/Journalism) 1978 California State University at Fullerton
- SREA Course 201- Principles of Income Property Appraising
- Expert witness testimony before State of Hawaii Land Use Commission and various state and county boards and agencies since 1983.
- Numerous professional seminars and clinics
- Contributing author to Hawaii Real Estate Investor, Honolulu Star Bulletin

On January 1, 1991, the American Institute of Real Estate Appraisers (AIREA) and the Society of Real Estate Appraisers (SREA) consolidated, forming the Appraisal Institute (AI).

Recent Maui Assignments (since 2000)

- Market Study, Economic Impact Analyses and Public Costs/Benefits Assessments
  - -- Wailea Ranch (Master Planned Community)
  - -- Palauea Bay (Resort/Residential)
  - -- Upcountry Town Center (Mixed-Use Planned Development)
  - -- Maui Lani (Residential and Industrial Components of Master Planned Community)
  - -- Maui Business Park, Phase II (Industrial/Commercial)
  - -- Four Seasons Private Estates and Residences Club (Resort/Residential)
  - -- Kualono Subdivision (Residential)
  - -- Kapalua Mauka (Master Planned Community)
  - -- Hailiimailii (Commercial)
  - -- Pulelehua (Master Planned Community)
  - -- Westin Kaanapali Ocean Villas Expansion (Resort/Timeshare)
- Major Valuation Assignments
  - -- Sheraton Maui Hotel
  - -- Outrigger Wailea Resort Hotel
  - -- Maui Lu Hotel
  - -- Coconut Grove Condominiums
  - -- Palauea Bay Holdings
  - -- Wailea Ranch
  - -- Maui Coast Hotel
  - -- Westin Maui Hotel
  - -- Maui Marriott Hotel
  - -- Waihee Beach
  - -- Kapalua Bay Hotel and The Shops at Kapalua

B

Pulelehua Design Book

Pulelehua

A New Traditional Community

Island of Maui
Hawai`i

TOWN FOUNDERS:

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The Vision

Maui Land & Pineapple's vision of holistic communities is based on the traditional Hawaiian concept of the ahupua'a — a section of land stretching from the summit of the mountains, down through the fertile valley lands, into the sea. Within each ahupua'a grew most of the products needed by the people who lived and worked there. The ahupua'a was managed as an ecological, social, and economic unit. The people of the ahupua'a understood the limits of its resources and their complex interrelationships.

Holistic communities respect our natural beauty and fragile ecosystems — and work to protect our exquisite places in perpetuity. This is demonstrated in the traditional Hawaiian value of malama`aina — caring for, protecting and preserving the land. Maui Land & Pineapple Company has pledged to continue to engage in responsible stewardship of the environment; Pulelehua town is an important part of this philosophy.

Land stewardship includes making critical decisions to determine where land can be developed, and where it is essential to preserve open space. While the vast majority of Maui Land & Pineapple Company's land holdings will remain in agriculture or preserved open space, Pulelehua town will serve a critical function - to provide affordable housing within close proximity to work for ML&P's employees, and other working families in West Maui. Providing the opportunity for people to live close to where they work is an important feature of sustainable design - increasing quality of life by decreasing time lost during a daily commute and decreasing traffic congestion.

During the planning workshops for Pulelehua, several other planning ideals emerged from the community that fit neatly with the ideas of holistic communities; these became the ***"First Principles"*** that guided the work of the design team:

A Compact, Sustainable Community

Create genuine neighborhoods, not just subdivisions. Genuine neighborhoods contain a mix of uses and housing types, accommodating a wide variety of people and activities. A compact community respects the land on which it is placed, protecting and restoring natural amenities within and around the town.

Affordable Housing with Dignity

Provide a variety of affordable housing options, integrated into complete neighborhoods. Include a wide variety of street-oriented, privacy-protecting buildings. Integrate density into the neighborhoods with careful urban design.

Mixed Uses for Livability

Include neighborhood-serving commerce and live/work units, but no "strip shopping center."

True Hawaii

Value traditional Hawaiian architecture, the landscape, the climate, important views, outdoor life, and the principal of malama`aina - and design with these issues in mind.

Connectedness

Incorporate networks of green space, streets and trails into the neighborhood, allowing multiple types of circulation. Encourage people-to-people contact through the architecture and urban design by creating high quality public buildings, houses with porches, parks, streets and sidewalks for all to enjoy.

Make it Walkable & Bike-able

The design of the streets and destinations located along them determine how they will be used; make great streets, not just ordinary ones, and people will use them for more than just driving.

"By integrating agriculture, wise stewardship and eco-effective design principles, Maui Land & Pineapple Company is committed to creating and managing holistic communities that build a sustainable future for Maui".

--"Cultivating Our Next 100 Years", Maui Land & Pineapple Company

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THE VISION

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THE PLANNING PROCESS

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The Planning Process

The week of March 19th - 26th 2004, West Maui residents joined together with Maui Land & Pineapple Company and a team of town planners, designers, and engineers to create a plan for new neighborhoods near the Kapalua West Maui Airport. This planning effort was initiated to create affordable housing in West Maui, so that people who worked in the area could also afford to live there. The idea for the neighborhood has enjoyed support from the beginning from many in the community, including West Maui workers and residents, Mayor Alan Arakawa, Maui County Planning Director Mike Foley, and Maui Land & Pineapple's CEO David Cole and Senior Vice-President of Land Planning and Development Bob McNatt. Having a high level of community involvement in the planning process was a top priority, to ensure that the plan that was created reflected the needs and wants of people who live and work in the area. Led by town planning firm Dover Kohl & Partners, the design team set out to conduct a week-long series of planning workshops to create a vision for the site. The planning workshops were promoted throughout the month of March on the radio and local newspapers, inviting anyone who was interested to attend.

The design team began with an analysis of the site, located mauka of Honoapiilani Highway, and roughly bounded by Kahanaiki Gulch to the north and Mahinahina Gulch to the south. The team walked and drove over the entire site, noting important views and topographical features. The team then toured the surrounding neighborhoods, becoming familiar with the existing roadways, houses, and shops in the area. The team also researched traditional Hawaiian towns and architecture, studying Lahaina, Lanai City, and other towns; specific elements that make these settlements memorable were noted, such as the lanais and porches, the relationships of buildings to the streets, and the quality of public open spaces.

On Friday March 19th, a community kick-off presentation was held at the Ritz-Carlton Kapalua. This event informed the public about the upcoming planning events, and how they could be involved in the process. The night began with introductions by Mayor Alan Arakawa, Maui County Planning Director Mike Foley, and Maui Land & Pineapple's Bob McNatt, encouraging the crowd of approximately 250 to continue participating in the planning process. Victor Dover, town planner and head of the design team, gave a presentation about traditional neighborhood design, and transportation planner Rick Hall followed with a presentation about walkable street design. Towards the end of the evening, an open microphone session was held, to allow those in attendance the chance to speak out about what was on their mind and ask questions.

Studying the land.

The kick-off presentation introduced the community to the planning process.

An open microphone session allowed participants the opportunity to voice their opinions.

On Saturday March 20th, an interactive hands-on design session allowed participants to share their ideas in the design of the new community. Community members worked together with a facilitator from the design team in small groups, drawing ideas on large maps of the site. Discussions involved desired land uses, activities, services, and physical characteristics for the new neighborhoods. At the end of the design session, one member from each table presented their work to the entire group. A general consensus emerged quickly; some of the most widely shared ideas were:

- provide high quality affordable housing for the workers of West Maui, to allow people to live near where they work

- include a mix of housing types to accommodate residents of different backgrounds, ages, and incomes

- reflect Hawaiian building traditions with native landscaping, island architecture, and common open spaces for community gathering and recreation

- provide needed amenities for West Maui residents, such as a community / cultural center, an elementary school, and a network of open spaces and trails

- create pedestrian-friendly streets to promote walkability to destinations within the neighborhood

Following the hands-on session, the design team set up an on-site studio for the week at Napili Plaza, to synthesize the many ideas heard into one cohesive vision for the site. West Maui citizens were invited to stop by to check the progress of the plan and continue to offer input. The table drawings from the Saturday session were placed around the room for visitors to review what their fellow community members had in mind for the neighborhood. Throughout the week, technical meetings were held with representatives of various government agencies, including the Maui County departments of Planning, Public Works, the Affordable Housing Technical Review Committee, and the Maui Office of the State of Hawaii Department of Transportation.

On Tuesday March 23rd, a Community Open House was held at the design studio, to review the preliminary plans and sketches for Pulelehua. Approximately 100 residents came by to review the work that had been produced to date. The design team spoke with the attendees and listened to their ideas and concerns, then incorporated what was learned into the evolving plan.

The hands-on design session allowed community members to work together in small groups.

Each table drew their own ideas for the site.

At the end of the day, one member from each table presented their work to the entire group.

On Friday March 26th, a Work-In-Progress presentation was held at the Ritz Carlton Kapalua. David Cole, CEO of Maui Land & Pineapple Company, began the event by welcoming the approximately 180 attendees, and gave a brief introduction about the new direction of Maui Land & Pineapple Company and how Pulelehua fits within that vision. He then introduced Victor Dover, who presented the preliminary ideas and drawings that had been produced over the previous week. The "First Principles" that guided the design of the site reflected the ideas heard at the hands-on session, and including "affordable housing with dignity," "mixed uses for livability," and "true Hawaii." Plans and visualizations conveyed these principles in a physical form.

After the presentation, people gathered around maps of the plan that had been posted in the room, and spoke with members of the design team. Initial feedback was generally positive. Lee Altenberg, University of Hawaii professor and attendee that evening, was quoted in the Maui News saying "This is the most concentrated collection of intelligent ideas I've heard since I came to Maui nine years ago."

Following the planning workshops, the design team returned to their offices to continue refining the details of the plan. Continued public involvement in the planning and approvals process is encouraged, to ensure that Maui residents get the high quality, affordable, and attractive neighborhoods that they deserve.

PULELEHUA CHARRETTE TEAM:

Maui Land & Pineapple Company, Inc.

David Cole, *President & CEO*
Bob McNatt, *Vice-President/ Land Planning & Development*
Randy Endo, *Development Manager*
Leilani Pulmano, *Development Manager*

Design Team

Victor Dover, *Dover, Kohl & Partners*
Joe Kohl, *Dover, Kohl & Partners*
James Dougherty, *Dover, Kohl & Partners*
Amy Groves, *Dover, Kohl & Partners*
Margaret Marshall, *Dover, Kohl & Partners*
Eduardo Castillo, *Dover, Kohl & Partners*
Chris Podstawski, *Dover, Kohl & Partners*
Marice Chael, *Chael Cooper & Associates*
Seth Harry, *Seth Harry & Associates*
Rick Hall, *Hall Planning & Engineering*

At the on-site design studio, the design team worked on synthesizing the community's ideas into one plan.

The Open House allowed interested community members to review the work-in-progress.

The rendering of the work-in-progress plan.

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THE PLANNING PROCESS

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PLAN NARRATIVE

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Pulelehua: A Unique Site, A Unique Opportunity

The site chosen for the Pulelehua neighborhoods presents many unique opportunities. The gentle slope of the land provides exceptional views from many vantage points; remarkable gulches form natural divisions for neighborhoods, and can be preserved as amenities for future residents; natural features such as the topography, wind direction, and the sun angle can be used to inform the designers of ways to organize the orientation of new buildings and streets.

Pulelehua

Within the initial plans for Pulelehua, there are three distinct neighborhoods proposed, each with their own individual character. The central neighborhood, anchored by Akahele Street, will be a complete neighborhood unit with a mix of uses including Pulelehua-serving retail, public uses including an elementary school and Wellness Center, open park and recreation spaces, and a variety of residential options. The uses and building types are to be organized with the most intense and closely spaced uses (commercial and higher density) in the central Crossroads area, with less intense uses (single family homes and less density) toward the edges.

The Crossroads mixed-use neighborhood center.

Houses frame vistas to the water.

Terrace houses and apartments are a part of the housing mix.

A corner store can be found along a neighborhood street.

The central Crossroads is to include a main street area, consisting of shopfront buildings with apartments above, and live/work units. At one end of the main street will be a Wellness Center overlooking a long terracing green that leads back to the highway. At the other end of the main street is the proposed site for the elementary school — healthy living and education will provide the anchors for the neighborhood. Near the airport, a light industrial, "workplace edge" area will be located - this area can accommodate airport-serving uses such as an air courier or car rental shop, and will serve as a buffer for residential units below.

A range of housing types will complete this area; attached units would be found near the neighborhood center, allowing privacy and homeownership in a compact, affordable form. Single family homes in the form of island cottages or bungalows, duplexes, or courtyard apartment buildings are some of the building types that would be found in the "neighborhood general" area — between the center and edge. Larger single family lots would be found along the outer edge, completing a variety of housing types and price options.

All of the buildings in the neighborhood will reflect traditional Hawaiian architecture; inspiration in their design was drawn from the work of architect Charles Dickey and from traditional Hawaiian settlements such as Lanai City. Houses located along streets that run mauka-makai will frame vistas to the water and the islands of Molokai and Lanai. These views can be enjoyed by pedestrians, bicyclists, and motorists on the streets, as well as residents on their front lanais.

Other proposed new neighborhoods are to be located to the north and south, separated from the central neighborhood by preserved gulches; these are to have a different, predominantly residential character. The north neighborhood is an opportunity to complete the Kahana Ridge neighborhood, providing shared park space and a network of walkable streets and trails to connect residents to other areas of Pulelehua town. Near the airport a green buffer area is to be created, including a large parcel for community gardens. The south neighborhood will contain new houses and parks that are intended to eventually become an interconnected part of a complete neighborhood, when linked to development on the Department of Hawaiian Homelands property.

Walking trails are found throughout the neighborhoods.

Proposed roundabout at the intersection of Akahele and Honoapiilani.

Circulation through the new neighborhoods was an important consideration during the design process. Vehicular circulation is to occur along a network of interconnected streets to disperse traffic throughout the neighborhood. There are to be multiple connections to Honoapiilani Highway to allow a series of options to enter and exit. Not all of these connections would have traffic signals, and those that do would have synchronized lights, to keep traffic flowing along the highway.

Pedestrian circulation, as well as vehicular circulation, was given a high priority by the designers. Neighborhood streets will be designed for lower vehicle speeds, with appropriately narrow lanes, sidewalks, street trees, and buildings close to the street. A second circulation system of linked paths and trails will allow pedestrians and bicyclists to have another option for movement through the neighborhood. These paths and trails will run through a strategically located network of green spaces and exterior greenbelt that will make the neighborhoods livable for residents.

Pulelehua Illustrative Master Plan.

A connected network of open/green spaces.

A connected network of circulation systems.

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PLAN NARRATIVE

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ILLUSTRATIVE MASTER PLAN

NEIGHBORHOOD CORE
(Main Street and Live/Work)

NEIGHBORHOOD CENTER
(Main Street, Live/Work, and Higher Density Residential)

NEIGHBORHOOD GENERAL
(Live/Work, Corner Store, and a Mix of Residential Units)

NEIGHBORHOOD EDGE
(Lower Density Residential)

ESTATE EDGE
(Estate House Lots)

WORKPLACE EDGE
(Workshop / Loft Buildings)

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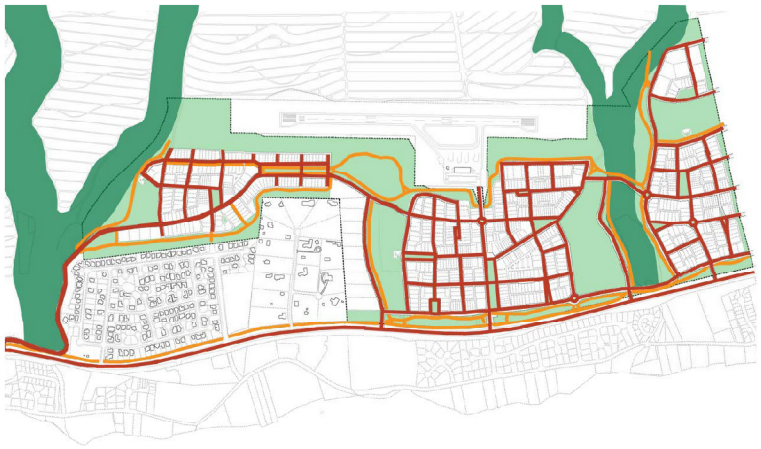
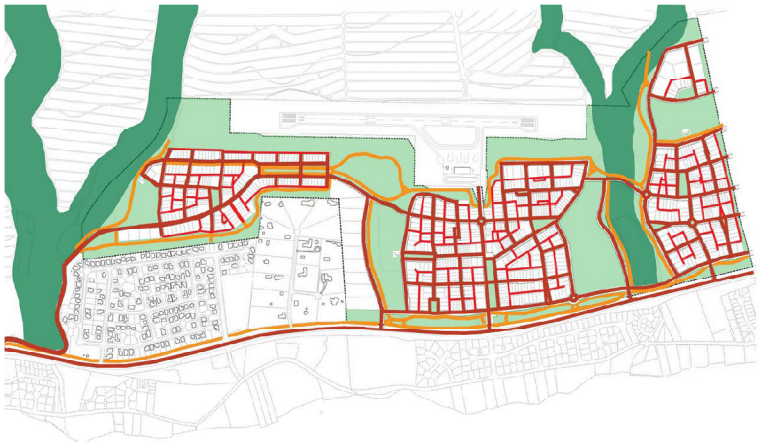
Pulelehua — Green Network

Pulelehua — Vehicular & Trail Networks



Pulelehua — Vehicular Network

Pulelehua — Vehicular, Trail & Pedestrian Networks



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PLAN DIAGRAMS

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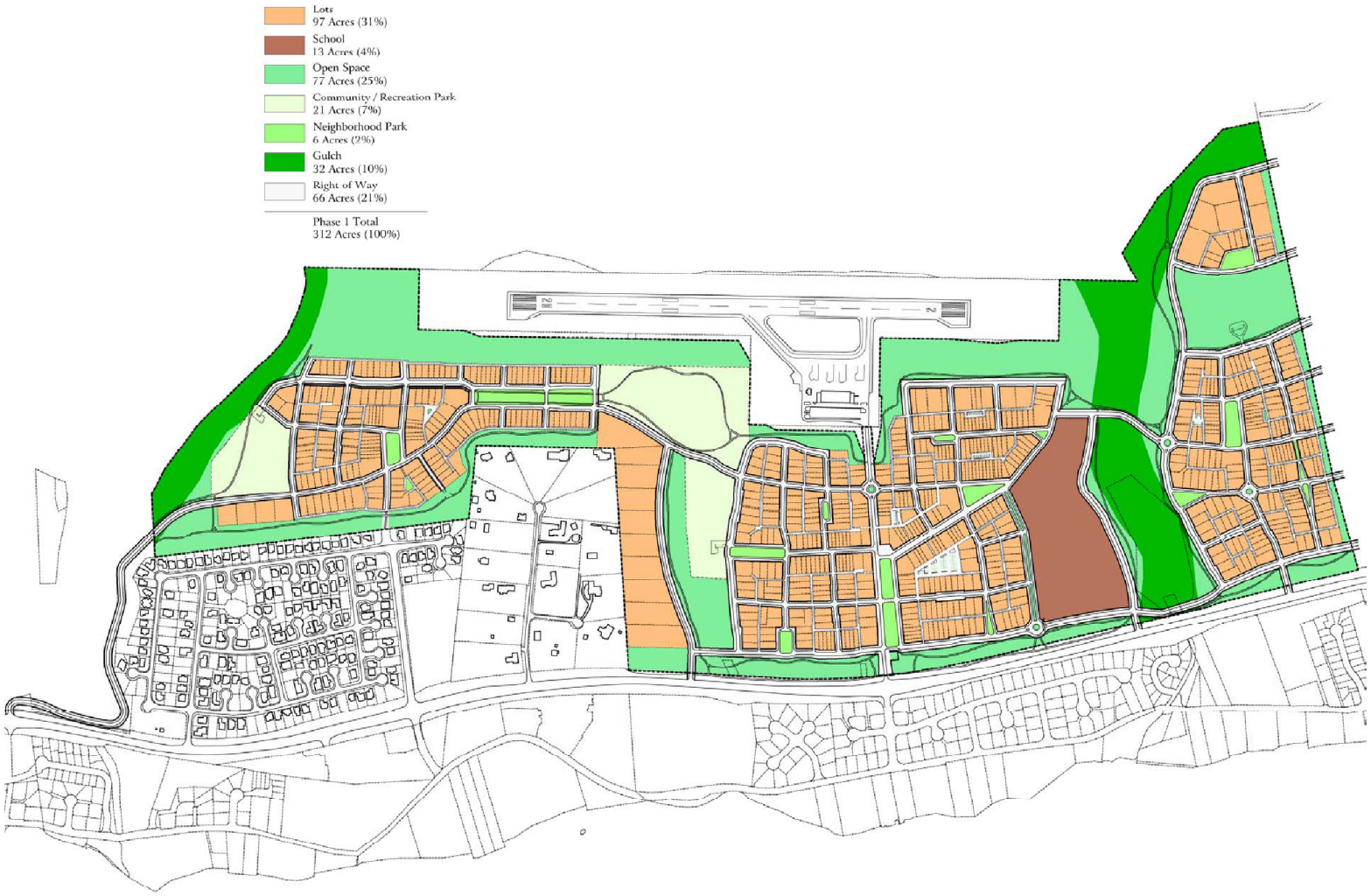
ACREAGE DIAGRAM



The above diagram compares the areas devoted to developed land, usable open space, gulches, rights-of-way, and the neighborhood school.

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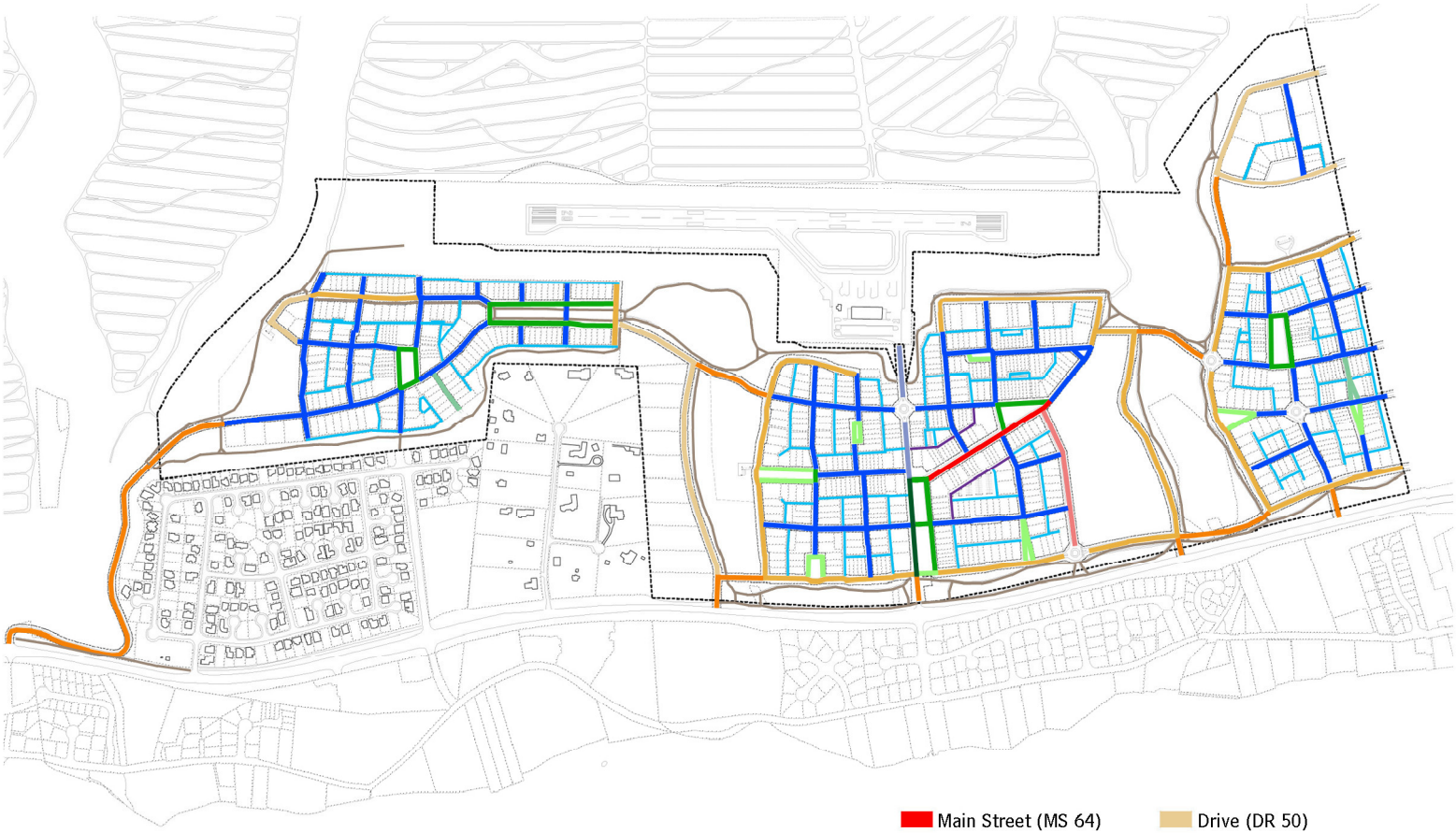
VEHICULAR NETWORK DIAGRAM



- Main Street (MS 64)
- Avenue (AV 60)
- Green Street (ST 60)
- Green Street (ST 35)
- Green Street (ST 25)
- Street (ST 60)
- Street (ST 44)
- Drive (DR 57)
- Drive (DR 50)
- Road (RD 50)
- Alley (A 20-20)
- Rear Lane (LA 20-10)
- Trail (TR 16-8)
- Pedestrian Street (PED 30)

The Street Type Locator Diagram identifies where certain street sections, contained in the Development Standards, should be used in the plan.

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REGULATING PLAN

	CORE
	CENTER
	GENERAL
	EDGE
	ESTATE EDGE
	WORKPLACE EDGE
	OPEN SPACE
	PROPOSED SCHOOL SITE

The Regulating Plan specifies a Transect Zone for each area of the plan, which corresponds to regulations in the Development Standards.

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Aerial perspective of the central neighborhood of Pulelehua.

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PERSPECTIVE IMAGES

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PERSPECTIVE IMAGES

A mix of uses and housing types will create a diverse neighborhood and permit families to establish long-lasting roots in Pulelehua.

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The central Crossroads area will include shopfronts, apartments, live/work units, and attached housing, such as terrace houses, which allow affordable units to maximize both privacy and neighborly appeal.

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PERSPECTIVE IMAGES

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PERSPECTIVE IMAGES

Houses located along streets that run mauka-makai will frame vistas to the water.

A main street area, including shopfront buildings with apartments above and live/work units, will be the center of activity in the neighborhood.

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An interconnected system of paths and trails will allow ready access to the parks and greenbelt.

The modern roundabout provides a traffic calmed alternative to a busy intersection.

Estate Houses will be found in the Neighborhood Edge areas.

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PERSPECTIVE IMAGES

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ARCHITECTURAL DRAWINGS

Conceptual sketches of a Courtyard Apartment House and a typical Apartment House

Conceptual sketch of a row of Terrace Houses

Conceptual sketch of a Corner Store Building

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Conceptual sketch of two Cottage Houses

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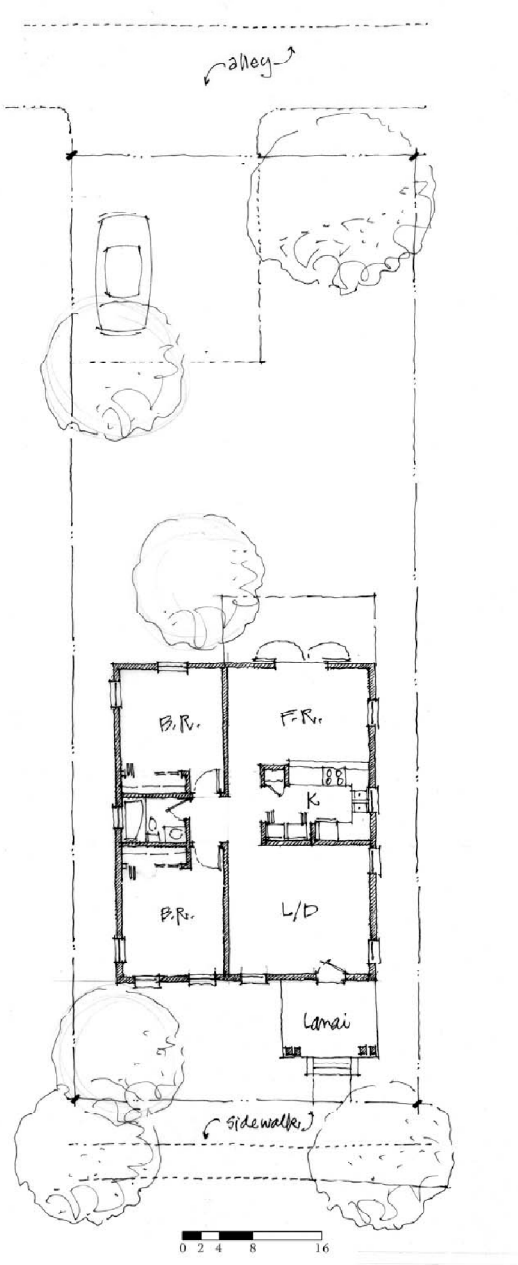

Conceptual floorplan of a Cottage House

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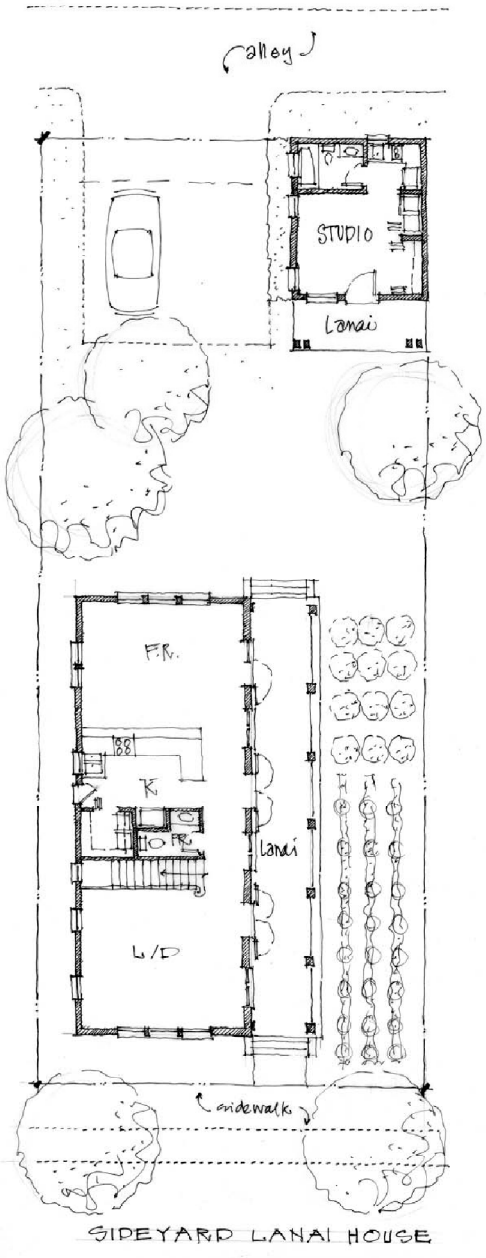
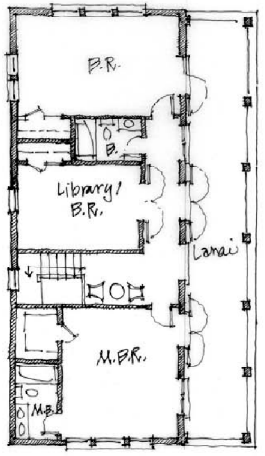


SIDEYARD LANAI HOUSE



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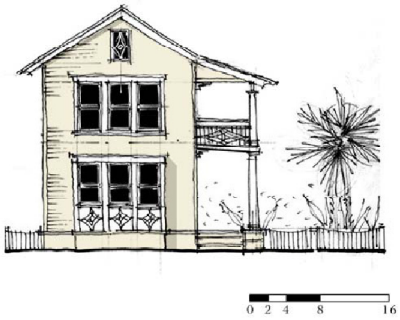
Conceptual floorplans of a Sideyard Lanai House



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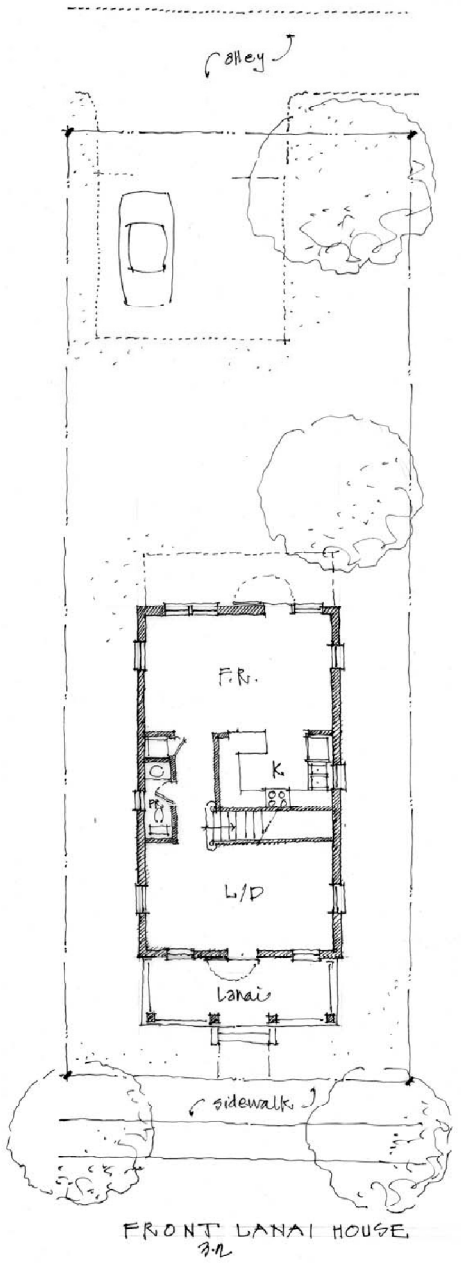
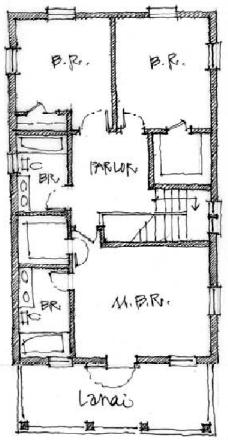
Conceptual sketch of a Sideyard Lanai House

Conceptual sketch of two Front Lanai Houses





Conceptual floorplans of a Front Lanai House

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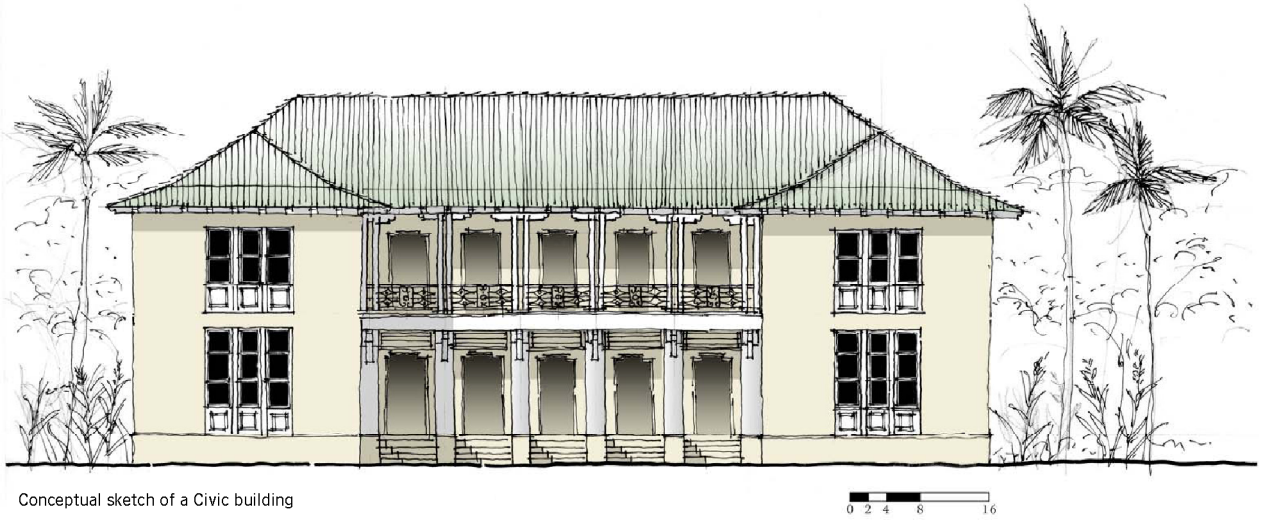
ARCHITECTURAL DRAWINGS

Conceptual sketch of an Estate Lot House

Conceptual sketch of a Workshop / Loft Building



Conceptual sketch of a Civic building

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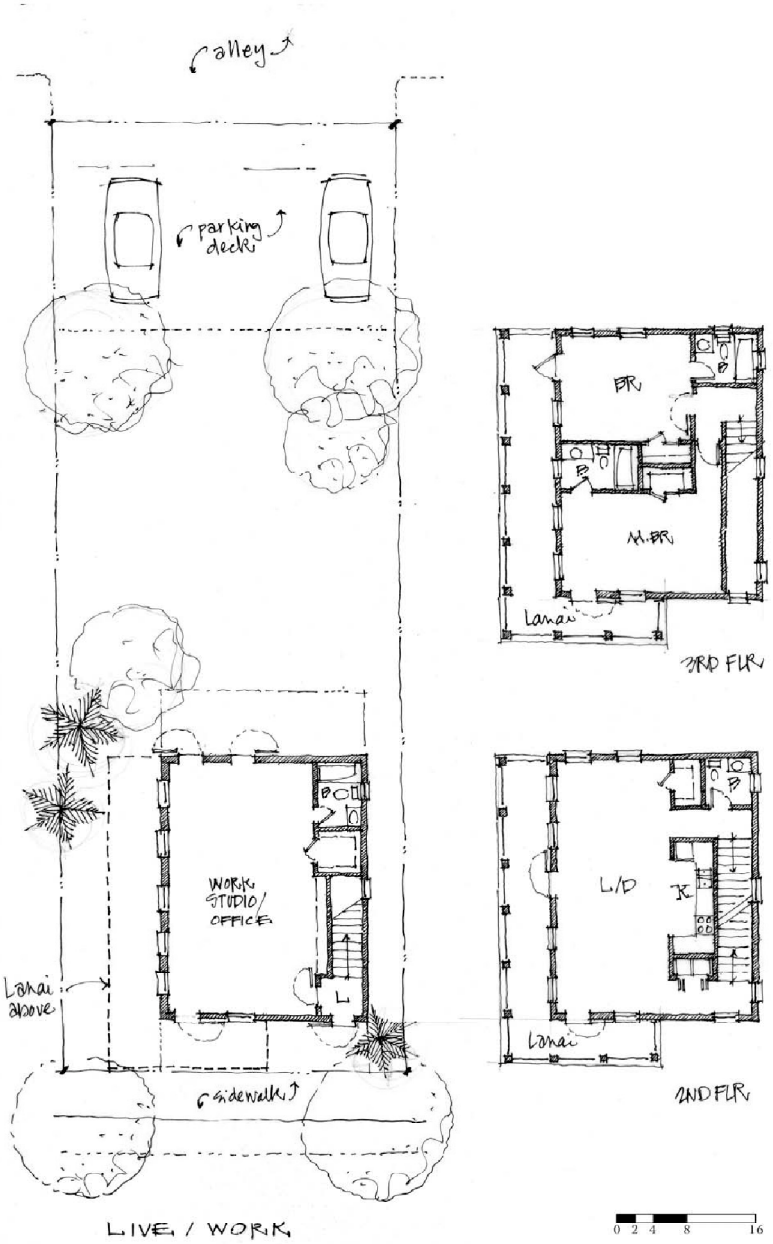
Conceptual sketch of a Main Street Building

Conceptual sketch and floorplans of a Live / Work Building



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ARCHITECTURAL DRAWINGS

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C

Marine Environment Assessment Report

AN ASSESSMENT OF THE MARINE ENVIRONMENT
IN THE VICINITY OF THE PROPOSED
PULELEHUA DEVELOPMENT
WEST MAUI, HAWAII

Prepared for

Kapalua Land Company, Inc.
1000 Kapalua Dr.
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By

Marine Research Consultants
1039 Waakaua Pl.
Honolulu, HI 96822

May 2004

Revised
February 2005

I. INTRODUCTION AND PURPOSE

Maui Land and Pineapple Co. Inc. is in the planning stages to develop the Pulelehua residential community in West Maui, Hawaii. The Pulelehua community will be located on approximately 312 acres of land located between Honoapiilani Highway and the Kapalua West Maui Airport (Figure 1). At least 51% of the community will be affordable to Maui residents earning between 80% and 140% of the HUD median income. Development of the Pulelehua community will transform pineapple fields into a residential community. The change in land use is not expected to have significant adverse effects on the existing watershed, downstream properties, or coastal marine waters. While post-development runoff is expected to increase slightly, detention and desilting basins will maintain the existing levels of runoff leaving the site. In addition, water quality of the runoff from the site is expected to improve from the present scenario of pineapple fields, particularly in terms of sediment runoff.

While all planning and construction activities will place a high priority on maintaining the existing nature of the marine environment, it is nevertheless important to address any potential impacts that may be associated with the planned project. None of the proposed land uses includes any direct alteration of the coastal areas or nearshore waters. The potential exists, however, for the project to affect the composition and volume of groundwater that flows beneath the project site, as well as surface runoff emanating from the project. As all groundwater that could be affected by the project subsequently reaches the ocean, it is recognized that there is potential for the project to affect the marine environment. Therefore, important questions include the potential impacts from soil, fertilizers, and other chemicals, which could cause alterations to water quality and marine life.

In the interest of addressing these concerns and assuring maintenance of environmental quality, a baseline marine environmental assessment and potential impact analysis of the nearshore areas off the Pulelehua property was conducted in May 2004. The rationale of this assessment was to determine the existing condition of the marine environment in the vicinity of the Pulelehua project, and to evaluate the effects that input from land has on water quality at the present time, prior to the commencement of any new construction activities. Combining this information with estimates of changes in groundwater and surface water flow rates and chemical composition that could result from the project will provide a basis to evaluate the potential effects to the marine environments. Results of the combined evaluation will indicate if, and to what degree, there is the potential for negative effects to the marine environments from the proposed project.

II. ANALYTICAL METHODS

A. Water Chemistry

Water quality was evaluated along three transects that extended from the shorelines out to the open coastal ocean, a distance of approximately 500 m. Transects were located in Ka'opala Bay, located near the northern boundary of the project, Pohaku Bay (also known as "S-turns") near the center of the project site, and Mahinahina, located off the southern end of the project (see Figure 1). These sites were selected in order to cover the geographical range of the project. The Ka'opala and Mahinahina sites are also located off the drainages of the two gulches that pass through the Pulelehua acreage. As a result, the transects are situated to evaluate the effects of surface runoff that reaches the ocean.

All fieldwork was conducted on April 20, 2004. Swimmers working from shore collected samples from within 10 m of the shoreline. All other samples were collected using a small boat. Water samples were collected using 1.8-liter, Niskin-type oceanographic sampling bottles. These bottles were lowered to the desired sampling depths with spring-loaded endcaps cocked in an open position ensuring complete flow-through of water. At the desired depth, a messenger released from the surface triggered closure of the endcaps. Following collection with the Niskin samplers, water was transferred to triple-rinsed 1-liter polyethylene bottles and placed on ice.

Water samples were collected at nine stations along each transect ranging from the highest wash of waves to approximately 500 offshore. Sampling was concentrated in the innermost portions of the transects, as these are the regions which are most likely to receive inputs from land. From 10 m from the shoreline seaward, water samples were collected at two depths; a surface sample was collected within approximately 20 cm of the surface, and a bottom sample was collected within 20 cm of the sea floor. At the sampling stations located within 10 m of the shoreline, only surface samples were collected.

Water quality parameters evaluated included the specific criteria designated for embayments in Chapter 11-54, Section 06 (Open Coastal waters) of the State of Hawaii, Department of Health (DOH) Water Quality Standards. These criteria include: total nitrogen (TN), nitrate + nitrite nitrogen (NO_3^- + NO_2^-), ammonium (NH_4^+), total phosphorus (TP), chlorophyll *a* (Chl *a*), turbidity, temperature, dissolved oxygen saturation, pH and salinity. In addition, orthophosphate phosphorus (PO_4^{-3}) and silica (Si) were also reported because these parameters are sensitive indicators of biological activity and the degree of groundwater/surface water mixing with ocean water. Dissolved organic phosphorus (TOP) and dissolved organic nitrogen (TON) were calculated as the difference between TP and inorganic P (PO_4^{-3}), and TN and inorganic N (NO_3^- + NH_4^+), respectively.

Subsamples for nutrient analyses were immediately placed in 125-milliliter (ml) acid-washed, triple rinsed, polyethylene bottles and stored on ice until returned to Honolulu. Analyses for NH_4^+, PO_4^{-3}, and NO_3^- + NO_2^- 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 on unfiltered samples following oxidative digestion. Detection limits for nutrients are 0.01 µM (0.14 µg/L) for NO_3^- and NH_4^+, 0.01 µM (0.31 µg/L) for PO_4^{-3}, 0.1 µM (1.4 µg/L) for TN and 0.1 µM (3.1 µg/L) for TP.

Water for other analyses was subsampled from 1-liter polyethylene bottles and kept chilled until analysis. 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 -20o C for 12-24 hours, and the fluorescence before and after acidification of the extract was measured with a Turner Designs fluorometer. Salinity was determined using an AGE Model 2100 laboratory salinometer with a precision of 0.0003‰. In-situ field measurements of pH, temperature, dissolved oxygen and turbidity were acquired with portable field meters (readability of 0.01 pH units, 0.01°C, 0.01% saturation, and 0.01 nepthelometric turbidity units [ntu], respectively).

All laboratory water chemistry analyses were conducted by Marine Analytical Specialists (Honolulu, HI). Marine Analytical Specialists possesses the appropriate approval ratings for these analyses from the State of Hawaii Department of Health, and the U.S. Environmental Protection Agency.

B. Assessment of Marine Community Structure

All fieldwork for the benthic community assessment was carried out on May 5, 2004, and was conducted from a 26-foot boat. Biotic structure of benthic (bottom dwelling) communities inhabiting the reef environment was evaluated by establishing a descriptive and quantitative baseline between the shoreline and the 10 meter (m) (~33 foot) depth contour. Initial qualitative reconnaissance surveys were conducted that covered the area off the Pulelehua property from the shoreline out to the limits of coral reef formation. These reconnaissance surveys were useful in making relative comparisons between areas, identifying any unique or unusual biotic resources, and providing a general picture of the physiographic structure and benthic assemblages occurring throughout the region of study.

Following the preliminary survey, three quantitative transect sites were selected offshore of the development area at approximately the same sites as the water quality transects (see Figure 1). Site 1 was located at the northern property boundary in Ka'opala Bay, Site 2 was off the approximate center of the property

in Pohaku Bay, and Site 3 was located near the southern end of the Pulelehua site at Mahinahina. At each site, two transect stations were selected, one in each of the dominant reef zones. Each transect was oriented parallel to depth contours so as to bisect a single reef zone. Care was taken to place transects in random locations that were not biased toward either peak or low coral cover. In total, six quantitative transects were conducted.

Quantitative benthic surveys were conducted by stretching a 50-m long surveying tape in a straight line over the reef surface. An aluminum quadrat frame, with dimensions of 1 m by 0.66 m, was sequentially placed over 10 random marks on the transect tape so that the tape bisected the long axis of the frame. At each quadrat location a color photograph recorded the segment of reef area enclosed by the quadrat frame. In addition, a diver knowledgeable in the taxonomy of resident species visually estimated the percent cover and occurrence of organisms and substratum type within the quadrat frame. No attempt was made to disturb substrata to observe organisms, and no attempt was made to identify and enumerate cryptic species dwelling within the reef framework. Only macrofaunal species greater than approximately 2 centimeters were noted.

Following the period of fieldwork, quadrat photographs were projected onto a grid and units of bottom cover for each benthic faunal species and bottom type were recorded. Results of the photo-quadrats were combined with the in-situ cover estimates and community structure parameters (percent cover, species diversity) were calculated. The photo-quadrat transect method is a modification of the technique described in Kinzie and Snider (1978), and has been employed in numerous field studies of Hawaiian reef communities (e.g. Dollar 1979, Grigg and Maragos 1974). The method has proven to be particularly useful for quantifying coverage of attached benthos such as corals and large epifauna (e.g., sea urchins, sea cucumbers). This method provides for accurate estimates of abundance of organisms that cover a large percentage of the reef surface through photographic coverage, as well as occurrence of very small and/or rare organisms that are not visible in photographs. Few, if any other methods provide for such accurate characterization of both extremes of benthic community structure.

While this methodology is quantitative for the larger exposed fauna, many coral reef invertebrates are cryptic or nocturnal. Coupled with the generally small size of cryptic invertebrates, quantitative assessment of these groups requires methodologies that are beyond the scope of the present monitoring program.

Assessment of reef fish community structure was conducted in conjunction with the benthic surveys. As the transect tape was being laid along the bottom, all fish observed within a band approximately 2 meters wide along the transect path

were noted within abundance classes of "rare", "occasional" or "abundant". Care was taken to conduct the fish surveys so that the minimum disturbance was created by divers, ensuring the least possible dispersal of fish. Only readily visible individuals were included in the census. No attempt was made to seek out cryptic species or individuals sheltered within coral. This transect method is an adaptation of techniques described in Hobson (1974).

III. RESULTS

A. WATER CHEMISTRY

1. Environmental Conditions

The entire nearshore area fronting the Pulelehua project site consists of a broad shallow, gently sloping reef platform consisting primarily of a fossil reef pavement intersected by numerous sand channels. The shoreline consists of either narrow sand beaches or rocky escarpments. Weather and sea conditions that occur in the area are distinguished primarily by the strength of tradewinds, and size of breaking surf on the reef platform. Owing to the orientation of West Maui to the direction of tradewinds and the orographic structure of Maui, the Pulelehua area is often subjected to strong side-shore northerly winds. In addition, the coastal orientation to long period swells from the north also result in regular periods of breaking waves across the reef during the winter months. In addition, surface drainage in West Maui is generally handled by drainageways and culverts that discharge directly into the ocean. While there are numerous retention basins along the coastline, these structures are not completely effective in restricting delivery of terrigenous sediment to the nearshore ocean. As a result, after heavy rains a turbid zone of muddy water that can extend up to several hundred meters offshore often characterizes the nearshore area off the Pulelehua site. These conditions (wind, waves, turbidity) all restrict fieldwork. Conditions on the day when fieldwork was carried out (April 20, 2004) consisted of slack winds, virtually no surf and no significant turbidity. Hence, results of surveys depict what can considered the best, rather than worst environmental conditions that occur in the subject area.

2. Horizontal Stratification

Tables 1 and 2 show results of water chemistry analyses for samples collected during April 2004 along the three transects shown in Figure 1. Figures 2 and 3 show plots of thirteen water chemistry constituents as functions of distance from the shoreline. At all three sites, the results of water chemistry analyses indicate

distinct horizontal gradients. Plots of Si, NO_3^-, TN and TP exhibit peaks at the most shoreward stations, and decrease moving seaward (Figure 2). Conversely, salinity shows a marked decrease at the shoreline with sharp increases moving seaward (Figure 3). The steepest gradients were in Pohaku Bay with the lowest salinity about 27‰, compared to minimum salinities of about 31‰ at Mahinahina and 32‰ at Ka'opala (Tables 1 and 2). While no freshwater springs or seeps were visible at the shoreline, the sharp gradients near the shoreline indicate that there is a source of groundwater or surface water entering the ocean throughout the survey area. In Pohaku Bay, the data indicate that freshwater mixing with ocean water was evident up to 250 m from shore. At the other two sites, mixing of freshwater did not extend beyond about 150 m from shore (Figures 2 and 3). Beyond these distances from shore, concentrations of all inorganic nutrients were essentially constant at levels typically found in open coastal waters (Tables 1 and 2, Figures 2 and 3).

Concentrations of NH_4^+, TOP and TON showed little consistent trend relative to distance from the shoreline at any of the sampling stations, and were of the same overall magnitude among the three transects (Figure 2). Such patterns are consistent with the low concentrations of these organic constituents in groundwater and surface water relative to ocean water.

Turbidity, TSS and Chl *a* in surface waters was distinctly elevated in the samples collected within 100 m of the shoreline on all three transects (Figure 3). The shape of the gradients and the values of turbidity and TSS were remarkably similar at all three sampling sites (Figure 3). Such similarity indicates that conditions that cause the increased turbidity and TSS in the nearshore regions (primarily resuspension by wave action) are very similar at all three locations.

At Mahinahina, temperature was higher in the nearshore region with decreasing values with distance from shore. At Ka'opala and Pohaku the opposite trend occurred, with low values near the shore and a relatively steady increase with distance from shore (Tables 1 and 2, Figure 3). Oxygen saturation and pH both showed consistent trends of decreasing values with distance from shore. (Tables 1 and 2).

Overall, concentrations of most nutrients, turbidity, TSS and Chl *a* within about 200 m of the shoreline were higher, and salinity lower, throughout the area of study (Figures 2 and 3). These results suggest that within the nearshore zone, water quality is affected by input from land.

3. Vertical Stratification

Figures 2 and 3 also show concentrations of water chemistry parameters as functions of distance offshore with respect to vertical stratification. As low salinity groundwater and surface water is less dense than ocean water, incoming freshwater often forms a surface lens characterized by decreased salinity and

increased nutrient content. On all three transects off of Pulelehua surface concentrations of Si and NO_3^- were higher, and salinity lower than the corresponding bottom sample (Tables 1 and 2, Figures 2 and 3). Similar distinct vertical gradients were not evident for concentrations of NH_4^+, TOP or TON (Figure 2). The degree of vertical stratification is clearly a function of the difference in concentration between groundwater and ocean water, and the proximity to the source of groundwater input at the shoreline. Turbidity, TSS and Chl a showed no distinctive differences between surface and bottom samples (Figure 3).

4. Conservative Mixing Analysis

A useful treatment of water chemistry data for interpreting the extent of material inputs from land is application of a hydrographic mixing model. It is possible to evaluate the extent of nutrient input from terrestrial sources by plotting the concentration of the dissolved material as a function of salinity (Officer 1979, Smith and Atkinson 1994, Dollar and Atkinson 1992). 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.

Figure 4 shows plots of concentrations of four constituents (Si, NO_3^-, NH_4^+, PO_4^{3-}) as functions of salinity for the samples collected off the Pulelehua site in April 2004. Each graph also shows conservative mixing lines that are constructed by connecting the endpoint concentrations of open ocean water and groundwater from two potable wells located upslope of Kapalua that were sampled in May 2001 (Tables 1 and 2). The average concentrations of NO_3^-, (18 µM) and Si (608 µM) used to construct the mixing lines from data collected in 2001 is similar to the average values of five wells in the Napili-Honokohua sampled from 1993-1997 as shown in Soicher and Peterson (1997) (average NO_3^- = 18.7µM; average Si = 654 µM). These similarities indicate that the nutrient concentrations in pristine groundwater in the area has not changed substantially over the last decade.

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 near, the conservative mixing line. If, however, nutrients are added to the system through processes such as leaching of fertilizers to groundwater, data points will fall above the mixing line. If material is being removed from the system by processes such as biological uptake, data points will fall below the mixing line.

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, and is generally not utilized rapidly within the nearshore environment by biological processes. It can be seen in Figure 4 that when Si concentrations are plotted versus salinity, data points prescribe a straight line that fall near the conservative mixing line. Linear regression of Si as a function of salinity yields significant

correlation R^2 of 0.89 for the combined Pulelehua data set. The upper (774 µM) and lower (633 µM) (confidence limits around the y-intercept of regressed data are slightly above the mean concentration of Si in the two wells (608 µM). The Y-intercept can be regarded as the concentration of Si at salinity of zero. Hence, it is clear that the concentrations of Si in the water samples collected off Pulelehua are primarily a mixture of only ocean water and groundwater.

It is of interest to note that similar analyses conducted by Marine Research Consultants in Honolua Bay over the last decade have consistently produced a different result. Honolula Bay is a well-defined embayment located several kilometers north of the Pulelehua site on West Maui. Honolua Stream discharges into Honolua Bay and water circulation and mixing in the Bay is far less than on open coastlines owing to shelter from waves. In Honolua Bay, plots of Si versus salinity produced a trend below the conservative mixing lines. It is likely that the deviation of the data to positions below the mixing line was a result of input of a source of surface water from Honolua Stream into Honolua Bay. Such a distinction is possible because of the lower concentration of Si in surface water than in groundwater. Because of the deep indentation of Honolua Bay into the shoreline, circulation within the inner Bay is low, and stream water appears to be retained in the inner zone.

This comparison suggests that surface water was not a component of the nearshore waters off the Pulelehua site at the time of sampling. The overall linear distribution of the Si data points in Figure 4, however, indicates that the mixing model provides a valid representation of the system under investigation.

The plots of NO_3^- versus salinity for the April 2004 data from the Pulelehua transects show very different patterns compared to the linear distributions of dissolved Si (Figure 4). Data points from the Pulelehua transects fall in a linear array substantially above the conservative mixing lines. Linear regression of NO_3^- versus salinity resulted in significant correlation off Pulelehua (R^2 of 0.89). The y-intercept of the concentrations of NO_3^- plotted as functions of salinity is 346 µM. With a mean concentration of NO_3^- in high level groundwater at Kapalua (18 µM) these data show a substantial subsidy of NO_3^- to the ocean from sources other than natural groundwater. These subsidies increase the NO_3^- in groundwater almost 20-fold over the concentration that would occur with mixing of ocean water and naturally occurring groundwater alone.

As NO_3^- is the form of nitrogen most common in fertilizer mixes, it is likely that the source of the subsidy of NO_3^- evident from the mixing model is leaching of fertilizers from agriculture, and possible residential areas in the vicinity of the Pulelehua site. Soicher and Peterson (1997) report that agriculture contributes about 60% of the nitrogen to groundwater throughout West Maui. As a result, it is not surprising to see substantial inputs of NO_3^- into the ocean directly downslope of former agricultural lands.

If biotic uptake of nutrients were an important factor in controlling nutrient concentrations in the water column, distinct upward concave curvilinearity would be evident. The curve prescribed by the data points for NO_3^- as functions of salinity at Mahinahina suggest upward curvilinearity. Substantial cover of fleshy algae characterizes the reef flat in this area (see section on Biotic community Structure). Such a result is important in that it indicates that marine plants may be removing nutrients from the water column to a detectable degree. At Ka'opala and Pohaku, however, there is no indication of upward concavity. Hence, the nutrient subsidies from land to the ocean at these locations are not being taken up by algae or plankton in the nearshore zone at a detectable level, but rather are mixed by physical processes with ocean water to background levels.

The other form of dissolved inorganic nitrogen, NH_4^+, does not occur in elevated concentrations in groundwater relative to ocean water. The conservative mixing lines in Figure 4 are essentially "flat" with similar concentrations in groundwater and open ocean water. For the April 2004 survey off Pulelehua, plots of NH_4^+ as functions of salinity result in a scatter of data above the mixing line (Figure 4) with no significant linearity. The lack of a relationship between salinity and NH_4^+ suggests that concentrations off the project site are primarily a consequence of biotic activity rather than input from sources on land.

Orthophosphate phosphorus (PO_4^{3-}) is also a component of fertilizer, 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. It can be seen that most of the PO_4^{3-} points from all three transects fall above the mixing line (Figure 4). Linear regression reveals significant linearity (R^2= 0.84), indicating input of PO_4^{3-} to the nearshore ocean by groundwater flux. Comparing the y-intercept of the regressed data (5 µM) to the mean concentration of PO_4^{3-} in Kapalua well water (1.7 µM) indicates a near three-fold increase from terrestrial sources.

5. Compliance with DOH Standards

DOH water quality standards for open coastal waters under "wet" conditions are shown in Tables 1 and 2 are. The coastal area off of the Pulelehua site is considered open coastal waters rather than a series of embayments because there are no restricted openings to coastal waters defined by a ratio of total bay volume to the cross-sectional entrance area of seven hundred to one or greater. The criteria for wet conditions are applied to the Pulelehua site because this area likely receives at least 3 million gallons per day of freshwater discharge per shoreline mile. DOH standards include specific criteria for three situations; criteria that are not to be exceeded during either 10% or 2% of the time, and criteria that are not to be exceeded by the geometric mean of samples. With only one sample set collected from each sampling station, comparison of the 10% or 2% of the time for any sample is not statistically meaningful. However, comparing

sample concentrations to these criteria provide an indication of whether water quality is near the stated specific criteria.

During the April 2004 survey the 10% criterion for NO_3^- and TN was exceeded within 50 m of the shoreline at all three sampling locations. At Pohaku, the surface samples exceeded the 10% criterion for NO_3^- at a distance of 250 m from shore. Even with the high input of NO_3^- at the shoreline, water from samples beyond 50 m from the shoreline at Ka'opala and Mahinahina did not contain concentrations of NO_3^- above the DOH limits. With a single exception of an anomalously high value of Chl *a* at one station in Ka'opala Bay, no other constituents exceeded the DOH standards during the sampling in April 2004.

It is important to note that during the sampling in April 2004, none of the measured values exceeded the DOH criteria of 3.0 ntu (not to exceed 10% limit) or 5.0 ntu (not to exceed 2% limit). These results reflect conditions of little visual turbidity of the water column associated with runoff. Observations of the nearshore area immediately following heavy rainfall and surface runoff have revealed extremely turbid condition that would undoubtedly exceed the DOH limits. While such instances of highly turbid conditions are episodic and generally short-lived, they area taken into account in an overall consideration of water quality.

B. BIOTIC COMMUNITY STRUCTURE

1. Physical Environment

The physical structure of the nearshore area off the Pulelehua project site is relatively homogeneous. The area is characterized by a wide shallow reef terrace that extends in a gradual slope from the shoreline. The average width of the reef between the shoreline and the 10-m (33-foot) isobath is approximately 0.75 km (0.5 mile). Near the shoreline, bottom cover consists primarily of sand that is kept in a near-constant state of resuspension by wave action. Within about 50 m of the shoreline, the reef platform, composed of a fossil limestone bench, is covered with algal turf, as well as a variety of macroalgae. In some regions, the limestone bench grades into a plain of white sand that is serves as substratum for fields of the calcareous green algae *Halimeda* spp. In other areas, the reef platform extends further offshore. While the overall reef platform contains a relatively small percentage of living coral cover, localized areas that are elevated above the reef pavement serve as settling area for mounds of living coral, predominantly of the genus *Porites*.

All of the study stations are directly exposed to long-period swells generated by storms in both the north (winter) and south (summer) Pacific. As a result of these physical processes, the nearshore areas off the Pulelehua site are subjected to

extreme stress from wave impact and scouring of sediment from wave action. As in many locations in the Hawaiian Islands, the composition of reef communities off West Maui are structured primarily in response to physical forces of breaking waves (Dollar 1982, Dollar and Tribble 1993).

2. Coral Community Structure

Overall, coral were relatively scarce throughout the study area. As mentioned above, the reef flat is a relatively harsh environment for corals owing to wave impact, sediment input, and turbidity associated with regular episodes of rainfall and runoff. Table 3 shows results of photo-quadrats transect surveys at the three survey sites, with the survey results summarized in Table 4. With the exception of the deepest transect (M-2) coral cover on transects ranges from less than 1% to about 9%, with only five species encountered.

At Ka'opala Bay, the inner region (K-1) consisted primarily of a solid limestone bottom consisting of highly bioeroded coral mounds (Figure 5). Survey results showed coral cover in this area to total about 7% of bottom cover, predominantly composed of the flat encrusting forms of *Porites lobata* and *Montipora patula*. The outer areas of Ka'opala Bay consisted almost exclusively of sand plains covered with relatively dense growth of the calcareous algae *Halimeda* spp (Figure 6). Widely dispersed large dome-shaped colonies of *Porites lobata* (visible in the top photo of Figure 6) were the predominant coral on transect K-2.

The inner region of Pohaku Bay, within the surf area known as "S-turns", is composed primarily of white sand channels interspersed within an eroded limestone reef platform (Figure 7). Coral cover in this area (1.2% of bottom cover on transect P-1) was primarily isolated heads of *Pocillopora meandrina* or flat encrustations of *Montipora* spp. The outer reef area of Pohaku Bay consisted of flat pavement with little coral development, but abundant expanses of *Halimeda* (Figure 8).

The inner reef fronting the Mahinahina drainage channel is similar in structure to the inner reef at Pohaku Bay, with the exception that this area probably receives less direct impact from breaking waves. Sand channels that intersect the reef platform are filled with sand in constant motion resulting in significant scouring of the bottom. Algal abundance is greater in this area than any other within the survey, and large mats of broken algal fragments have accumulated in the sand channels (Figure 9).

The outer reef off Mahinahina (transect M-2) comprised the best habitat for coral encountered in the present study. At a slightly deeper depth than the other transects (at similar depths off the other sites, bottom composition was entirely sand) wave and sediment stresses are somewhat reduced. In response, elevated areas of the reef platform contained small "finger reefs" consisting primarily of elongated amalgamations of colonies of *Porites* spp. (Figure 10). It can be seen

in Figure 10 that the reef platform surrounding the finger reefs is large devoid of the shifting layer of sand that is visible in the photographs of the other transect sites.

The only other macro-invertebrates that were observed in high abundance on the reef during the course of the survey were sea urchins. Numerous individuals of the boring sea urchins *Echinometra matheai* and *Echinostrephus aciculatus* were observed in eroded pits within the reef surface. The larger urchins, *Tripneustes gratilla* and *Echinothrix diadema* were also occasionally observed. In summary, the majority of the nearshore reef habitats that could be affected by activities on land present comprise very harsh environments for corals, and as a result coral colonization is very sparse.

3. Marine Algal Communities

The most abundant organisms of the reef platform throughout the region of study were marine plants (algae). It was beyond the scope of this assessment to provide an exhaustive species list of marine alga occupying the West Maui reefs. However, the dominant genera encountered throughout the study area were the green algae *Halimeda, Ulva* and *Cladophora*, and the red algae *Acanthophora* and *Hypnea* (Table 5). As discussed above, *Halimeda* occurred in vast fields on the sand plains that extended throughout the study area (Figures 6 and 8).

The introduced species, *Acanthopora specifera*, which is found ubiquitously on reef flats in many areas of Hawaii was similarly common throughout the study area.

Perhaps the two most abundant algal species in West Maui, *Ulva* and *Hypnea*, which are considered nuisance species owing to deposition and decomposition on beaches in West Maui and Kihei, were both common in the study area. However, while there were aggregations of fragments of these algae noted in sand channels off Mahinahina (Figure 9), there were no areas on the beaches of the study site where algae had accumulated.

4. Reef Fish Communities

In general, reef fish were considered scarce at all of the survey sites. Table 6 shows abundance estimates of reef fish off of Pulelehua classed by abundance. Of the twenty-six species observed, only several species of Pomacentrids (damselfish)(*Chromis* spp.) were considered common. These small fish were seen predominantly on the finger reefs at Transect M-2. On the flat reef platform, which comprised the majority of the survey sites, fish were sparse. The only large

(greater than 25 cm) fish that were seen with regularity were nenue (bigibbus) and the reef triggerfish humuhum nukunuku apua'a *Rhinecanthus rectangulus*). No fish of noteworthy commercial or sport fishing value were noted.

5. 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 coastlines of all of islands including Maui, and is known to feed on selected species of macroalgae. The endangered hawksbill turtle (*Eretmochelys imbricata*) is known infrequently from waters off of Maui. Hawaiian monk seals (*Monachus schlauslandi*) are also sighted occasionally around the islands. The shoreline area fronting the Pulelehua site consists primarily of sandy beaches, making the area accessible for turtle and seal haul-outs. Numerous green sea turtles were observed on the surface in waters fronting the project site. While seals undoubtedly occur periodically in the offshore areas and on the beaches, none were observed during the fieldwork for the present assessment.

Populations of the endangered humpback whale (*Megaptera novaeangliae*) winter in the Hawaiian Islands from December to April. The present survey was conducted in May, when whales are not present in Hawaiian waters. While whales are observed in high densities off West Maui, all of the reef areas where studies were conducted were too shallow for whales to normally inhabit.

IV. CONCLUSIONS

Results of the assessments of water chemistry and marine community structure in the nearshore areas off the proposed Pulelehua development provide some insight into the potential effects of the project. Analyses of water chemistry indicate that the nearshore area is presently receiving a substantial input of nutrients from groundwater. The major source of these nutrients is likely from the long-term percolation of fertilizers used on the agricultural fields of West Maui. As agriculture will be phased out from the Pulelehua site, it can be expected that the flux of groundwater nutrients will decrease in the future (however, it is not possible to predict how soon this decrease will happen). In addition, it has been observed that following heavy, or "back-to-back" rains, desilting basins designed to intercept surface flow before it reaches the ocean become overloaded. With the capacity of the basins exceeded, fine-grained terrigenous material (mud and silt) discharges to the ocean and remains in suspension in the nearshore zone until mixing processes disperse the sediment.

Biotic assemblages in the region reflect the harsh physical conditions associated with wave stress, sediment scour, and episodic input of terrigenous materials. In sum, the marine environment fronting the Pulelehua site is presently what might be termed "sub-optimal" as a result of these factors.

One goal in the planning of the Pulelehua development is to retain all drainage onsite, with no increase in the loading to the desilting basins. With the conversion from agricultural lands to land uses that do not result in continual exposure of soil to rainfall, it is likely that the sedimentation discharge to the ocean will be lessened significantly with the proposed plan. Similarly, with the change to land uses that do not require additions of nutrient subsidies (e.g., fertilizers), there is likely to be a decrease in the flux on nutrients to the ocean compared to past scenarios.

It is important to note that in the past decade, the West Maui coastal area has experienced the proliferation of several species of nuisance algae. One common perception (though never proven) is that the cause of the algal proliferation was nutrient subsidies to the nearshore ocean from anthropogenic land uses (e.g., sewage injection wells, agriculture). However, a study that compared the biomass of one of the main alga responsible for the nuisance situation (*Hypnea musciformis*) with the required nutrients to sustain growth showed that natural groundwater discharge was sufficient to support the algal biomass (Dollar and Andrews, 1997). Thus, nutrient subsidies from anthropogenic sources was not a requirement to trigger algal profieration. As a result, the proposed change in land use should have no effect on algal abundance.

It has been shown that the greatest contribution of nutrients to groundwater from human activities on West Maui is from agriculture. On the other hand, golf courses, resort and residential development provide a relatively small contribution (Soicher and Peterson 1997). If the proposed project replaces agriculture with residential development, the overall subsidies of nutrients delivered to the ocean should decrease.

All of these factors suggest that the proposed Pulelehua development has the potential to improve the marine environment by lowering inputs of dissolved and particulate materials that is has occurred with past land uses. With no changes to the shoreline structure, and the planning to keep all drainage onsite, there does not appear to be any potential for negative impacts to the marine environment associated with the project.

V. SUMMARY

- An assessment of the marine environment off the proposed Pulelehua residential development in Mahinahina, West Maui was conducted in April-May 2004. The purpose of the assessment was to collect data that could provide insight into the potential effects of the proposed development on the nearshore marine ecosystem.

- Water chemistry was evaluated by collecting a series of samples at three sites at the ends and center of the project area. Sample collection at each site extended from the shoreline to a distance offshore deemed to be beyond the influence of land. Results of water chemistry analyses reveal that horizontal gradients of salinity and nutrients occur at all sites as a result of inflow of brackish groundwater that contains high concentrations of Si, NO_3^- and PO_4^{3-} compared to ocean water. The most conspicuous groundwater input occurred at Pohaku Bay, but was also evident at Ka'opala Bay and off Mahinahina.

- Vertical stratification is also present at all survey sites, as a result of lower density groundwater "floating" on top of higher density oceanic water. Nutrient concentrations are elevated in the surface layer of low salinity water.

- Water chemistry constituents that do not occur in high concentrations in groundwater do not display distinct gradients of distribution. Measures of particulate material in the water column (turbidity, TSS and Chl a) displayed clear horizontal gradients with highest concentrations at the shoreline that decreased with distance from shore.

- Scaling nutrient concentrations to salinity provides important data on groundwater input to the coastal ocean within the area under study. The good fit of Si concentrations with a conservative mixing line indicate that the only freshwater entering the nearshore ocean at the time of the survey was groundwater. Subsidies of NO_3^- up to about twenty times what would be expected from pristine groundwater alone were evident in the sample data. The most likely sources of the subsidies of NO_3^- are leaching of fertilizer nutrients from agricultural fields of West Maui. Similar, but smaller subsidies of PO_4^{3-} were also evident, and are also attributable to past land practices.

- The only measurements of water quality constituents that were found to exceed State of Hawaii DOH standards was NO_3^- in a zone within about 100-250 m from shore. However, following heavy rainfall and runoff it is probable that turbidity in the same region would exceed DOH standards.

- The physical structure of the offshore areas consists primarily of a gently sloping fossil reef platform bisected by sand channels. At depths greater than about 8 m, the predominant bottom cover is sand. Coral communities are very sparse throughout most of the nearshore zones owing to harsh conditions that result from the combination of breaking surf, sediment resuspension and

discharge of terrigenous material. Similarly, reef fish communities are sparse, in large part due to the lack of vertical relief of much of the reef platform. Algae communities, however, are able to successfully settle on the sand-covered reef pavement, and are abundant and diverse. Large expanses of the offshore areas are composed of fields of the calcareous algae *Halimeda* growing on sand-covered bottom.

- The most common federally protected species in the area is the green sea turtle (*Chelonia mydas*). Numerous turtles were sighted in the area during the survey. None of the planning for the development includes any factors that could affect turtles, or other protected species, in a negative way

- The proposed project does not include any alteration of the shoreline or nearshore areas. In addition, the proposed land use is likely to be better than in the past in terms of reducing nutrient and sediment fluxes to the nearshore ocean. All drainage for the project is projected to remain onsite, eliminating terrigenous sediment input to the nearshore zone. In sum, it can be concluded that the proposed project has the potential to improve conditions in the marine environment, with little or no potential for causing any negative impacts. The proposed project should have no effect proliferation on nuisance alga that has occurred in the past in West Maui.

VI. REFERENCES CITED

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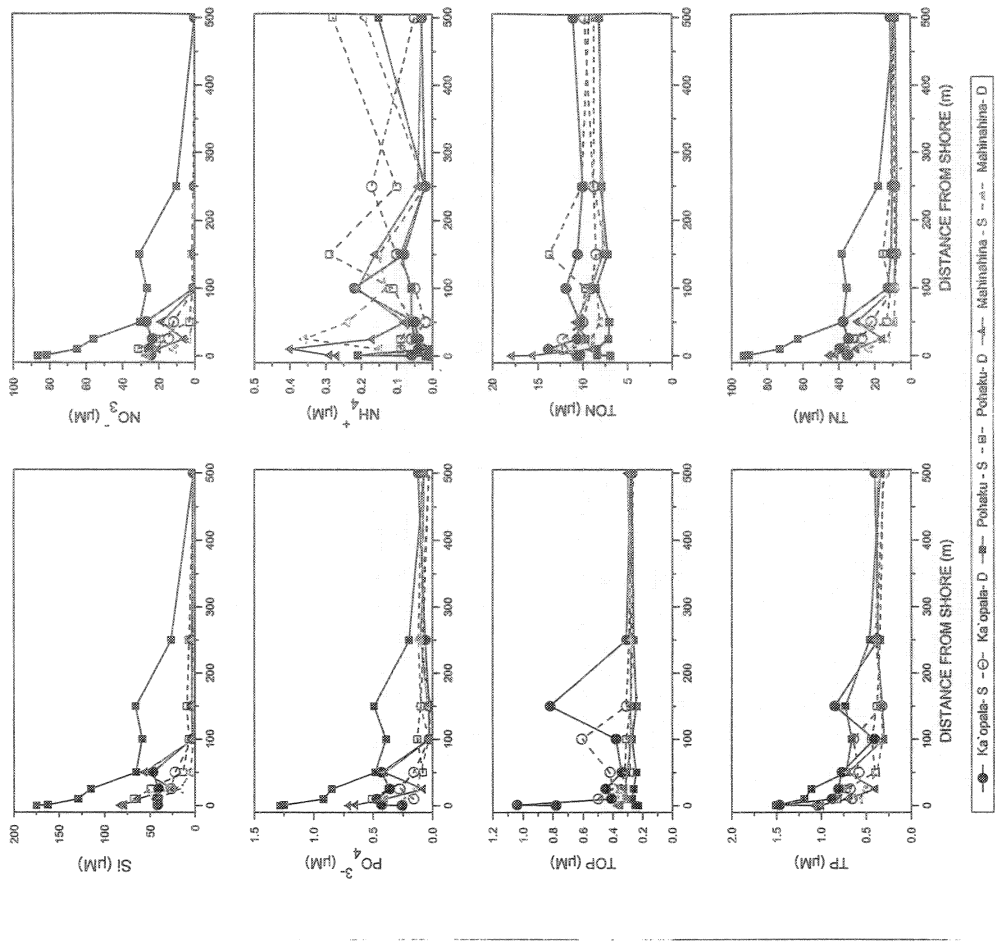

FIGURE 2. Plots of dissolved nutrients in surface (S) and deep (D) samples collected along three transects offshore of the Pulelehua development project on April 20, 2004 as a function of distance from the shoreline. For transect locations, see Figure 1.

FIGURE 1. Aerial photograph of Mahinahina area of west Maui showing Kapalua West Maui Airport and Honoapiilani Highway. Also shown are locations of three water quality sampling transects (dashed lines) in Ka'opala Bay, Pohaku Bay and off the Mahinahina drainage culvert. Locations of benthic community transects (with transect label) are shown as bars perpendicular to the water quality transects.

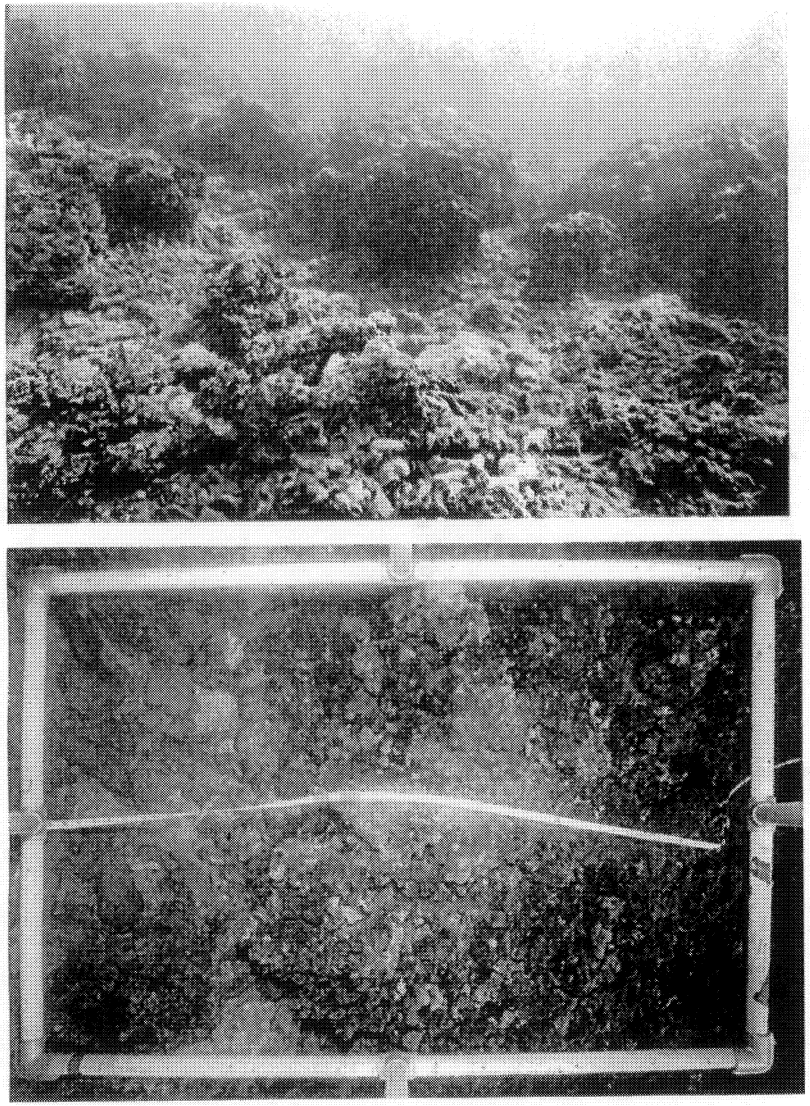

FIGURE 5. Two underwater views of reef off Ka'opala Bay. Top photo shows numerous coral mounds on rubble and rubble covered reef pavement on Transect K-1. Bottom photo shows typical photo-quadrat from Transect K-1. Water depth in top photo is approximately 3 m in both photos. Both photos taken on May 9, 2004.

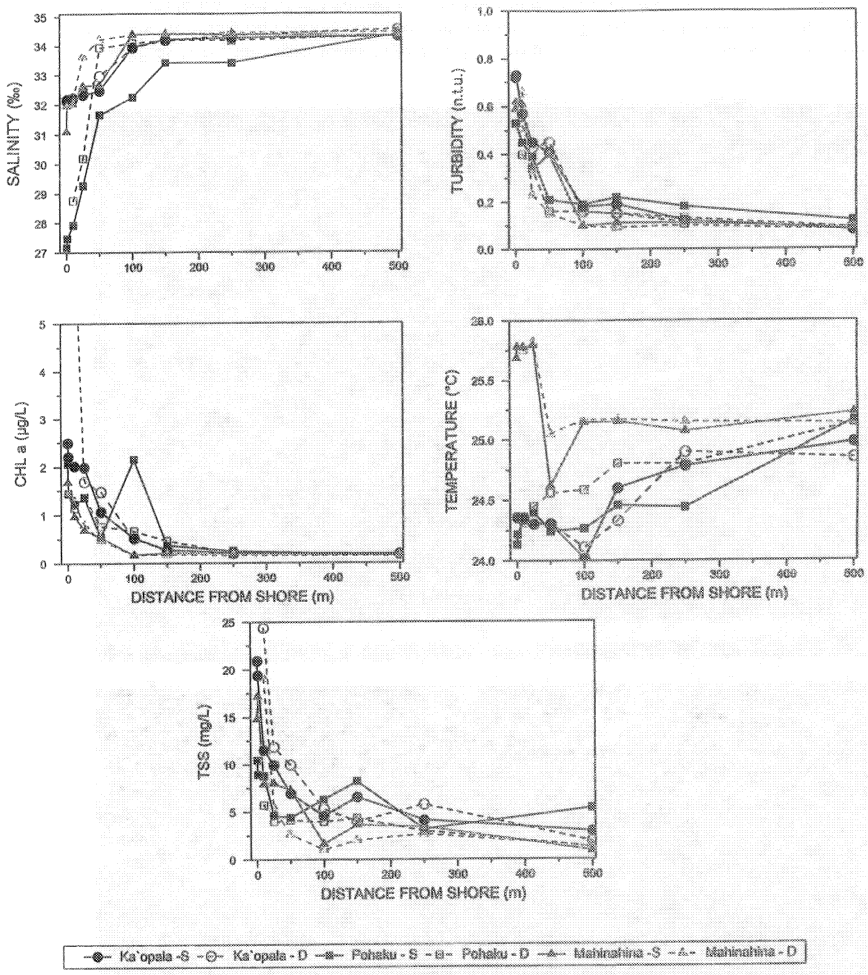

FIGURE 3. Plots of water chemistry constituents in surface (S) and deep (D) samples collected on three transects offshore of the Puleiehua development project on April 20, 2004 as a function of distance from the shoreline. For transect locations, see Figure 1.

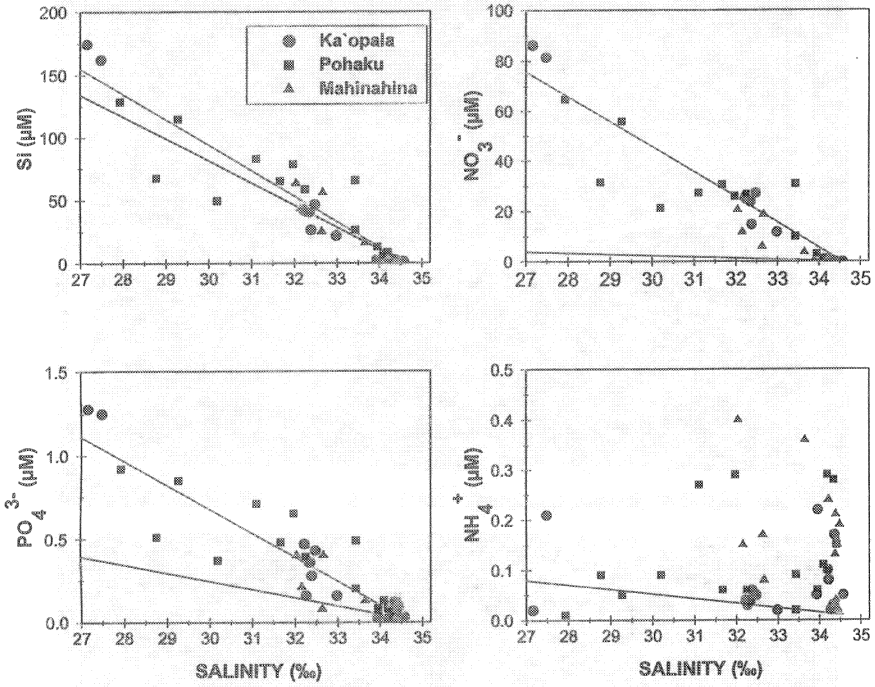

FIGURE 4. Mixing diagram showing concentration of dissolved nutrients from samples collected along three transects offshore of the Pulelehua development project on April 20, 2004 as functions of salinity. Solid straight line in each plot is conservative mixing line constructed by connecting endpoint concentrations in open coastal water and the average concentrations from two wells located in upland Kapalua. Dashed straight lines are linear regression lines fitted through all data points from three sampling transects. For transect locations, see Figure 1.

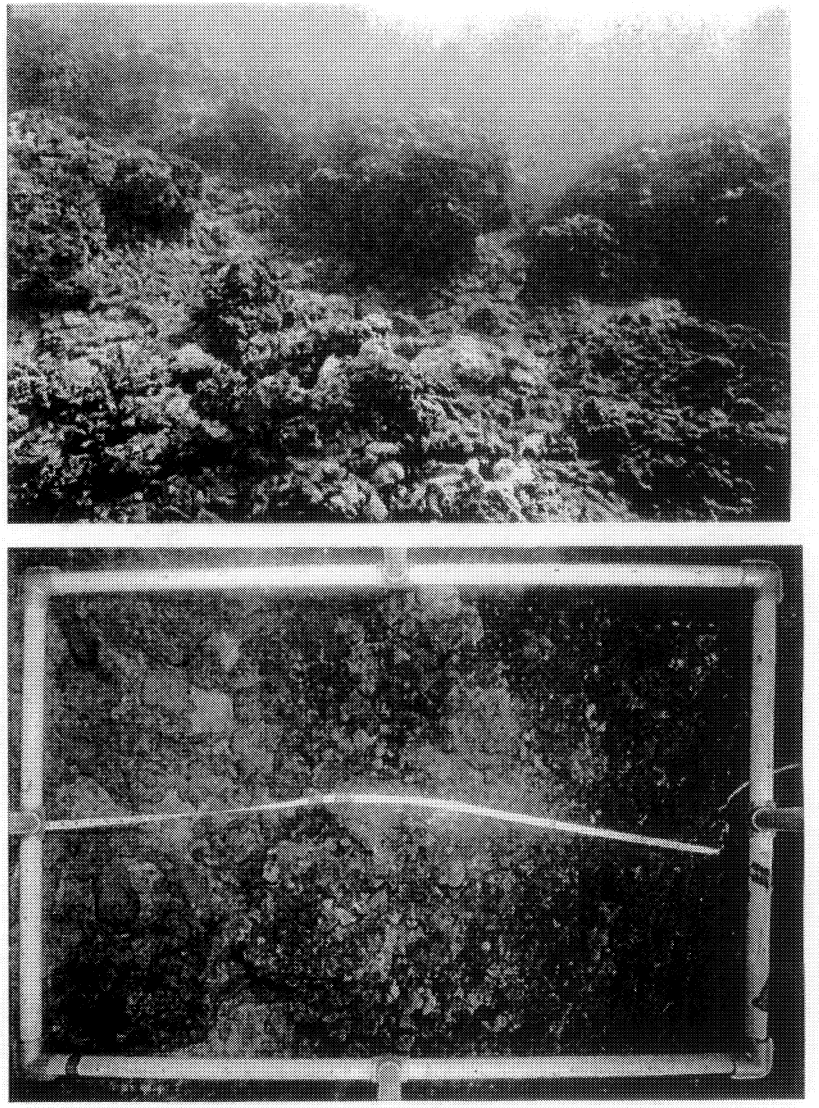

FIGURE 5. Two underwater views of reef off Ka'opala Bay. Top photo shows numerous coral mounds on rubble and rubble covered reef pavement on Transect K-1. Bottom photo shows typical photo-quadrat from Transect K-1. Water depth in top photo is approximately 3 m in both photos. Both photos taken on May 9, 2004.

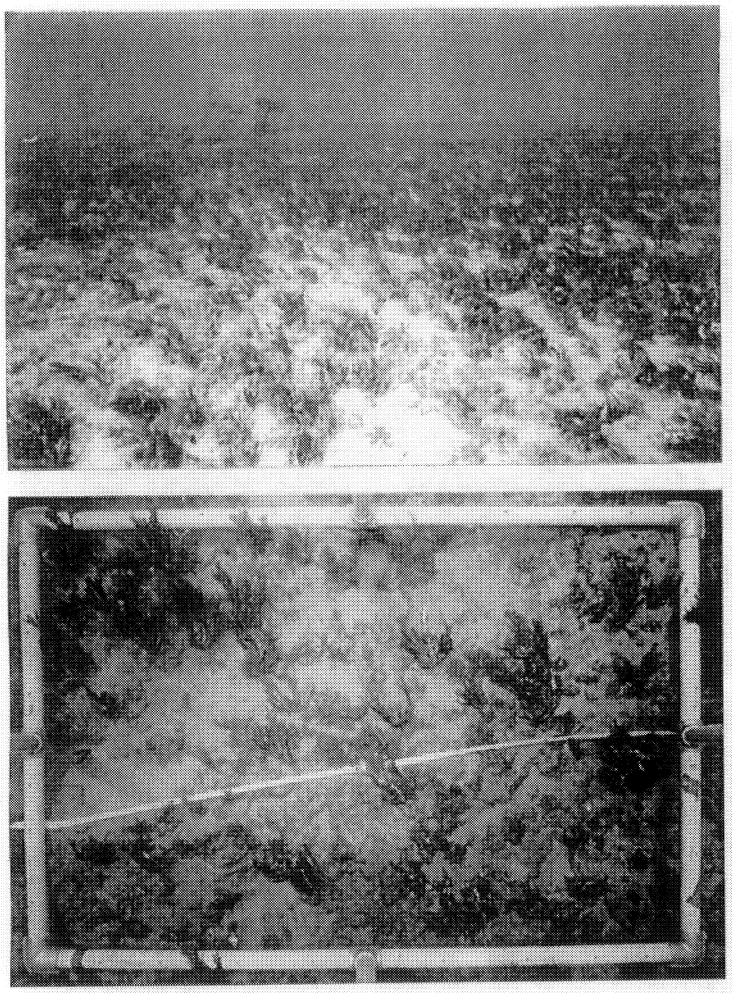

FIGURE 6. Two underwater views of reef in outer Ka'opa Bay. Top photo shows field of *Halimeda* spp. growing on sandy bottom. Bottom photo shows typical photo-quadrat from Transect K-2. Water depth is approximately 5 m. Both photos taken on May 9, 2004.

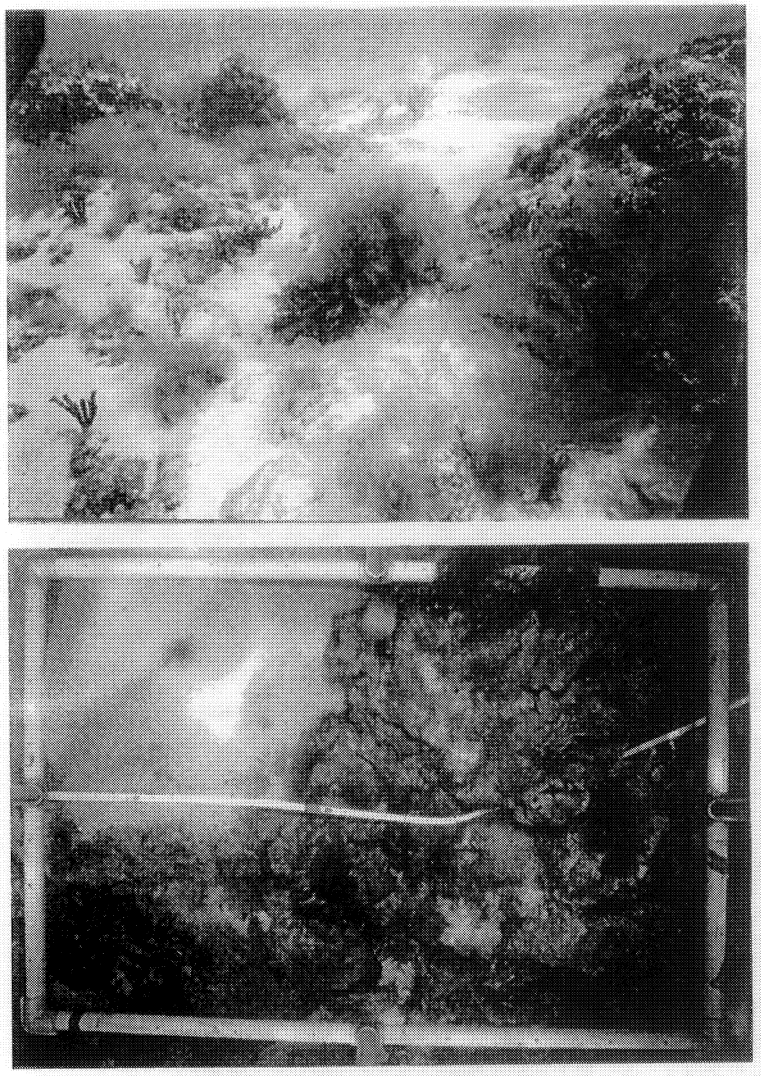

FIGURE 7. Two underwater views of inner reef off Pohaku Bay (S-turns). Top photo shows abundant fleshy green alga *Ulva* spp. growing on rubble and limestone reef pavement in the vicinity of Transect P-1. Bottom photo shows typical photo-quadrat from Transect P-1. Water depth in top photo is approximately 2 m. Both photos taken on May 9, 2004.

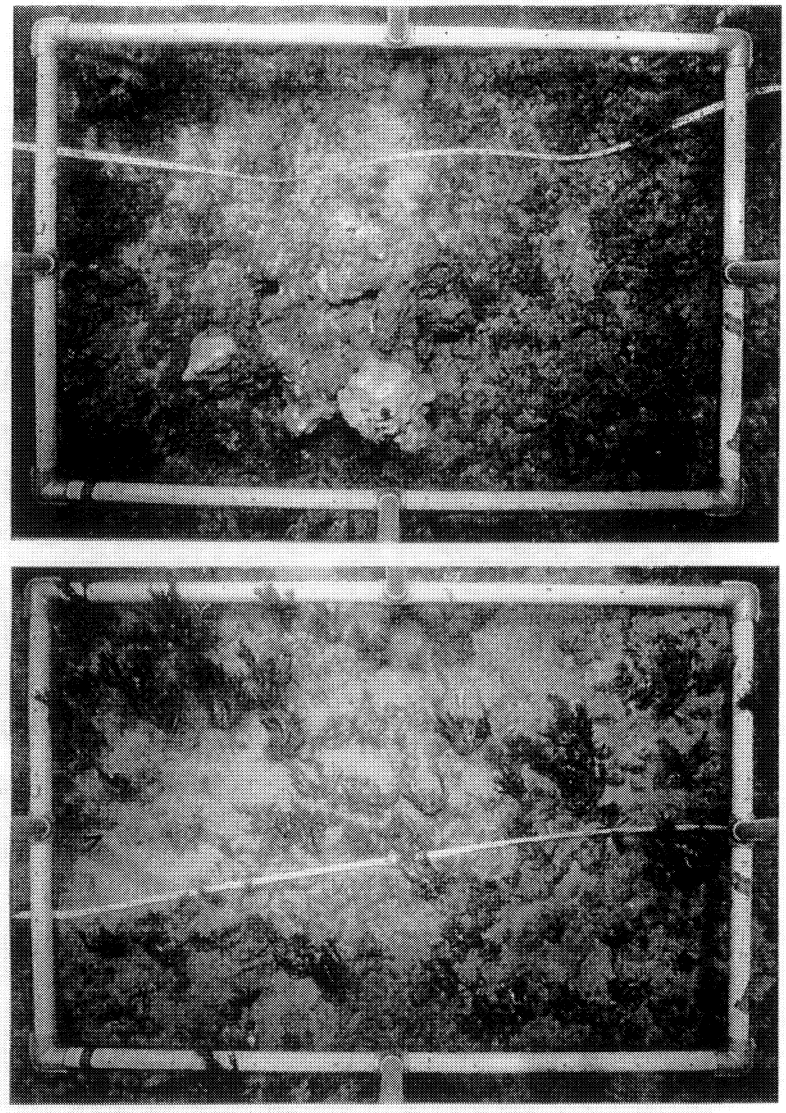

FIGURE 8. Two photo-quadrat photos taken on transect P-2 in outer Pohaku Bay. Top photo shows a colony of *Porites lobata* in lower center of photo. Bottom photo shows numerous stalkes of the calcaeous green algae *Halimeda* spp. on sand-covered reef pavement. Water depth is approximately 3 m in both photos. Both photos taken on May 9, 2004.

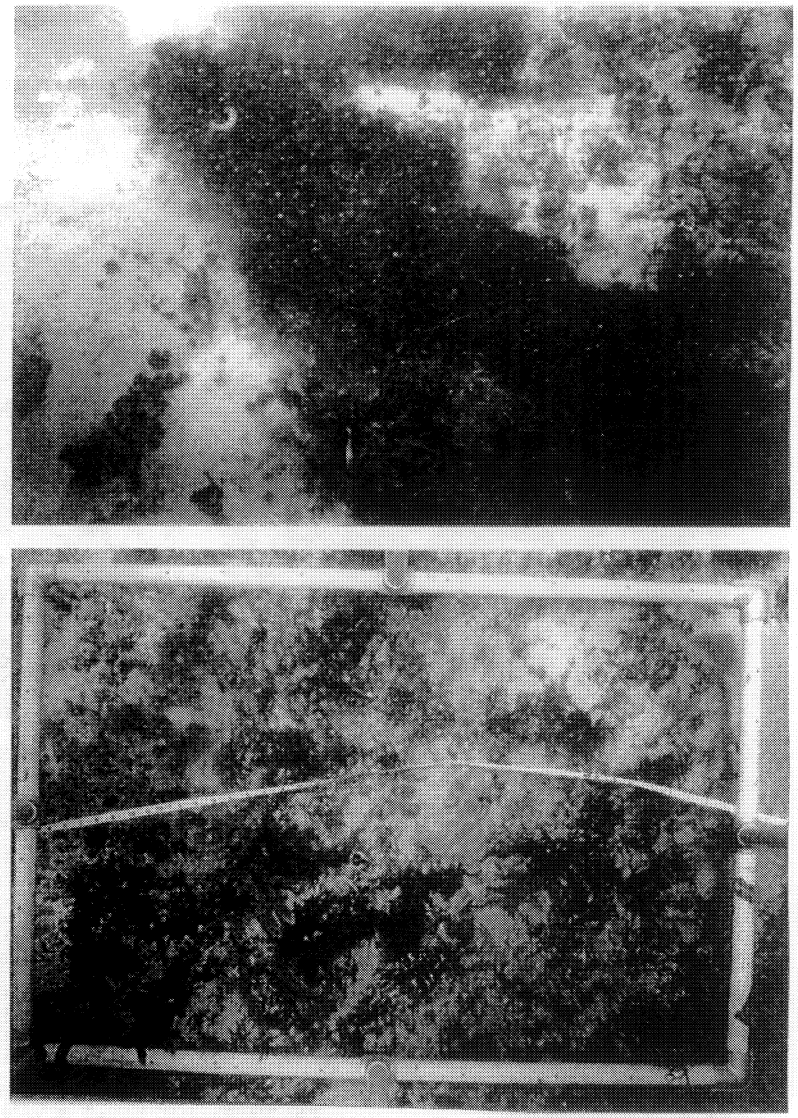

FIGURE 9. Two photos taken on transect M-1 on the inner reef flat off Mahinahina. Top photo shows a aggregated mat of algal fragments in a sand channel on the inner reef. Bottom photo shows a photo-quadrat from transect M-1 with numerous alga growing on sand-covered reef pavement. Water depth is approximately 2.5 m in both photos. Both photos taken on May 9, 2004.

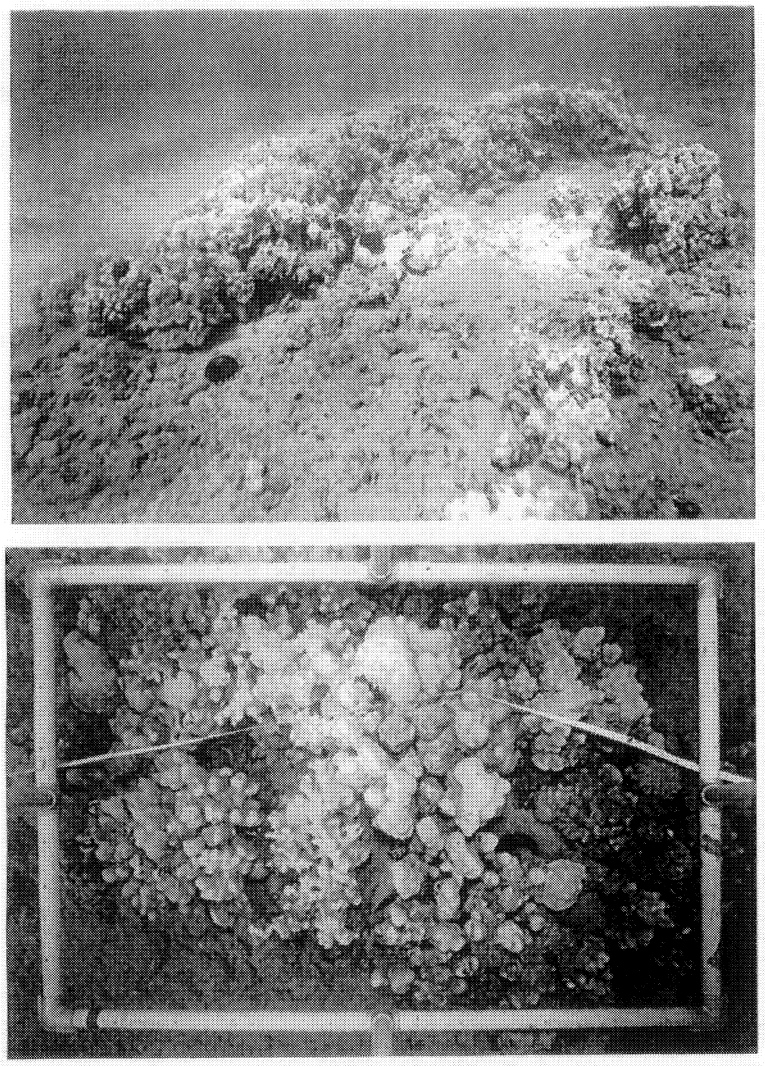

FIGURE 10. Two underwater views of reef off Mahinahina. Top photo shows a finger of live coral, predominantly of the species *Porites lobata* and *P. compressa* growing on the reef pavement in the vicinity of transect M-2. Bottom photo shows typical photo-quadrat from Transect M-2 covering a coral mound. Water depth in both photos is approximately 7 m. Both photos taken on May 9, 2004.

TABLE 1. Water chemistry measurements offshore of the proposed Pulelehua development in West Maui, Hawaii collected on April 20, 2004. Abbreviations as follows: S=surface; D=deep; DFS=distance from shore; BDL=below detection limit. Also shown are the State of Hawaii, Department of Health (DOH) "not to exceed more than 10% of the time" and "not to exceed more than 2% of the time" water quality standards for embayments under "wet" conditions. Shaded and boxed values exceed DOH 10% standards. For sampling transect locations, see Figure 1.

TRANSEC	NO.	DFS (m)	PO4 (µM)	NO3 (µM)	NH4 (µM)	Si (µM)	TOP (µM)	TON (µM)	TP (µM)	TN (µM)	TURB (NTU)	TSS (mg/L)	SALT (‰)	CHL a (µg/L)	TEMP (deg.C)	O2 (%sat.)	pH
Ka'opala Bay	1S	0.1	0.26	24.60	0.01	42.08	0.78	10.70	1.04	35.31	0.72	20.93	32.120	2.50	24.4	102.4	8.23
	2S	1	0.43	24.47	0.06	41.87	1.04	10.37	1.47	34.90	0.73	19.40	32.184	2.21	24.4	102.8	8.23
	3S	10	0.47	25.67	0.04	42.67	0.41	13.85	0.88	39.96	0.57	11.54	32.217	2.01	24.4	102.4	8.23
	3D	10	0.16	24.88	0.03	41.63	0.50	12.31	0.66	37.20	0.52	24.37	32.257	7.53	24.3	101.7	8.22
	4S	25	0.38	23.89	0.04	40.78	0.45	10.70	0.81	34.73	0.45	9.85	32.341	1.69	24.3	101.9	8.22
	4D	25	0.28	14.64	0.06	28.65	0.40	12.27	0.68	27.17	0.43	11.87	32.382	1.69	24.3	102.1	8.22
	5S	50	0.43	27.31	0.05	46.66	0.34	10.35	0.77	37.71	0.41	6.94	32.475	1.07	24.3	102.3	8.22
	5D	50	0.16	11.94	0.02	22.15	0.42	10.08	0.58	22.02	0.45	8.93	32.979	1.43	24.3	102.3	8.22
	6S	100	0.03	0.63	0.22	3.14	0.36	11.91	0.41	12.76	0.18	4.59	33.853	0.52	24.0	97.6	8.01
	6D	100	0.03	0.22	0.05	3.02	0.61	9.05	0.64	9.32	0.16	5.33	33.929	0.51	24.1	94.6	8.01
	7S	150	0.03	0.22	0.08	3.26	0.82	10.61	0.85	10.91	0.19	8.55	34.217	0.27	24.6	100.6	8.07
	7D	150	0.02	0.02	0.10	3.45	0.31	8.53	0.33	8.65	0.15	3.98	34.191	0.26	24.3	92.9	8.06
	8S	250	0.06	0.18	0.02	3.63	0.31	10.03	0.37	10.23	0.12	4.12	34.284	0.21	24.6	97.1	8.05
	8D	250	0.10	0.04	0.17	3.07	0.29	8.79	0.39	9.00	0.11	5.76	34.354	0.20	24.9	94.1	8.06
	9S	500	0.12	0.02	0.03	1.95	0.28	11.06	0.40	11.11	0.08	2.93	34.333	0.19	25.0	98.3	8.08
	9D	500	0.03	0.01	0.05	1.46	0.27	9.81	0.30	9.68	0.09	1.87	34.566	0.16	24.9	94.2	8.09
Pohaku	1S	0.1	1.28	86.45	0.02	174.77	0.23	8.93	1.51	93.40	0.53	10.48	27.159	2.08	24.1	108.6	8.18
	2S	1	1.25	81.60	0.21	162.44	0.25	8.41	1.50	90.22	0.53	8.95	27.460	1.45	24.2	108.8	8.18
	3S	10	0.92	64.69	0.01	126.88	0.27	8.43	1.19	73.13	0.45	8.80	27.924	1.23	24.3	109.0	8.18
	3D	10	0.51	31.51	0.09	67.67	0.31	8.54	0.82	40.14	0.40	5.73	28.788	1.14	24.4	111.3	8.17
	4S	25	0.85	55.87	0.05	114.93	0.26	7.13	1.11	63.05	0.39	4.62	29.273	1.35	24.4	111.5	8.17
	4D	25	0.37	21.39	0.09	49.57	0.35	9.71	0.72	31.19	0.34	3.86	30.195	1.37	24.4	111.3	8.17
	5S	50	0.48	30.55	0.06	65.34	0.24	7.05	0.72	37.66	0.21	4.41	31.888	0.55	24.2	99.0	8.09
	5D	50	0.08	3.21	0.06	13.24	0.32	10.24	0.40	13.51	0.18	4.13	33.949	0.77	24.6	94.4	8.07
	6S	100	0.39	25.86	0.06	56.75	0.27	8.57	0.66	35.61	0.19	6.29	32.280	2.15	24.3	97.5	8.08
	6D	100	0.13	1.26	0.11	6.57	0.31	9.73	0.44	11.10	0.18	3.96	34.089	0.67	24.6	95.2	8.06
	7S	150	0.49	30.93	0.09	65.87	0.24	7.20	0.73	38.23	0.22	6.24	33.431	0.37	24.5	93.9	8.07
	7D	150	0.10	1.88	0.29	8.88	0.26	13.71	0.39	15.58	0.15	4.33	34.168	0.48	24.6	95.0	8.08
	8S	250	0.20	10.17	0.02	26.53	0.26	7.96	0.46	18.13	0.16	3.15	33.429	0.25	24.4	94.2	8.07
	8D	250	0.08	0.73	0.10	8.46	0.27	10.15	0.35	10.88	0.13	2.86	34.167	0.21	24.6	94.7	8.08
	9S	500	0.07	0.14	0.15	1.78	0.27	8.12	0.34	8.41	0.12	5.37	34.404	0.16	25.2	98.9	8.10
	9D	500	0.03	0.03	0.28	1.43	0.28	9.30	0.31	9.61	0.09	1.28	34.336	0.17	25.1	94.4	8.10
Mahinahine	1S	0.1	0.71	27.26	0.27	62.85	0.37	17.51	1.06	45.48	0.59	14.83	31.103	1.69	25.7	112.2	8.25
	2S	1	0.65	26.10	0.29	78.69	0.35	15.57	1.00	41.66	0.62	17.20	31.970	1.46	25.8	129.9	8.24
	3S	10	0.40	20.61	0.40	63.62	0.30	9.05	0.70	30.06	0.61	7.85	32.040	0.98	25.8	129.6	8.24
	3D	10	0.21	11.84	0.15	43.80	0.38	11.31	0.57	23.30	0.66	19.11	32.157	1.29	25.8	131.0	8.21
	4S	25	0.08	6.14	0.17	25.41	0.32	9.67	0.40	15.98	0.34	8.01	32.837	0.69	25.8	129.5	8.22
	4D	25	0.13	3.02	0.36	16.06	0.38	9.05	0.51	13.23	0.23	5.36	33.648	0.80	25.8	128.6	8.21
	5S	50	0.40	16.75	0.08	56.20	0.30	10.78	0.70	28.61	0.40	7.30	32.997	0.53	24.6	101.7	8.09
	5D	50	0.10	0.99	0.24	5.13	0.28	8.16	0.38	9.39	0.15	2.63	34.219	0.48	25.0	101.3	8.12
	6S	100	0.02	0.17	0.21	1.94	0.28	9.10	0.30	9.48	0.10	1.64	34.337	0.16	25.1	97.2	8.10
	6D	100	0.03	0.12	0.13	1.66	0.29	8.49	0.32	8.74	0.10	1.00	34.377	0.17	25.2	97.4	8.10
	7S	150	0.04	0.13	0.16	1.42	0.26	7.79	0.32	8.08	0.11	3.85	34.415	0.21	25.2	97.1	8.10
	7D	150	0.10	0.11	0.15	1.29	0.23	7.35	0.33	7.82	0.09	2.01	34.430	0.18	25.2	96.9	8.10
	8S	250	0.10	0.02	0.04	1.85	0.28	7.77	0.38	7.83	0.11	3.39	34.391	0.19	25.1	96.6	8.09
	8D	250	0.12	0.08	0.02	2.57	0.26	8.78	0.40	8.86	0.10	2.54	34.446	0.16	25.2	96.1	8.10
	9S	500	0.07	0.07	0.03	1.17	0.30	8.26	0.37	8.36	0.09	0.89	34.388	0.15	25.2	96.6	8.10
	9D	500	0.09	0.01	0.19	1.52	0.26	8.75	0.35	8.95	0.08	1.26	34.478	0.14	25.1	96.8	8.12
DOH 10% STD				1.43	0.93				1.61	26.00	3.00			4.66	*	**	***
2% STD				2.50	1.43				2.42	38.71	6.00			8.86			

* Shall vary no more that 1 °C from "ambient conditions"

** Shall not be less than 75% saturation

*** Shall not deviate more than 0.5 units from a value of 8.1

TABLE 3. Benthic cover calculated from photoquadrat transect data at site off the proposed Pulelehua Development, West Maui, Hawaii. Data collected on May 9, 2004. For locations of survey sites, see Figure 1.

TRANSECT SITE:	PULELEHUA Ka'opala Bay K-1 10'	MEAN CORAL COVER	6.7 %
		STD. DEV.	4.0
DATE:	May 9, 2004	SPECIES COUNT	3
		SPECIES DIVERSITY	1.02

SPECIES	QUADRAT										SPECIES
	1	2	3	4	5	6	7	8	9	10	TOTAL
Porites lobata	4	2			1	3		3	8	4	2.5
Pocillopora meandrina	1	4	2			2		2			1.1
Montipora patula	2	4		4	5	5			6	5	3.1
QUAD CORAL TOTAL	7	10	2	4	6	10	0	5	14	9	6.7
Limestone pavement/tur	83	90	98	56	84	75	75	95	66	86	80.8
Sand									20	5	2.5
Rubble	10			40	10	15	25				10.0
NON-CORAL TOTAL	93	90	98	96	94	90	100	95	86	91	93.3

TRANSECT SITE:	PULELEHUA Ka'opala Bay K-2 17'	MEAN CORAL COVER	8.9 %
		STD. DEV.	20.6
DATE:	May 9, 2004	SPECIES COUNT	1
		SPECIES DIVERSITY	0.00

SPECIES	QUADRAT										SPECIES
	1	2	3	4	5	6	7	8	9	10	TOTAL
Porites lobata	65			5			10	2		2	8.4
QUAD CORAL TOTAL	70	0	0	5	0	0	10	2	0	2	8.4
Limestone pavement/tur	30			15	15	20	10	15	90	73	26.8
Sand		90	100	80	85	80	80	83	10	25	63.3
Rubble		10									1.0
NON-CORAL TOTAL	30	100	100	95	100	100	90	98	100	98	91.1

TRANSECT SITE:	PULELEHUA Pohaku Bay P-1 10'	MEAN CORAL COVER	1.2 %
		STD. DEV.	3.6
DATE:	May 9, 2004	SPECIES COUNT	2
		SPECIES DIVERSITY	0.64

SPECIES	QUADRAT										SPECIES
	1	2	3	4	5	6	7	8	9	10	TOTAL
Pocillopora meandrina										4	0.4
Montipora patula										8	0.8
QUAD CORAL TOTAL	0	0	0	0	0	0	0	0	0	12	1.2
Limestone pavement/tur	90	80	50	75	10	10	1	70	90	82	55.8
Sand	10	20	50	25	90	90	99	30	5	6	42.5
Rubble											0.0
NON-CORAL TOTAL	100	100	100	100	100	100	100	100	95	88	98.3

TRANSECT SITE:	PULELEHUA Pohaku Bay P-2 18'	MEAN CORAL COVER	3.5 %
		STD. DEV.	7.4
DATE:	May 9, 2004	SPECIES COUNT	1
		SPECIES DIVERSITY	0.00

SPECIES	QUADRAT										SPECIES
	1	2	3	4	5	6	7	8	9	10	TOTAL
Porites lobata							10	24	1		3.5
QUAD CORAL TOTAL	0	0	0	0	0	0	10	24	1	0	3.5
Limestone pavement/tur	50	60	65	65	75	80	60	71	94	100	72.0
Sand	50	40	35	35	25	20	40	5	5		25.5
Rubble											0.0
NON-CORAL TOTAL	100	100	100	100	100	100	100	76	99	100	97.5

TRANSECT SITE:	PULELEHUA Mahinahina M-1 10'	MEAN CORAL COVER	0.4 %
		STD. DEV.	1.2
DATE:	May 9, 2004	SPECIES COUNT	1
		SPECIES DIVERSITY	0.00

SPECIES	QUADRAT										SPECIES
	1	2	3	4	5	6	7	8	9	10	TOTAL
Porites lobata										4	0.4
QUAD CORAL TOTAL	0	0	0	0	0	0	0	0	0	4	0.4
Limestone pavement/tur	5	40	70	40	90	55	30	60	65	80	53.5
Sand	95	60	30	60	10	45	70	40	35	20	46.5
Rubble											0.0
NON-CORAL TOTAL	100	100	100	100	100	100	100	100	100	100	100.0

TRANSECT SITE:	PULELEHUA Mahinahina M-2 20'	MEAN CORAL COVER	18.1 %
		STD. DEV.	28.4
DATE:	May 9, 2004	SPECIES COUNT	5
		SPECIES DIVERSITY	0.83

SPECIES	QUADRAT										SPECIES
	1	2	3	4	5	6	7	8	9	10	TOTAL
Porites lobata	30	55	35			5					12.5
Porites compressa			45								4.5
Pocillopora meandrina		2				2					0.4
Montipora capitata	1										0.1
Montipora patula			4	2							0.6
QUAD CORAL TOTAL	31	57	84	2	0	7	0	0	0	0	18.1
Limestone pavement/tur	69	43	16	78	80	93					37.9
Sand				20	20		100	100	100	100	44.0
Rubble											0.0
NON-CORAL TOTAL	69	43	16	98	100	93	100	100	100	100	81.9

TABLE 2. Water chemistry measurements off the proposed Pulelehua development in West Maui, Hawaii collected on April 20, 2004 with concentrations of nutrients in micrograms per liter (µg/L). Abbreviations as follows: S=surface; D=deep; DFS=distance from shore, BDL=below detection limit. Also shown are the State of Hawaii, Department of Health (DOH) "not to exceed more than 10% of the time" and "not to exceed more than 2% of the time" water quality standards for embayments under "wet" conditions. Shaded and boxed values exceed DOH 10% standards. For locations of sampling transect, see Figure 1.

TRANSECT LOCATION	NO.	DFS (m)	PO4 (µg/L)	NO3 (µg/L)	NH4 (µg/L)	Si (µg/L)	TOP (µg/L)	TON (µg/L)	TP (µg/L)	TN (µg/L)	TURB (NTU)	TSS (mg/L)	SALT (‰)	CHL a (µg/L)	TEMP (deg C)	O2 (%sat.)	pH
Ka'opala Bay	1S	0.1	8.06	344.40	0.14	1182.45	24.18	149.80	32.24	494.34	0.72	20.93	32.150	2.50	24.4	102.4	8.23
	2S	1	13.33	342.56	0.84	1170.93	32.24	145.18	45.57	488.80	0.73	19.40	32.194	2.21	24.4	102.8	8.23
	3S	10	14.57	359.38	0.56	1199.03	12.71	193.90	27.28	553.84	0.57	11.54	32.217	2.01	24.4	102.4	8.23
	3D	10	4.96	346.04	0.42	1169.80	15.50	172.34	20.46	520.80	0.52	24.37	32.257	7.53	24.3	101.7	8.22
	4S	25	11.16	335.68	0.56	1145.92	13.95	149.80	25.11	488.22	0.45	9.95	32.341	1.99	24.3	101.9	8.22
	4D	25	8.68	207.78	0.84	748.87	12.40	171.78	21.08	380.38	0.43	11.87	32.382	1.69	24.3	102.1	8.22
	5S	50	13.33	382.34	0.70	1316.77	10.54	144.90	23.87	527.94	0.41	6.94	32.475	1.07	24.3	102.3	8.22
	5D	50	4.96	167.16	BDL	622.42	13.02	141.12	17.98	308.28	0.45	9.98	32.979	1.48	24.3	102.3	8.22
	6S	100	0.93	8.82	3.08	88.23	11.78	166.74	12.71	178.64	0.18	4.59	33.953	0.52	24.0	87.8	8.01
	6D	100	0.93	3.08	0.70	84.86	18.91	126.70	19.84	130.48	0.16	5.33	33.929	0.51	24.1	84.6	8.01
	7S	150	0.93	3.08	1.12	91.61	25.42	148.54	26.35	152.74	0.19	6.55	34.217	0.27	24.6	100.8	8.07
	7D	150	0.62	0.28	1.40	96.95	9.61	119.42	10.23	121.10	0.15	3.98	34.191	0.26	24.3	92.9	8.06
	8S	250	1.86	2.52	2.38	102.00	9.61	140.42	11.47	143.22	0.12	4.12	34.264	0.21	24.8	97.1	8.05
	8D	250	3.10	0.56	2.38	86.27	8.99	123.06	12.09	126.00	0.11	5.76	34.354	0.20	24.9	94.1	8.06
	9S	500	3.72	0.28	0.42	54.80	8.68	154.84	12.40	155.54	0.08	2.93	34.333	0.19	25.0	98.3	8.08
	9D	500	0.93	BDL	0.70	41.03	8.37	137.34	9.30	138.04	0.09	1.87	34.566	0.18	24.9	94.2	8.09
Pohaku	1S	0.1	39.68	1210.30	0.28	4911.04	7.13	97.02	46.81	1307.60	0.53	10.46	27.159	2.06	24.1	108.6	8.18
	2S	1	38.75	1142.40	2.94	4564.56	7.75	117.74	46.50	1283.08	0.53	8.95	27.480	1.45	24.2	108.8	8.18
	3S	10	28.52	903.68	0.14	3621.53	8.37	118.02	36.89	1023.92	0.45	8.80	27.924	1.23	24.3	109.0	8.18
	3D	10	15.81	441.14	1.26	1901.53	9.61	119.56	25.42	561.96	0.40	5.73	28.766	1.14	24.4	111.3	8.17
	4S	25	26.35	782.18	0.70	3229.53	8.06	99.82	34.41	882.70	0.39	4.62	29.273	1.35	24.4	111.5	8.17
	4D	25	11.47	269.48	1.26	1392.92	10.85	135.94	22.32	436.88	0.34	3.98	30.195	1.37	24.4	111.3	8.17
	5S	50	14.88	427.70	0.84	1836.05	7.44	98.70	22.32	527.24	0.21	4.41	31.666	0.55	24.2	99.0	8.09
	5D	50	2.48	44.94	0.84	372.04	9.92	143.36	12.40	189.14	0.16	4.13	33.946	0.77	24.6	94.4	8.07
	6S	100	12.09	376.92	0.84	1650.88	8.37	119.98	20.46	497.14	0.19	6.29	32.250	2.15	24.3	97.5	8.08
	6D	100	4.03	17.64	1.54	184.62	9.61	136.22	13.64	155.40	0.16	3.96	34.089	0.67	24.6	95.2	8.08
	7S	150	15.19	433.02	1.26	1850.95	7.44	100.80	22.63	535.08	0.22	8.24	33.431	0.37	24.5	93.9	8.07
	7D	150	3.10	21.84	4.06	249.53	8.68	191.94	11.78	217.84	0.15	4.33	34.188	0.46	24.8	95.0	8.08
	8S	250	6.20	142.38	BDL	745.49	8.06	111.44	14.26	253.82	0.18	3.15	33.429	0.25	24.4	94.2	8.07
	8D	250	2.48	10.22	1.40	181.53	8.37	142.10	10.85	153.72	0.13	2.96	34.187	0.21	24.8	94.7	8.08
	9S	500	2.17	1.96	2.10	50.02	8.37	113.68	10.54	117.74	0.12	5.37	34.404	0.16	25.2	96.9	8.10
	9D	500	0.93	0.42	3.92	40.18	8.68	130.20	9.61	134.54	0.09	1.28	34.336	0.17	25.1	94.4	8.10
Mahinahina	1S	0.1	22.01	381.92	3.78	2328.09	11.47	250.74	33.48	638.44	0.59	14.83	31.103	1.69	25.7	112.2	8.25
	2S	1	20.15	365.40	4.06	2211.19	10.85	217.98	31.00	587.44	0.62	17.20	31.970	1.46	25.8	129.9	8.24
	3S	10	12.40	286.54	5.60	1787.72	9.30	126.70	21.70	420.84	0.61	7.95	32.040	0.98	25.8	129.6	8.24
	3D	10	6.51	165.78	2.10	1230.78	11.16	158.34	17.67	326.20	0.66	19.11	32.157	1.29	25.8	131.0	8.21
	4S	25	2.48	85.96	2.38	714.02	9.92	135.38	12.40	223.72	0.34	8.01	32.837	0.69	25.8	129.5	8.22
	4D	25	4.03	53.48	5.04	451.85	11.78	126.70	15.81	185.22	0.23	5.36	33.649	0.80	25.8	128.6	8.21
	5S	50	12.40	252.50	1.12	1579.22	9.30	150.92	21.70	414.54	0.40	7.30	32.667	0.53	24.6	101.7	8.09
	5D	50	3.10	13.86	3.36	144.15	8.68	114.24	11.78	131.46	0.15	2.63	34.219	0.48	25.0	101.3	8.12
	6S	100	0.62	2.38	2.94	54.51	8.68	127.40	9.30	132.72	0.10	1.64	34.387	0.18	25.1	97.2	8.10
	6D	100	0.93	1.68	1.82	46.65	8.99	118.86	9.92	122.36	0.10	1.00	34.377	0.17	25.2	97.4	8.10
	7S	150	1.24	1.82	2.24	39.90	8.68	109.06	9.92	113.12	0.11	3.65	34.415	0.21	25.2	97.1	8.10
	7D	150	3.10	1.54	2.10	36.25	7.13	103.04	10.23	106.68	0.09	2.01	34.430	0.18	25.2	96.9	8.10
	8S	250	3.10	0.28	0.56	51.99	8.68	108.78	11.78	109.62	0.11	3.39	34.391	0.19	25.1	98.8	8.09
	8D	250	3.72	1.12	BDL	72.22	8.68	122.92	12.40	124.04	0.10	2.64	34.446	0.16	25.2	96.1	8.10
	9S	500	2.17	0.98	0.42	32.88	9.30	115.64	11.47	117.04	0.09	0.89	34.366	0.15	25.2	96.8	8.10
	9D	500	2.79	0.14	2.66	42.71	8.06	122.50	10.85	125.30	0.08	1.26	34.478	0.14	25.1	96.8	8.12
DOH	10% STD		20.00	13.00					50.00	350.00	3.00			4.50	*		***
	2% STD		35.00	20.00					75.00	500.00	5.00			8.50		**	

* Shall vary no more that 1 °C from "ambient conditions"

** Shall not be less than 75% saturation

*** Shall not deviate more than 0.5 units from a value of 8.1

TABLE 5. Marine algae occurrence at Survey stations in the vicinity of the Pulelehuc Development, West Maui, Hawaii.

Abundance code: "R" = rare (0 - 5 individuals sighted on station)
"O" = occasional (5 - 20 individuals sighted on station)
"C" = common (more than 20 individuals sighted on station)

FAMILY	KA'OPALA		POHAKU		MAHINAHINA	
Species	K-1	K-2	P-1	P-2	M-1	M-2
CHLOROPHYTA						
(Green algae)						
Ulva spp.	C	O	C		C	O
Cladphora sp.	C		C		O	
Enteromorpha sp.	O		O			
Halimeda spp.	C	C	C	C	C	C
Neomeris annulata	C	C	C	C		C
Valonia spp.		R				
CYANOPHYTA						
(Blue-green algae)						
Lyngbya majuscula	C	C	C	C	C	C
PHAEOPHYTA						
(Brown algae)						
Dictopteris app.	C		C		C	C
Dictyota spp.	C				C	
Padina spp.						
Turbinaria ornata		R			R	
RHODOPHYTA						
(Red Algae)						
Acanthophora specifera	C	C	C	C	C	C
Amansia glomerata		R				
Asperagopsis taxiformis						C
Desmia hornemanii						
Dotyella hawaiiensis						
Galaxaura spp.						
Hydrolithon spp.		C		C		
Hypnea musciformis	R		R		C	
Martensia fragilis						
Neogoniolithon sp.						
Peysonellia rubra sp.		C		C		C
Porolithon spp.		C		C		C

TABLE 4. Summary of coral and non-coral substratum data for photoquadrat transects off the proposed Pulelehua development in West Maui. For locations of transect sites, see Figure 1.

CORAL SPECIES	SITE	KA'OPALA		POHAKU		MAHINAHINA	
	Transect	K-1	K-2	P-1	P-2	M-1	M-2
	Depth (m)	30 m	60 m	30 m	60 m	30 m	60 m
Porites lobata		2.5	8.4		3.5	0.4	12.5
Porites compressa							4.5
Pocillopora meandrina		1.1		0.4			0.4
Montipora patula		3.1		0.8			0.6
Montipora capitata							0.1
TOTAL CORAL COVER		6.7	8.4	1.2	3.5	0.4	18.1
NUMBER OF SPECIES		3	1	2	1	1	5
CORAL COVER DIVERSITY		1.02	0.00	0.64	0.00	0.00	0.83
ST. DEV.		4	20.6	3.6	7.4	1.2	28.4
NON-CORAL SUBSTRATA							
Pavement/Algae		80.8	26.8	55.8	72.0	53.5	37.9
Sand		2.5	63.3	42.5	25.5	46.5	44.0
Rubble		10.0	1.0	0.0	0.0	0.0	0.0

TABLE 6. Reef fish abundance on survey transects in the vicinity of the proposed Pulelehua Project, West Maui, Hawaii. For location of sampling stations, see Figure 1.

Abundance code: "R" = rare (0 - 5 individuals sighted on station)
"O" = occasional (5 - 20 individuals sighted on station)
"C" = common (more than 20 individuals sighted on stati

FAMILY	KA'OPALA		POHAKU		MAHINAHINA	
Species	K-1	K-2	P-1	P-2	M-1	M-2
CIRRHITIDAE						
Cirrhitops fasciatus						R
Paracirrhites arcatus						R
MULLIDAE						
Parupeneus multifasciatus	R					
CHAETODONTIDAE						
Chaetodon quadrimaculatus						R
C. miliaris	R		R			O
C. multicinctus		R				R
POMACENTRIDAE						
Chromis vanderbilti		R		R		C
C. hanui						
C. ovalis		R				C
Stegastes fasciolatus						
LABRIDAE						
Bodianus bilunulatus						R
Thalassoma duperrey		R		R		R
KYPHOSIDAE						
Kyphosus bigibbus	R	R		O		R
ACANTHURIDAE						
Acanthurus olivaceus				R		R
A. triostegus		R		R		R
A. blochii			R			
Naso lituratus				R		R
Naso unicornis		R				
Zebrasoma flavescens						O
Ctenochaetus strigosus		R	R			R
BALISTIDAE						
Sufflamen bursa						R
S. fraenatus						
Melichthys niger	R	R	R	R	R	
Rhinecanthus rectangulus	R	R	R	R	R	O
TETRADONTIDAE						
Canthigaster jactator						R
ZANCLIDAE						
Zanclus cornutus						R
NUMBER SPECIES	5	10	5	8	2	19

D

Botanical Resources Assessment Study

BOTANICAL RESOURCES ASSESSMENT STUDY

PULELEHUA PROJECT

LAHAINA DISTRICT, MAUI

by

Winona P. Char

CHAR & ASSOCIATES
Botanical Consultants
Honolulu, Hawai'i

Prepared for: **MAUI LAND & PINEAPPLE COMPANY, INC.**

May 2004

BOTANICAL RESOURCES ASSESSMENT STUDY
PULELEHUA PROJECT
LAHAINA DISTRICT, MAUI

INTRODUCTION

The Pulelehua project site consists of approximately 280 acres located on a portion of TMK (2) 4-3-01: 31 in West Maui. It is bound by the Kapalua West Maui Airport to the east, pineapple fields to the north and south, and Honoapi'ilani Highway and a residential area (Kahana Ridge subdivision) to the west. Most of the property is under pineapple cultivation. Two gulches (Kahanaiki Gulch and Mahinahina Gulch) along with a small grass-covered drainageway cross the property.

Field studies to assess the botanical resources on the Pulelehua project site were conducted on 21 April 2004 by a team of two botanists. The primary objectives of the field studies were to:

1) prepare a general description of the vegetation on the Pulelehua site;
2) search for threatened and endangered species as well as species of concern; and
3) identify areas of potential environmental problems or concerns and propose appropriate mitigation measures.

SURVEY METHODS

Prior to undertaking the field studies, a search was made of the pertinent literature to familiarize the principal investigator with other botanical studies conducted in the general area. Topographic maps as well as recent aerial photographs were examined to determine vegetation cover patterns, terrain characteristics, access, boundaries, and reference points. All of the property can be easily accessed by way of the network of dirt roads which

cross the pineapple fields.

A walk-through survey method was used. Notes were made on plant associations and distribution, substrate types, disturbances, drainage, exposure, etc. The less disturbed gulch areas were more intensively surveyed as these sites were more likely to harbor native plant communities and, perhaps, rare plants.

DESCRIPTION OF THE VEGETATION

The plant names used in this report follow Wagner et al. (1990) and Wagner and Herbst (1999). The few recent name changes are those reported in the Hawaii Biological Survey series (Evenhuis and Eldredge, eds., 1999-2002).

Two vegetation types are recognized on the Pulelehua site. Pineapple fields in various stages of cultivation cover the majority of the site, while gulch vegetation consists primarily of koa haole/Guinea grass scrub with scattered trees.

Pineapple Fields

Pineapple (Ananas comosus) fields occur on well-drained, dark reddish-brown colored soils of the Lahaina series (Foote et al. 1972) on gently sloping lands within the project site. The closed rows of grayish-green colored pineapple plants exclude most other plant species. A few weedy plants occur along the margins of the fields where they abut dirt roads. The most commonly observed weeds are sourgrass (Digitaria insularis), Guinea grass (Panicum maximum), Natal redtop grass (Melinis repens), little bell (Ipomoea triloba), swollen fingergrass (Chloris barbata), and nutgrass (Cyperus rotundus). Recently plowed fields, such as those found between Mahinahina Gulch and the airport, support bare soil with only a few scattered weedy patches.

Fallowed fields are found in the section between Akahele Street (road to airport)

and the residential area. Wild bittermelon vines (Momordica charantia) are abundant and form low, spreading mats over the soil. Scattered clumps of Guinea grass, 2 to 3 ft. tall, are common. Other weedy plants found here in smaller numbers include sourgrass, spiny amaranth (Amaranthus spinosus), slender amaranth (A. viridis), Crassocephalum crepidioides, nutgrass, virgate mimosa (Desmanthus prenambucanus), little bell, Natal redtop grass, and a few shrubs of dog tail (Buddleia asiatica) and sourbush (Pluchea carolinensis). Patches of pineapple plants, some dead and some alive, occur throughout the fallowed fields. Two native species which prefer more open, disturbed habitats are found here; these are popolo (Solanum americanum) and 'uhaloa (Waltheria indica).

Along Honoapi'ilani Highway, a row of ironwood trees (Casuarina equisetifolia) and clumps of Guinea grass border the fields. Around the subdivision, an oleander (Nerium oleander) hedge marks the boundary.

Gulch Vegetation

Retention basins are found at the lower ends of the two gulches; these both held muddy water at the time of the survey. The Kahanaiki Gulch retention basin is just outside of the project site. The vegetation around the retention basins and the areas just mauka of the basins consists primarily of dense, robust clumps of Guinea grass, 6 to 7 ft. tall.

Further up the gulches, above the retention basins, koa haole shubs (Leucaena leucocephala) form open to closed thickets. In those areas where the shrubs are more widely spaced, Guinea grass forms a dense cover. Along the bottom of the gulches, the koa haole shrubs are taller, 7 to 12 ft. tall, and trees of Chinaberry (Melia azedarach), Java plum (Syzygium cumini), kiawe (Prosopis pallida), 'opiuma (Pithecellobium dulce), silkoak (Grevillea robusta), and kukui (Aleurites moluccana) form small stands, 25 to 40 ft. tall. Christmas berry (Schinus terebinthifolius) and kolomona (Senna surattensis) shrubs are

occasionally encountered.

On the gulch slopes, the koa haole shrubs are of shorter stature, 5 to 7 ft. tall. Guinea grass or, in some places, green panicgrass (Panicum maximum var. trichoglume) form dense clumps between the koa haole shrubs and scattered trees. Where there are rock outcroppings or exposed stony soil, the vegetation cover is sparser. Natal redtop grass and 'uhaloa are common to abundant. Besides 'uhaloa, other native species found on these more open, stony soil areas are 'a'ali'i (Dodonaea viscosa), 'akia (Wikstroemia oahuensis), pua kala (Argemone glauca), koali 'awa (Ipomoea indica), and 'ulei (Osteomeles anthyllidifolia).

Fence posts and barbed wire can be found in places along the top of the gulches. Mahinahina Gulch is or was recently used for grazing cattle. A small rock crushing operation is found along Mahinahina Gulch. The piles of boulders, soil, and gravel support patches of Guinea grass and a mixed assortment of weedy species including tree tobacco (Nicotiana glauca), lion's ear (Leonotis nepetifolia), castor bean (Ricinus communis), Natal redtop grass, spiny amaranth, golden crown-beard (Verbesina encelioides), and buffelgrass (Cenchrus ciliaris).

DISCUSSION AND RECOMMENDATIONS

The majority of the Pulelehua project site is under active pineapple cultivation. Weedy species associated with agricultural lands are found primarily along the margins of the pineapple fields. Fallowed fields support scattered patches of weeds, mostly low mats of wild bittermelon and clumps of Guinea grass.

Gulch vegetation consists primarily of koa haole/Guinea grass scrub with scattered trees or small stands of trees. A few native species are associated with rock outcrops and stony soils on the gulch slopes.

No threatened and endangered species or species of concern (U.S. Fish and Wildlife Service 1999a, 1999b; Wagner et al. 1999) occur on the Pulelehua site.

The seven native species which were observed on the site are the 'uhaloa (Waltheria indica), popolo (Solanum americanum), 'a'ali'i (Dodonaea viscosa), 'ulei (Osteomeles anthyllidifolia), koali 'awa (Ipomoea indica), 'akia (Wikstroemia oahuensis), and pua kala (Argemone glauca). The last two species, 'akia and pua kala, are endemic, that is, they are native only to the Hawaiian Islands. The others are all indigenous, that is, they are native to the Hawaiian Islands and elsewhere. During the botanical studies for the nearby Ka'anapali 2020 project (Char 2002), these native species were also found associated with the lower gulch areas which cross agricultural lands. All seven native species are widespread throughout the Hawaiian Islands where they occur in similar lowland, dry to mesic environments.

The proposed use of the site for a residential development is not expected to have a significant negative impact on the botanical resources as most of the site is covered by pineapple fields. The gulch areas will not be developed. There are no botanical reasons to impose any restrictions, conditions, or impediments to the proposed development of the site.

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E

Avifaunal & Feral Mammal Field Survey

AVIFAUNAL AND FERAL MAMMAL FIELD SURVEY OF PULELEHUA TMK (2) 4-3-01: 31 IN WEST MAUI

Prepared for:

PBR Hawaii
And
Kapalua Land Company, Ltd.

Prepared by:

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Revised
18 May 2004

INTRODUCTION

The purpose of this report is to provide the findings of a two day (30 April, 1 May 2004) field survey of approximately 300 acres at TMK (2) 4-3-01:31 in West Maui. References to pertinent published and unpublished sources are also provided in the report in order to allow a broader perspective of the birds and mammals known from this region of Maui. The goal of the field survey were to:

1- Document the species of birds and mammals presently found on or near the property.

2- Examine all habitats on the site and nearby lands.

SITE DESCRIPTION

The majority of the land on this site is currently covered in low grass and recently plowed fields. Kapalua West Maui Airport and Honoapiilani Highway are located on the makai and mauka boundaries. Brush-filled gulches occur on the north and south ends of the site. Surrounding lands include residential properties and agricultural fields. A small gulch with a drainage ditch makai of Honoapiilani Highway was also examined on the survey. This ditch is filled with brush. A cement catchment area at the makai end of the gulch contained standing water.

METHODS OF THE FIELD SURVEY

The survey was conducted on foot and by car along existing roads in and around the site. Observations were made during the morning, late afternoon and early evening hours. All habitats on the site were investigated and birds seen or heard were noted. Data on mammals were obtained from visual observations and tracks. No trapping of mammals was conducted. The length and nature of the survey did not warrant trapping. The evening observation (30 April) was devoted to looking for owls and the endangered Hoary Bat (*Lasiurus cinereus semotus*). A Pettersson Elektronik AB Ultrasound Detector D-100 was used to listen for echolocating bats. Weather during the survey was partly cloudy with 10-20mph winds from the east.

The scientific and common names used in this report follow Pyle (2002), Honacki et al. (1982) and Tomich (1986). These sources use the names found in the current scientific literature.

RESULTS OF THE FIELD SURVEY

Native Land Birds:

No native species were observed on the survey. The only species that might on rare occasions occur in this area is the Hawaiian Owl (*Asio flammeus sandwichensis*) and the Nene (*Branta sandvicensis*). The Hawaiian Owl or Pueo forages over fields as well

as forests. It is day active and nests on the ground in areas with tall grass (Pratt et al. 1987, Hawaii Audubon Society 1993). Pueo are listed by the State of Hawaii as endangered on the island of Oahu but not elsewhere in Hawaii. The Nene is the State Bird of Hawaii and is federally listed as endangered throughout its range in Hawaii. They utilize scrublands, grasslands, golf courses, and sparsely vegetated slopes (Hawaii Audubon Society 1993). Nene were recently reintroduced to West Maui at the West Maui Forest Reserve in Hana'ula (DLNR 2001-2002). I have seen Nene in West Maui (Bruner 2002), but none were observed on the survey.

Native Waterbirds:

No native waterbirds were seen on the survey. No wetland habitat suitable for foraging waterbirds was found on the property. A cement catchment mauka of the bridge on the makai end of a small gulch makai of Honoapiilani Highway held a little water but did not appear to contain resources suitable for foraging waterbirds.

Seabirds:

No seabirds were seen on the survey and none would be expected on this site. Some species might fly over the property on their way between the mountains where they nest and the sea but none would nest in this area due to the presence of ground predators and human disturbance.

Migratory Birds:

Two Pacific Golden- Plover (*Pluvialis fulva*) were seen on the plowed fields at the west end of the site. Both birds were females with little or no breeding plumage and were thin. They likely will remain in Hawaii this summer rather than migrate to their arctic breeding grounds. Much research has been conducted on Pacific Golden-Plover in Hawaii and Alaska (Johnson et al. 1981, 1989, 1993, 2001a, 2001b). No other migratory shorebirds were recorded on the survey. The Ruddy Turnstone (*Arenaria interpres*) utilizes similar wintering habitats as plovers and may occur in this area during August through April. Neither of these migrants are listed as endangered.

Introduced (Alien) Birds:

A total of eleven alien species were tallied on the survey. Table One provides the names of these species. None of these birds are listed as endangered. The eleven species are common birds in this area. Previous studies in the region have also reported these species (Bruner 1994, 2001a, 2001b, 2002).

Mammals:

Three Small Indian Mongoose (*Herpestes auropunctatus*) and one Roof Rat (*Rattus rattus*) were observed on the survey. Mice (*Mus musculus*) and feral cats (*Felis catus*) likely occur in this area but were not detected on the survey. No endangered Hawaiian Hoary Bat (*Lasiurus cinereus semotus*) were found on the survey. This bat

does occur in Maui but in relatively low numbers (Tomich 1986, Kepler and Scott 1990, Duvall and Duvall 1991). They are most abundant on Kauai and the Big Island. The Hawaiian Hoary Bat utilizes a variety of habitats when foraging for flying insects. They are often observed in native forest, agricultural lands as well as urban areas (Tomich 1986). Jacobs (1991, 1993) and Reynolds et al. (1998) provide data on this species in forested habitats on the Big Island.

CONCLUSIONS

The purpose of this survey was to document the birds and mammals currently found on this site. Although no native birds were recorded two native species are known from similar lands in this region and could potentially occur on rare occasions at this site. These two species are the Nene and the Pueo or Hawaiian Owl. The only migrant seen on the survey was the Pacific Golden-Plover. Migratory shorebirds such as the plover typically depart Hawaii for their arctic breeding grounds at the end of April. If the survey been conducted earlier in April it is likely a few more plover and possibly Ruddy Turnstones might have been found foraging in the fields and on the grass areas around the airport. The absence of seabirds and waterbirds was not unexpected due to the lack of suitable habitat for these birds at this location. The eleven alien (introduced) species were the typical array found in this region. Likewise the introduced mammals found on

the survey are those expected in this area. The absence of the endangered Hawaiian Hoary Bat was not unusual due to its relatively low numbers on Maui.

The survey examined all the habitats on the property. These resources are typical of the agricultural lands in West Maui. Native plant and animal communities have been replaced by introduced species throughout most of the lowlands in Hawaii.

TABLE ONE

Introduced (alien) birds recorded on the survey of Pulelehua TMK (2) 4-3-01:31 in West Maui.

COMMON NAME	SCIENTIFIC NAME
Cattle Egret	*Bulbucus ibis*
Gray Francolin	*Fancolinus pondicerianus*
Ring-necked Pheasant	*Phasianus colchicus*
Spotted Dove	*Streptopelia chinensis*
Zebra Dove	*Geopelia striata*
Barn Owl	*Tyto alba*
Japanese White-eye	*Zosterops japonicus*
Common Myna	*Acridotheres tristis*
Red-crested Cardinal	*Paroaria coronata*
Northern Cardinal	*Cardinalis cardinalis*
Nutmeg Mannikin	*Lonchura punctulata*

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F

Archaeological Inventory Survey Report

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March 3, 2005

Jeffrey Pantaleo
Archaeological Services Hawai'i, LLC
16 South Market Street, Suite G
Wailuku, Hawai'i 96793

LOG NO: 2005.0411
DOC NO: 0502MK22

Dear Mr. Pantaleo:

SUBJECT: Historic Preservation Review - 6E-42 – Revised Archaeological Inventory Survey Proposed Pulelehua Community Project for Maui Land and Pineapple, Inc.
Mahinahina 1, 2, 3, 4, and Kahana Ahupua'a, Lahaina District, Maui
TMK: (2) 4-3-01:31

Thank you for the opportunity to review this revised report which was submitted in November 2004 (Pantaleo and Titchenal 2004, *Archaeological Inventory Survey Report for the Pulelehua Community Project, TMK 4-3-01: 31 Por., Mahinahina 1, 2, 3, Mahinahina 4, and Kahana Ahupua'a, Lahaina and Ka'anapali Districts, Island of Maui*...Archaeological Services Hawai'i, LLC, ms). We requested revisions (Log 2004.2545/Doc 0408MK11) in August of 2004. We also commented in August of 2004 on the Environmental Impact Statement Preparation Notice for the Proposed Pulelehua New Traditional Community (Log 2004.2634/Doc 0408CD52).

The requested revisions included the following:

1. An SIHP number for the glass scatter.
2. A discussion of the condition/current use of SIHP 50-50-03-5553, a plantation era flume.

The glass scatter has been assigned SIHP 50-50-03-5641 and has been acceptably documented and plotted on the appropriate maps. SIHP 50-50-03-5553, the flume, was abandoned in 1917 due to deterioration.

We concur that both sites are significant under Criterion "D", for the potential to yield information important to prehistory and history of the area. Adequate information has been collected from both sites.

Jeffrey Pantaleo
Page 2

We concur with the commitment for monitoring in the vicinity of the glass scatter (possibly Mahinahina Camp) as well as in the general vicinity of the isolated artifact find (hammer stone), as a mitigation against adverse impacts to historic properties. We will await a monitoring plan designating the precise areas within which monitoring will occur.

We find this revised report to be acceptable. As always, if you disagree with our comments or have questions, please contact Dr. Melissa Kirkendall (Maui/Lana'i SHPD 243-5169) as soon as possible to resolve these concerns.

Aloha,

Nathan Napoka

for MELANIE A. CHINEN, Administrator
State Historic Preservation Division

MK:jen

c: Bert Ratte, DPWEM, County of Maui
Michael Foley, Director, Dept of Planning, 250 S. High Street, Wailuku, HI 96793
Maui Cultural Resources Commission, Dept. of Plng, 250 S. High St, Wailuku, HI 96793
Jeffrey Pantaleo, Principle Investigator, ASH, LLC, 808 837-0131

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August 19, 2004

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Archaeological Services Hawai'i, LLC.
16 South Market Street, Suite G
Wailuku, Hawai'i 96793

LOG NO: 2004.2545
DOC NO: 0408MK11

Dear Mr. Pantaleo,

SUBJECT: Chapter 6E-42 Historic Preservation Review - Archaeological Inventory Survey Proposed Pulelehua Community Project for Maui Land and Pineapple, Inc.
Mahinahina 1, 2, 3, 4, and Kahana Ahupua'a, Lahaina District, Maui
TMK (2) 4-3-01:31

Thank you for the opportunity to review this report which our staff received on June 25, 2004 (Pantaleo and Titchnal 2004, *Archaeological Inventory Survey Report for the Pulelehua Community Project, TMK 4-3-01:31 Por., Mahinahina 1, 2, 3, Mahinahina 4, and Kahana Ahupua'a, Lahaina and Ka'anapali Districts, Island of Maui*. Archaeological Services Hawai'i, LLC, ms).

The background section acceptably establishes the ahupua'a settlement pattern and predicts the likely site pattern in the project area. The historical information provided summarizes the history of the post-contact period land uses. The summary of previous archaeological work in the area provides a baseline for the current work. The expected pattern of pre-contact use would be clusters of habitation components at the shoreline, and evidence of traditional agricultural use within the gulches. Post-contact historic agricultural pursuits have all but obliterated evidence of traditional use within the areas recently and currently used for pineapple cultivation, while historic era activities may still yield archaeological markers.

The survey has adequately covered the 312.604-acre project area documenting one historic property in the project area. SIHP 50-50-03-5553 consists of a historic flume in Mahinahina 1, 2, 3 Gulch. Constructed in the 19th century by Pioneer Mill, the flume served to provide water to the sugar cane fields. Three isolated surface artifacts, (a hammerstone/*ulu maika*, two glass medicine bottles, and non-diagnostic glass sherds) were also identified. A SIHP number may need to be assigned to the scatter if it appears to be a primary deposit; the accompanying text should then indicate that the scatter in which the medicine bottles were found may be associated with the plantation camps in the vicinity. Please obtain a site number for this find, and replace the "artifact" number with the SIHP number on *Figure 11*, page 27.

Please also make minor revisions on page 24, paragraph 4. In a discussion with Dr. Kirkendall of SHPD-DLNR, she indicated that while backhoe trenching may not be necessary in large tracts of cultivated land, it is necessary to identify areas in which testing may have the potential of identifying subsurface deposits. Surface indicators may include soil discolorations, general locations of historic plantation camps, or, as in the case of this report, isolated artifact finds. In other words, while SHPD does not advocate intensive backhoe testing of large agricultural tracts, background research conducted prior to field work as well as the identification of the field indicators mentioned above may suggest judicious placement of backhoe trenching where needed.

We concur that Site 50-50-03-5553 is significant under Criterion "D", for information important to the understanding of history. You do not indicate if the flume is still in use. Please clarify. We do not concur that archaeological monitoring is necessary for the entire tract. We may agree that certain areas, especially those in the vicinity of the artifact scatters, and possibly, if identified, the location of Mahinahina Camp may need archaeological monitoring. Please make the recommendations specific in the revised report. The precise location of Mahinahina Camp is not clear, and is not depicted on the project area map. If possible, this will allow us to better assess the mitigation recommendation.

Please submit the revisions on perforated replacement pages, or you may submit a final draft report after incorporating the recommended revisions. As always, if you disagree with our comments or have questions, please contact Dr. Melissa Kirkendall (Maui/Lana'i SHPD 243-5169) as soon as possible to resolve these concerns.

Aloha,

P. Holly McElwaney

P. Holly McElwaney, Administrator
State Historic Preservation Division

MK:jen

c: Michael Foley, Director, Department of Planning, County of Maui, FAX 270-7634
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Maui Cultural Resources Comm, Dept of Ping, 250 S. High Street, Wailuku, HI 96793

ARCHAEOLOGICAL INVENTORY SURVEY REPORT FOR THE PULELEHUA COMMUNITY PROJECT TMK 4-3-01:31 POR. MAHINAHINA 1, 2, 3, MAHINAHINA 4, AND KAHANA *AHUPUA'A* LAHAINA AND KA'ANAPALI DISTRICTS ISLAND OF MAUI

for
Maui Land and Pineapple, Inc.

by
Jeffrey Pantaleo, M.A.
and
Paul Titchenal, M.A.

June 2004
Revised November 2004

ARCHAEOLOGICAL SERVICES HAWAII, LLC.
16 S. Market St. Suite G
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ABSTRACT

Archaeological Services Hawaii, LLC, of Wailuku, conducted an archaeological inventory survey of the proposed Pulelehua residential community project in Mahinahina 1, 2, 3, Mahinahina 4, and Kahana *ahupua'a*, Lahaina and Ka'anapali Districts, island of Maui. The purpose of this investigation was to determine presence/absence, extent, and significance of cultural remains in the project area.

Results of the current investigation identified Site 50-50-03-5553, a flume, in Mahinahina 1, 2, 3 Gulch, and Site 50-50-03-5641, a historic bottle scatter. Site 5553, a flume, was constructed during the late 19th Century by Pioneer Mill Company to supply water to its sugarcane fields. The flume was abandoned in 1917 due to deteriorating conditions. Site 5641 is a historic bottle scatter located along a steep slope in the north central portion of the project area near Kahanaiki Gulch. Sparse amounts of glass fragments from beer bottles and unidentified fragments were identified in the scatter. Two intact medicine bottles manufactured after 1930 were collected from this scatter. An isolated hammerstone/*ulu maika* was found on the surface along a pineapple road in the southeastern portion of the project area.

Although not required by the State Historic Preservation Division (SHPD), subsurface testing by backhoe was conducted in the cultivated portion of the project area to determine presence/absence of subsurface cultural remains or deposits and source of the surface artifacts, and examine the general nature of the stratigraphy. A total of twenty backhoe trenches were placed throughout the project area. Trenches 1-5 were placed along existing pineapple access roads within Land Commission Award 75, Trenches 6-14 were placed in fallow pineapple fields, and Trenches 15-20 were placed along existing pineapple access roads in the northern portion of the project area.

No subsurface cultural remains or deposits were encountered in any of the trenches. Stratigraphic analysis revealed a two to three layer stratigraphic sequence. Layer I was the till zone consisting of silt with moderate amounts of roots/rootlets and no rocks, and black sheeting and irrigation lines from pineapple cultivation. Underlying the till zone was Layer II, homogenous silty clay. Layer II in Trench 9 was fill material for installation of a PCV pipe. Underlying Layer II was Layer III, compact silty clay with abundant rocks and saprolitic rock. Layer IV in Trench 20 was basalt outcrop.

Based on the Hawaii Register of Historic Places significance evaluation criteria, Sites 50-50-03-5553 and 5641 are considered significant under Criterion D, which states that these sites have yielded or have the potential to yield more information significant to our understanding of the history of this region and Maui Island. Site 5553 is situated outside the proposed development area and will not be impacted during the current project. Thus, no further work is recommended for Site 5553. Sufficient information was obtained during the current investigation for Site 5641, and no further work is recommended.

Based on the negative results of subsurface testing in the parcel, together with evidence for previous disturbances in the subject project area from pineapple cultivation, no further inventory-level archaeological work is recommended. However, due to the presence of surface artifacts and an LCA and Grant, archaeological monitoring is recommended during initial construction activities to document any subsurface cultural remains or deposits underlying the till zone. Prior to commencing any construction activities, an archaeological monitoring plan shall be prepared for approval by SHPD.

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Table 1. Dimensions and Stratigraphic Information for T1 through T18 31

INTRODUCTION

At the request of the landowner, Maui Land and Pineapple, Inc., Archaeological Services Hawaii, LLC, of Wailuku, conducted an archaeological inventory survey of the proposed Pulelehua residential community project in Kahana, Mahinahina 1, 2, 3, and Mahinahina 4 *ahupua'a*, Lahaina and Ka'anapali Districts, island of Maui. The purpose of this investigation was to determine presence/absence, extent, and significance of cultural remains in the project area. Fieldwork was conducted between May 3 and 5, 2004, by Ian Bassford, B.A., Paul Titchenal, M.A., and Jeffrey Pantaleo, M.A.

PROJECT LOCATION

The project area (TMK 4-3-01:31 por.), encompassing 312.804-acres, is situated along the lower leeward northwestern slopes of West Maui in Kahana, Mahinahina 1, 2, 3, and Mahinahina 4 *ahupua'a*, Lahaina and Ka'anapali Districts, Maui Island (Fig. 1). Portions of the parcel are still being used for pineapple cultivation. It is bounded by Honoapi'ilani Highway and the Kahana-Hui and Kahana Ridge residential subdivisions to the west, Kapalua West Maui Airport to the east, pineapple fields to the south and southeast, and Kahanaiki Gulch to the north (Fig. 2). Akahele Street extends through the central portion of the project area, providing access from Honoapi'ilani Highway to the Kapalua West Maui Airport.

ENVIRONMENT

The project area occurs on the lower leeward slopes of the West Maui volcano, on a plateau between Kahanaiki Gulch to the north and Mahinahina 1, 2, 3 Gulch to the south. Except for these gulches, the project area is dominated by existing and fallow pineapple. Elevation of the project area ranges from 100 to 250 feet above mean sea level. Rainfall averages between 20 to 30 inches annually, with most occurring during the months of October to April (Armstrong 1973).

Currently, cultivated and fallow pineapple (*Ananas comosus*) dominates the majority of the project parcel (Fig. 3), with *kiawe* (*Prosopis pallida*), *haole koa* (*Leucaena glauca*), *kukui* (*Aleurites moluccana*), *'ilima* (*Sida fallax*), mango (*Mangifera indica*), *wilelaiki* or Christmas-berry (*Schinus terebinthifolius*), and various grasses and weeds in the gulches. The lower (western) portions of both gulches exhibited extensive modifications including construction of desilting basins and culverts (Figs. 4 and 5). Rock quarrying activities were occurring along the northern edge of Mahinahina 1, 2, 3 Gulch (Fig. 6).

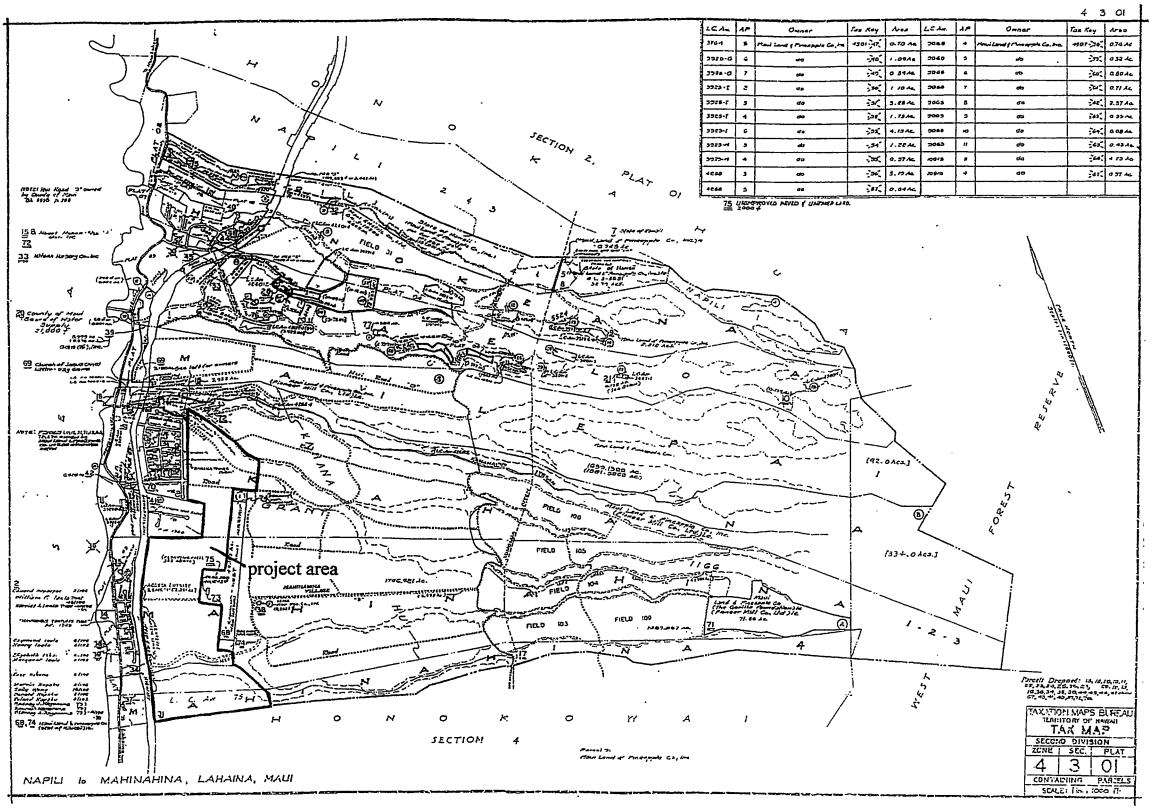

Figure 2. Project Area on TMK 4-3-01

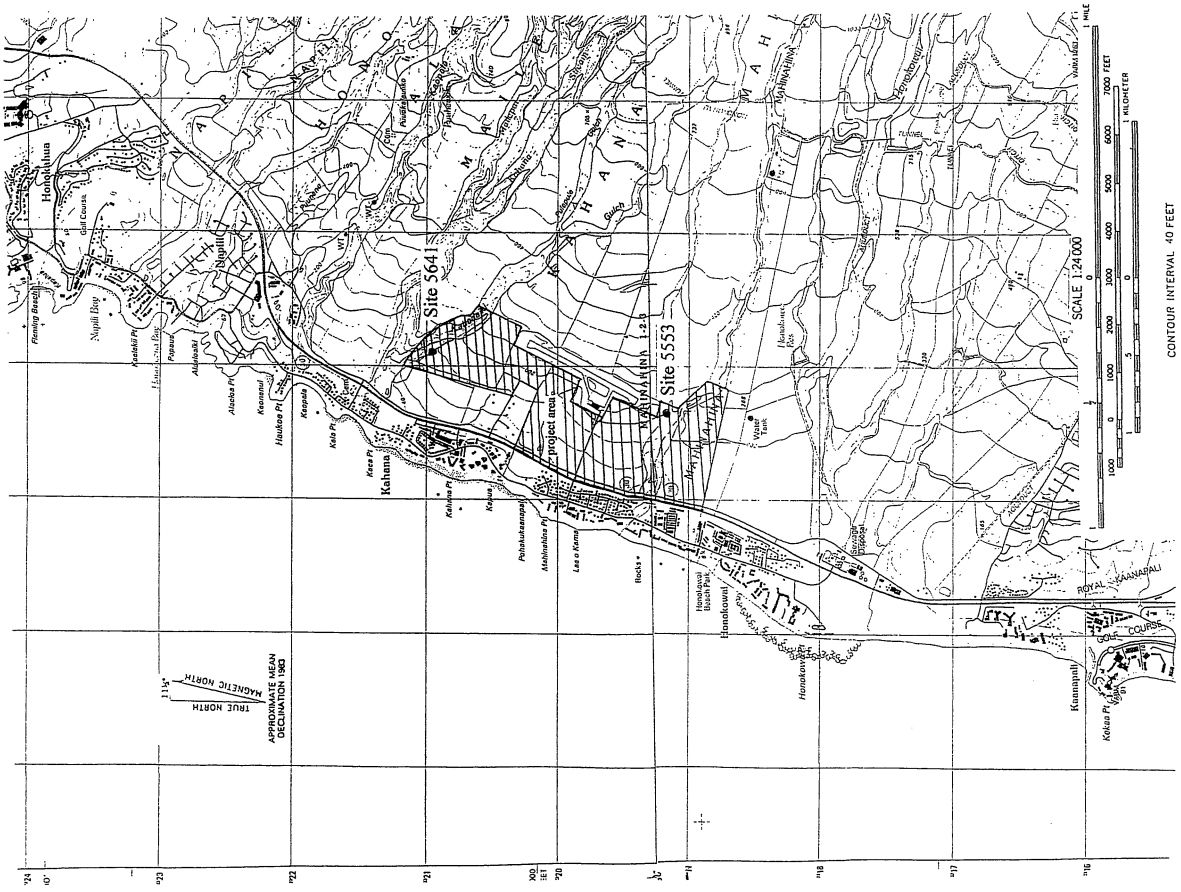

Figure 1. Location of Project Area on USGS Lahaina and Napili Quadrangles

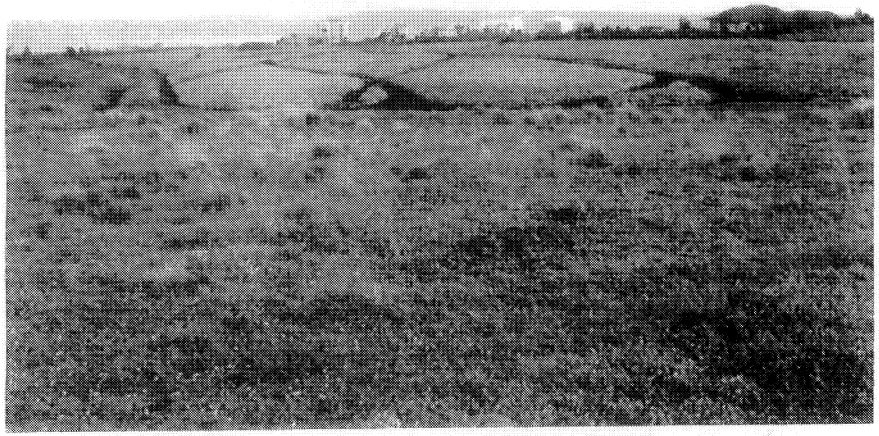

Figure 3. Overview of Project Area Showing Fallow Pineapple Fields, View to Northwest

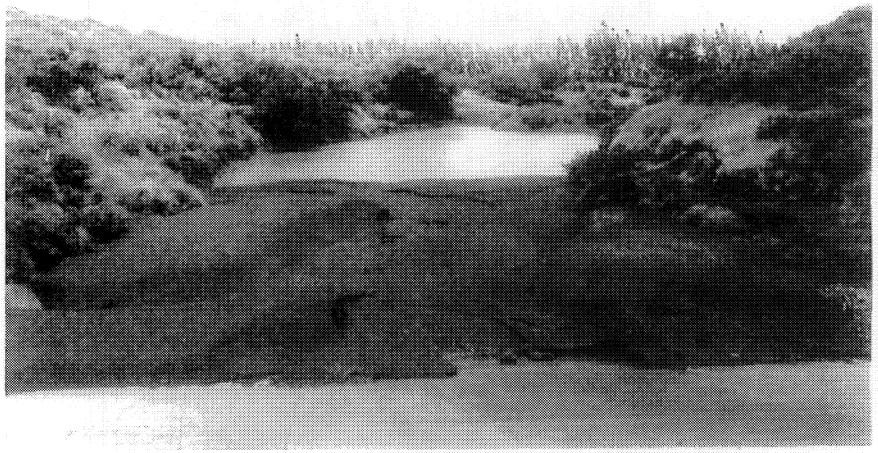

Figure 4. Desilting Basin in Mahinahina 1, 2, 3 Gulch, View to West

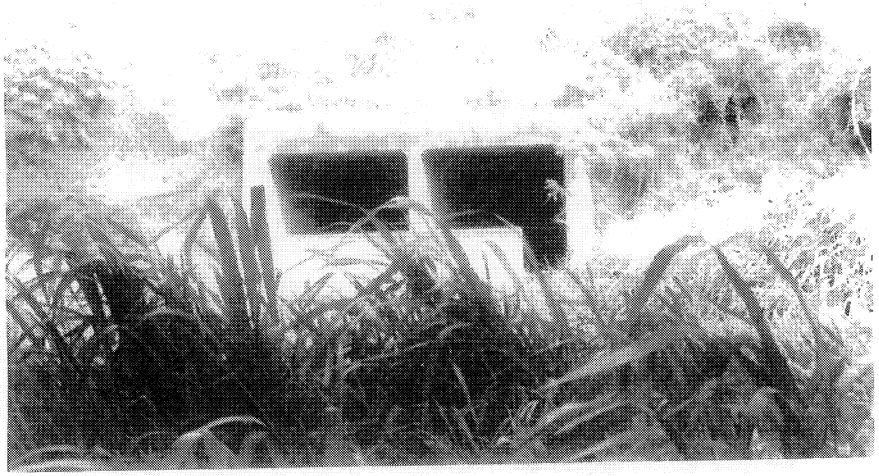

Figure 5. Culvert in Kahanaiki Gulch, View to East

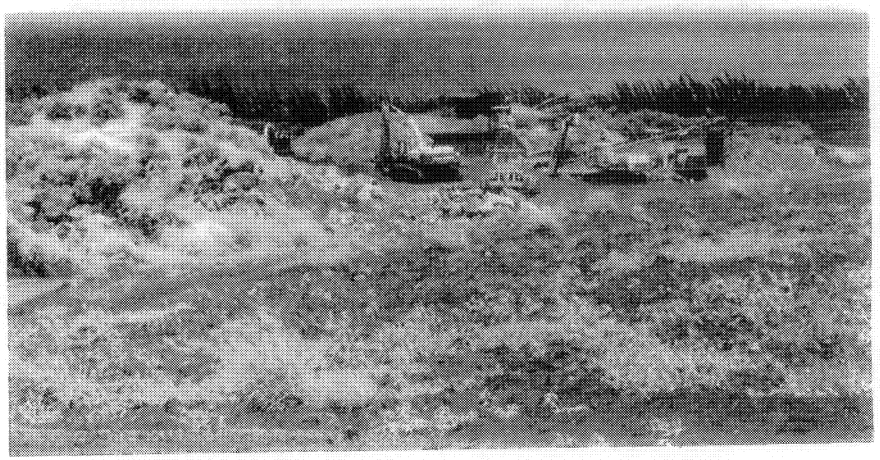

Figure 6. Rock Quarrying Activities Along Mahinahina 1, 2, 3 Gulch, View to Southwest

Soils in the project area include Lahaina silty clay, 3-7% slopes, and 7-15% slopes, and Rough Broken and Stony Land. Lahaina Series, consisting of well-drained soils on upland areas, developed in material weathered from basic igneous rock (Foote et al. 1972). Lahaina silty clay, 3-7% slopes and 7-15% slopes, occurs on smooth uplands. Cobblestones are common on the surface. These soils are used for sugarcane and pineapple. For Lahaina silty clay, 3-7% slopes, permeability is moderate, runoff is slow, and the erosion hazard is slight. For Lahaina silty clay, 7-15% slopes, runoff is medium, and erosion hazard is moderate.

Rough Broken and Stony Land consists of very steep stony gulches. Soil material is generally less than 20 inches deep over saprolite or bedrock. About 3-25% of the surface is covered with stones. Runoff is rapid, and geologic erosion is active. The land type is used for pasture, wildlife habitat, and watershed.

HISTORICAL BACKGROUND AND SETTLEMENT PATTERN

Due to the early foreign presence and the rapid transition from traditional modes of life to those dictated by Euroamerican influence, the history of the project area, its settlement patterns and the use of the land are inextricably intertwined and are presented here together in a chronological format.

The project area occupies portions of three long, narrow *ahupua`a:* Mahinahina 4, Mahinahina 1, 2, 3, and Kahana; which run from east to west from upland slopes to the sea. In combination, these three *ahupua`a* form a roughly pie-shaped area incorporating about 3,000 acres with roughly two miles of mostly rocky coastline, and extending to an apex about five miles inland on the upland slopes of the West Maui Range (see Fig. 1). The project area is located at the base of a crested, moderately sloping, alluvial fan about 500 meters inland from the coast; and ranges from about 100 feet above sea level on the coastal side to about 250 feet above sea level on the mountain side, and is bordered on the south by Mahinahina Gulch and on the north by Kahanaiki Gulch.

Political boundaries defining the districts in the project area have changed through time. Presently, all of Mahinahina *ahupua'a* is within the Lahaina District; and the *ahupua'a* of Kahana, immediately to the north, resides in the Ka'anapali District; with the line separating the two *ahupua'a* also representing the district boundary. Historically a map, produced by Samuel P. Kalama at the missionary school at Lahainaluna in 1838, shows Honokowai, immediately south

of Mahinahina, to be in the Ka'anapali District (Moffat and Fitzpatrick 1995:24-25). Documents describing land grants and awards of the 1850s, examined in following paragraphs, place Mahinahina and lands to the north in Ka'anapali District and Honokowai and lands to the south in Lahaina District.

With the exception of modern resort and urban development, evidence suggests that both traditional and historical settlement patterns, and land use in the project area and adjacent coastal zones have to a large degree been dictated by the relative paucity of naturally occurring fresh water sources. Traditional or historical residential structures or compounds, while present in adjacent coastal areas, were probably never located within the present project boundary. Modern post 1960s development not withstanding, three general historical phases of land use and peripheral settlement can be identified. A traditional phase of land use is indicated spanning at least the late prehistoric period and lasting until the early decades of the 19th Century with populations centered in more favorable, well-watered coastal areas immediately north and south of the project area (Kahananui Stream and Honokowai Stream); while the relatively arid coastline of Mahinahina and Kahana probably remained only sparsely populated (fewer than 10 residential compounds are indicated in the mid-1800s) with upland slopes adjacent to the coastal margin, including the present project area, being utilized primarily for the cultivation of sweet potatoes. A phase of commercial ranching spans the period from ca. 1840 to ca. 1912, during which the area was given over to cattle grazing. Agricultural pursuits were restricted and population dwindled to a handful of coastal residential compounds. During this period, from the 1860s, the lands immediately south of Mahinahina in Honokowai were utilized for the production of sugarcane.

Following the construction of aqueducts in the early 1900s for the purpose of delivering water to sugarcane lands of the Pioneer Mill Co., a phase of commercial agriculture begins in the project area around 1912 and has continued to a degree, to the present. Prior to recent urban development, populations during this period were centered in three plantation camps located to the north, south, and east of the project area.

Traditional Setting

Land use and settlement patterns along the Ka`anapali coast of West Maui appear to conform to those described for similar regions of the Hawaiian Islands, expanding to the degree allowed by land form and availability of fresh water. Oral traditions, historical accounts, and the remnant

archaeological record indicate that the area around Keka`a and the well-watered valleys to the north and south supported a large traditional population. Oral traditions, believed to date to the early 16th century, giving an account of the reign of Kaalaneo, also known traditionally as Kakaalaneo, provide the following description.

> ...Kekaa was the capital of Maui when Kaalaneo was reigning over West Maui. It is said that there were many people there. Many houses were constructed and the people cultivated a great deal of potatoes, bananas, sugarcane, and other things of a like nature (Fornander 1918-1919:540).

In the valleys north of Keka`a, including Honokowai and Kahana, extensive agricultural complexes have been described and substantial attendant traditional populations are also indicated.

North of Lahaina are five valleys watered by streams draining the western slopes of the West Maui watershed: Honokowai, Kahana, Honokahua, Honolua, and Honokohau. The first four all had extensive *lo`i* lands in their valley bottoms, where terraces rose tier on tier in symmetrical stone-faced *lo`i*. ...Honokohau in particular, which is watered by a large rivulet flowing from far back in the mountains, had the most extensive system of *lo`i* along this coast (Handy and Handy 1972:494).

Handy (1940) relates that in response to inquires concerning Honokowai, Kahana, Honokahua, and Honolua, D.T. Fleming provided the following description:

> In all three valleys which you mention - Honokowai, Honokohua and Honolua, as well as Kahana, there was considerable taro raised in olden times; as a matter of fact, a great deal was raised in Honokowai, where there must have been 30 or 40 acres under cultivation at one time. A detailed map of the *kuleanas* in that valley is available, and a fairly accurate estimate of the area could be made from that. Honokohua did not have much taro land, but Honolua and Kahana had several acres each (Handy 1940:106).

W. M. Walker (1931) reported that three *heiau* were located in the vicinity- (all had been destroyed): one at Kahana Point (Walker site 12), one at Malilepai Point (Walker site 13), and one near Kalaeokaea Point (Walker site 14)- indicating ceremonial significance and suggesting also a significant attendant traditional population (Sterling 1998:50-52).

During the 18th century a series of battles were undertaken, which were intended to unify the islands. In West Maui, a form of scorched earth strategy was implemented, which may have seriously disrupted the agricultural output and lifestyles of residents in the region of the project area. In the mid-eighteenth century, Alapa`i nui of Hawaii was waging war against the O`ahu Mo`i Peleioholani on Maui in the regions surrounding Keka`a and Lahaina. Irrigation systems, terraces and *`auwai* were destroyed, negating the productive capabilities of the *lo`i* systems in the valleys below (Kamakau 1992:74).

> ...What was this war like? It employed the unusual method in warfare of drying up the streams of Kaua`ula, Kahana, and Mahoma (which is the stream near Lahainaluna). The wet taro patches and the brooks were dried up so that there was no food for the forces of Ka-uhi or for the country people. Alapa`i's men kept close watch over the brooks of Olowalu, Ukumehame, Wailuku and Honokowai...At Honokawai an engagement took place between the two armies, and the forces of Alapa`i were slaughtered and fled to Keawawa (Kamakau 1992:74).

Four decades after Aalapa`i's destructive strategies were employed, the effect on the regions' productivity could still be seen. Portlock (1789) confirmed that in 1786 western Maui had been devastated by the wars of unification.

In the first half of the 19th Century, during the Kamehameha dynasty, the port of Lahaina became a prominent center for the whaling industry and the seat of royal government. It is probable that during this period some of the agricultural output of the Ka`anapali District was diverted to this enterprise and the provisioning of the whaling fleet.

Nearly a century and a half of intensive commercial ranching and agriculture have destroyed most of the evidence of traditional residential and agricultural land use in the project vicinity. The most salient surviving evidence of traditional occupation may be provided by the distribution of Land Commission Awards of the 1850s, which, to a degree, reflect conditions extant some decades earlier. In the 1840s, during the reign of Kamehameha III, a dramatic change in land ownership, known as the Mahele or division, occurred in which lands previously administered by the king passed into private ownership; and it is from this division of land parcels that present ownership is established. The traditional system was a form of stewardship without ownership, in which tribute in the form of goods or services, generated by the common citizenship occupying the land, was passed through a hierarchy of overseers, sub-chiefs, and district chiefs or chiefeses to the king. The Mahele separated lands in three major divisions: Crown Lands, Government Lands, and

Konohiki Lands. Land Commission Awards were given, generally without cost except for surveying fees, to native tenants who could establish, through witnesses, that they had lived on or gained sustenance from a particular parcel of land. Government Lands (grants) could be purchased fee simple. Awards and grants were confirmed by a Royal Patent. In Lahaina, as well as Hilo and Honolulu, commoners claiming house lots were required to pay commutation amounting to one quarter of the appraised value, to the government before obtaining a Royal Patent on their awards (Chinen 1961:16).

The present project area includes portions of two properties for which Royal Patents were granted in 1853 (Grant #1166) and 1850 (LCA #75) (see Fig. 1). Kamehameha III granted a Royal Patent to Baldwin, Pogue and Bishop in August of 1853. Royal Patent Grant No. 1166 conveyed, fee simple, all of the *ahupua`a* of Kahana and Mahinahina 1, 2 and 3, a total of 2,675 acres for one dollar per acre (HSA, Book of Grants #2:1166). The property was purchased with the following stipulations:

> Reserving the rights of native tenants, this land is granted in the following proportions, to D. Baldwin one undivided half and to J.Y. Pogue and S.E.Bishop each one undivided forth part (HSA, Book of Grants #2:1166).

In 1850, Charles Cocket succeeded in acquiring the rights to all of the *ahupua`a* of Mahinahina 4 (LCA #75). Cocket successfully claimed that all of Mahinahina 4 was given to him on or before 1838 by Hoapili Kane, then Governor of Maui, as remuneration for services rendered (HSA, Foreign Testimony VI: 87).

Within Grant No. 1166 and Land Commission Award No. 75, several native tenants successfully claimed and were awarded house lots along the coast of Mahinahina and Kahana, some of which were accompanied by awards of agricultural plots along Honokowai Stream and Kahananui Stream. However, none of these falls within the present project boundaries. In Kahana these awards include LCA 9065 and LCA 4268, located adjacent to the Government road just north of Kahananui Stream; LCA 10813 which included a house lot on the south side of Kahananui Stream and four additional agricultural parcels; LCA 3925G, a house lot located adjacent to the Government Road and seven plots of *kula* land. Agricultural plots awarded along Kahananui Stream include LCAs 9065:3, 4268:2 and 4268:4. In Mahinahina 4, three LCAs, 4239, 6539, and 4248, are house lots located adjacent to the Government Road. LCA 4239, awarded to Kaukau, included potato land, *lo`i,* and pastureland, located in Honkowai (HSA, Foreign Testimony V7:245).

A map depicting the distribution of Hawaiian populations in 1853 (Fig. 7), produced by the geographer John Wesley Coulter, indicates a sizable cluster of inhabitants along the coast near the boundary between the districts of Lahaina and Ka`anapali (Moffat and Fitzpatrick 1995:19). The distribution of Land Commission Awards in the area, however, suggests that the majority of these people lived in the *ahupua'a* of Honokowai, near the effluence of Honokowai Stream. A Hawaiian Government Survey map of Maui produced by W.D. Alexander in 1883 (Registered Map #1270), depicts only 10 residences along the coastline of Mahinahina and Kahana.

Ranching Era ca 1850- ca 1910

Evidence suggests that from the 1850s until about 1910, the lands of Mahinahina and Kahana were used exclusively for the grazing of livestock; while the lands beginning immediately to the south in Honokowai were planted in sugarcane. A Hawaii Government Survey Map of Maui, produced by W.D. Alexander, S.E. Bishop, and F.S. Dodge in 1885 (Registered Map # 1268A), is color coded for land use. Lands utilized for the growing of sugarcane (Pioneer Mill Co.), extending from Honokowai in the north to Polanui in the south, are clearly outlined in red. Ranching lands (Honolua Ranch), beginning at Mahinahina in the south and extending to Honokohau in the north, are clearly outlined in yellow. Evidence indicates that this separation of land use remained extant throughout the later half of the 19th Century and until around 1912, when the slopes of Mahinahina and Kahana were planted in pineapple. The history and land use of Mahinahina and Kahana during this period revolve around two major land holding entities, Honolua Ranch and the Pioneer Mill Co. By around 1860 Henry Baldwin, presumably the son of D. Baldwin, majority owner of Mahinahina and Kahana (Grant 1166), had consolidated holdings that came to be known as Honolua Ranch.

> ...The largest water sources on this side of the island were the Honokohau and Honolua streams, on land to the southwest owned by Henry P. Baldwin known as Honolua Ranch. Honolua Ranch operations included selling livestock, wood, coffee, watermelons, onions, corn, alfalfa, potatoes, and pineapple, as well as running a store. But it did not raise sugarcane. That was left to Pioneer Mill Company, with lands on the Lahaina side of Honolua (Wilcox 1996:126).

The success of Pioneer Mill depended on satisfactory water agreements with Honolua Ranch, which controlled the major water-producing watershed (Honolua Ranch changed its name to Baldwin Packers, then Maui Pineapple Company, and finally, in 1969 to Maui Land and Pineapple Company, commonly referred to as Maui Land &Pine, or ML&P). The two companies agreed that Honolua Ranch would build and own the Honokohau Ditch, while Pioneer Mill would finance it and use the water (Wilcox 1996:126).

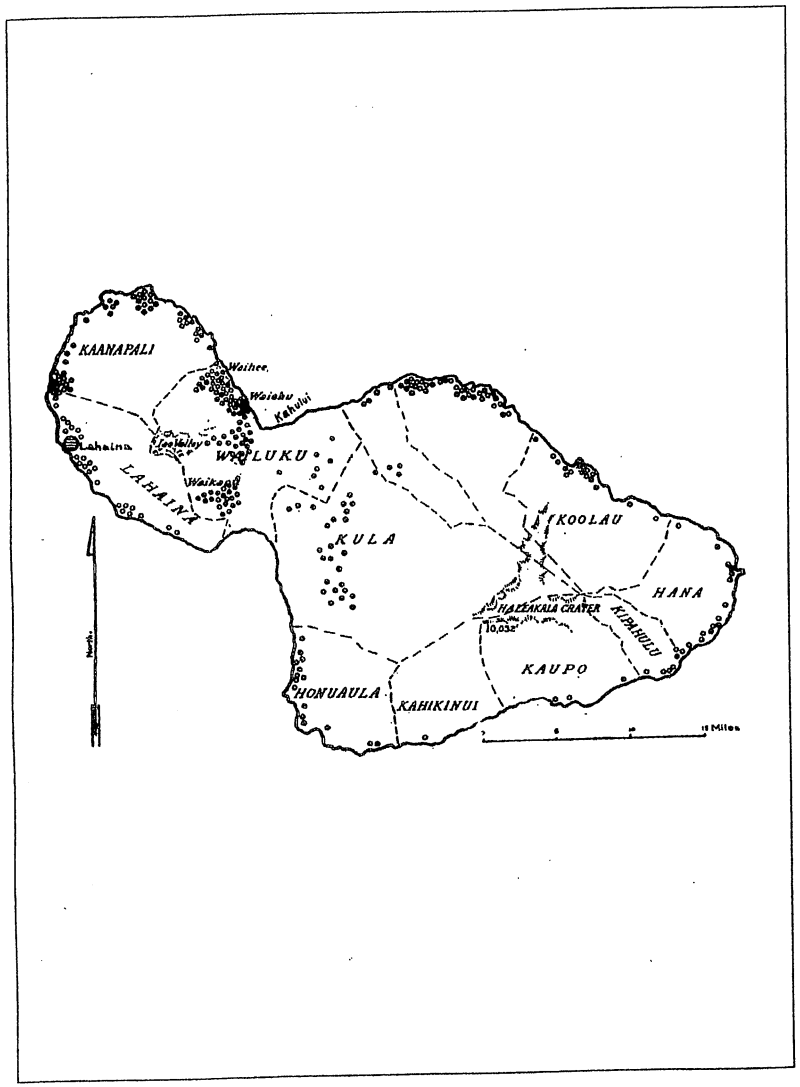

Figure 7. Distribution of Native Populations in 1853 (from Moffat and Fitzpatrick 1995:19)

The Honokohau Ditch, carrying water across Honolua Ranch lands to Pioneer Mill lands in the south, was begun in 1902 and completed in 1904. This original ditch was replaced by a new, nearly parallel ditch, which was begun in 1912 and completed in November of 1913 (Wilcox 1996:130).

The Pioneer Mill Co., and more specifically the Pioneer Mill Co. railroad, played a significant role in the historical and demographic development of the present project parcel and surrounding areas from the 1860s until relatively recent times (ca 1950s). The Pioneer Mill Co., engaged solely in the business of raising and processing sugarcane, was established in 1863 by Lahaina entrepreneurs James Campbell and Henry Turton in partnership with Benjamin Pitman, a Hilo merchant. In 1885 H. Hackfield & Company, predecessor of the present owner Amfac/JMB-Hawaii, Inc., bought control of the company (Dorrance 2000:63). The Pioneer Mill Co. built a narrow gauge railroad to transport cane from its west Maui fields to their mill in Lahaina. In 1883 construction of the railroad was completed, running from its terminus at Honokowai along the coast to the mill at Lahaina (Conde 1973:252-253). That the railroad terminated at Honokowai, together with Alexander, Bishop, and Dodge's 1885 map (registered map #1268A), which designates the land from Honokowai south for sugarcane and the lands of Mahinahina north for cattle grazing, strongly suggests that the boundary between Honolua Ranch land and that of the Pioneer Mill Co. was at or near the Mahinahina and Honokowai *ahupua'a* boundary.

Commercial Agricultural Era ca. 1910 To Present

In 1919 the railroad was extended from Honokowai to Kahana. However, this last five mile section of railroad was owned by Baldwin Packers (Honolua Ranch). Concerning the transport of Pioneer Mill Co. cane, Gilmore's *Hawaii Sugar Manual* ca. 1931 states:

> Transportation Equipment- All cane is delivered to the factory via the 30" gauge railroad, 36.3 miles in length; 30.95 miles owned by the Pioneer Mill Company and 5.35 miles owned by the Baldwin Packers Ltd. (in Conde 1973:254).

Evidence strongly indicates that around 1920 a lease was let to Pioneer Mill co. by Baldwin Packers (Honolua Ranch) allowing Pioneer Mill Co. to raise sugarcane in an area extending from Honokowai in the south to Mailepai in the north. Figure 8 provides a field map of Pioneer Mill Co. fields, produced by R.K. Tanaka in 1928. The lands from Honokowai to Mailepai are designated fields # 30, 31, 32, 33, and 34, differing from the alpha-numeric designation of fields from Honokowai south, indicating that these were the last fields to be added to the Pioneer Mill Co. area of cultivation and that they were added as a group (Conde 1973:255).

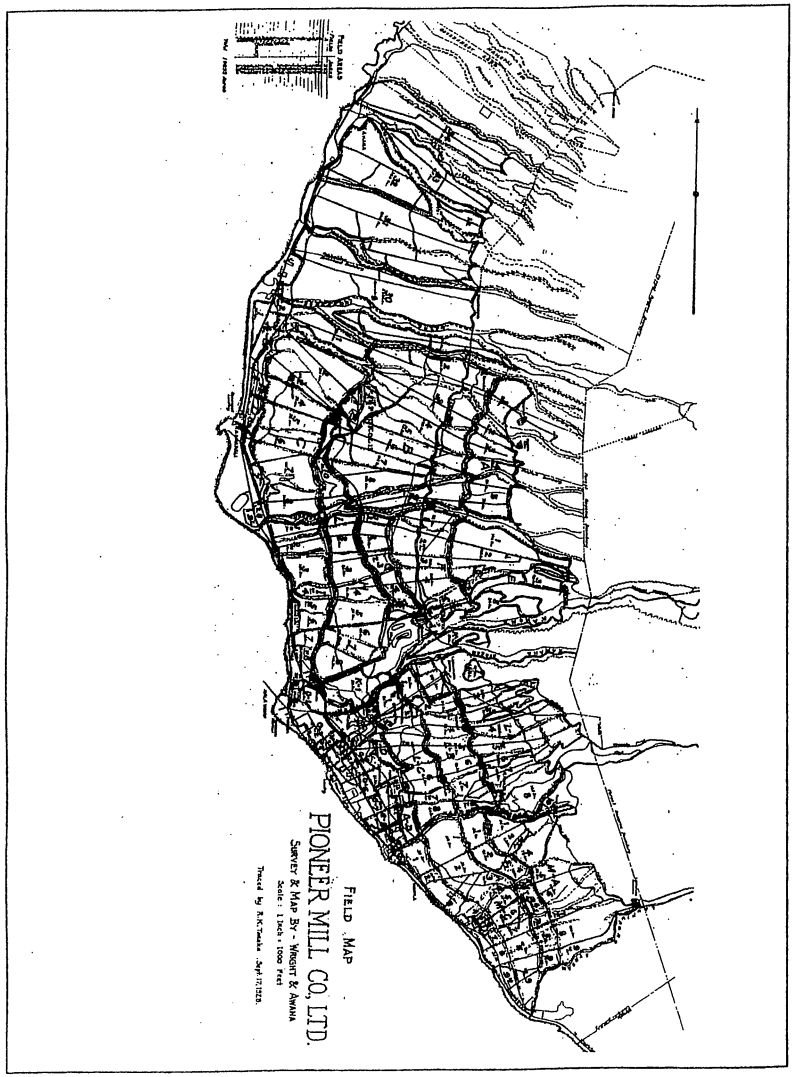

Figure 8. Pioneer Mill Co. Field Map 1928 by R.K. Tanaka (from Conte 1973:255).

Additional evidence indicates that the roughly 2,500-acre area comprising the lower slopes of Mahinahina and Kahana, including the present project area, may have been exempt from this lease and that this particular area has, from around 1912 onward, always been planted in pineapple and never in cane.

In 1912, David Fleming founded what was later to be renamed Baldwin Packers by planting pineapple on a small section of the Honolua Ranch in West Maui. Eventually, neatly planted fields covered 2,500 acres from Mahinahina on the south to Kahakuloa on the north. The fruit, processed at a cannery at Honokahua, departed for the outside world via Ka`anapali Landing. In 1922, the Territory of Hawaii erected Mala Wharf, motivating Baldwin Packers to build a cannery close by, in Lahaina. Pioneer Mill cane cars conveniently transported pineapples to this processing plant (Bartholomew 1994:70).

In interviews conducted by Xamanek Researches (Fredericksen et al. 1995), the Rodrigues family stated that lands northeast of the present project area, probably field #34 in Mailepai, (see Fig. 8) were leased by Honolua Ranch to the Pioneer Mill Co. for sugarcane production which continued into the 1970s (Dega 2001:10).

Populations in the area of the present project throughout most of the 20th Century were centered in three adjacent plantation camps. Figure 9 provides a portion of the 1925 USGS Lahaina Quadrangle map showing the locations of plantation camps and the relationship of the Pioneer Mill Co. railroad. Honokowai Camp probably dates to the 1880s. Mahinahina Camp, immediately east of the present project area, is situated just below the Honokohau Ditch. Mahinahina Camp probably dates to the construction of the ditch around 1904 and residents of this camp probably provided maintenance for the ditch and adjacent pineapple fields. Kahana Camp probably dates to the extension of the Pioneer Mill Co. railroad around 1919.

Summary

Evidence indicates that traditional land use in the project area generally conforms to that of similar regions of the Hawaiian Islands. Prior to the decline of native populations through the ravages of foreign disease in the early 19th Century, a large number of inhabitants occupied the regions around Keka`a. Near the project area populations were centered on the coast near Honokowai Stream and Kahananui Stream where intensive irrigation agriculture was practiced, along with the exploitation of marine resources. Dry land cultivation, primarily sweet potatoes, is

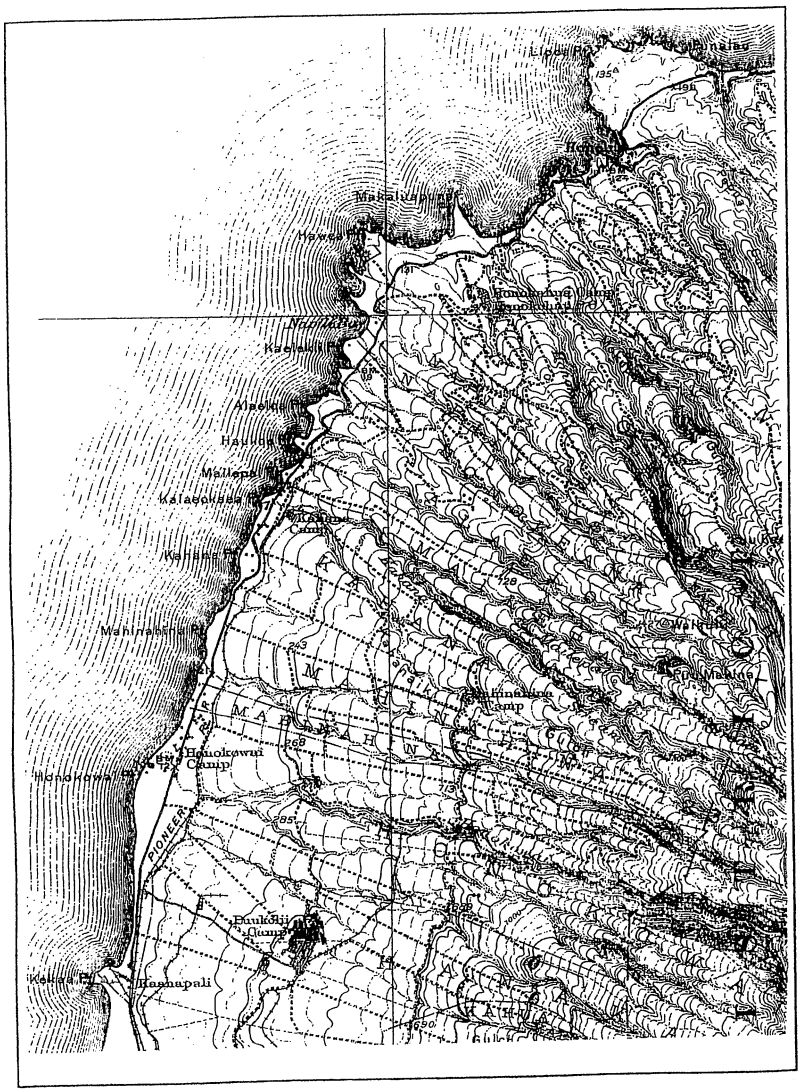

Figure 9. U.S.G.S. Lahaina Quadrangle 1925

indicated in areas adjacent to the coastal margin. The coastline of Mahinahina and Kahana, due to the lack of fresh water, was probably only sparsely populated, with residents engaged in fishing and possibly commuting to the streams north and south for the purpose of irrigation agriculture. Trenching in the project area revealed substantial basal soils which could easily have supported the cultivation of dry land crops such as sweet potatoes and gourds. From the mid-1800s onward, land use and the distribution of populations in the project area was primarily dictated by the management of the Honolua Ranch and the Pioneer Mill Company.

PREVIOUS ARCHAEOLOGY

No previous archaeological studies have been undertaken in the current project area; however, numerous studies have been completed in the vicinity. Figure 10 shows the location of these projects.

Winslow Walker (1931) conducted the first archaeological survey of West Maui. Sites 12 through 15 were recorded in Mahinahina and Kahana *ahupua'a*. Site 12, *Kahana Heiau* in Mahinahina, was located along the shore at Kahana Point and reported as being destroyed. Site 13, *Mailepai Heiau*, was located near the point of Mailepai and also reported as being destroyed. Site 14, *Hihiho Heiau*, was located along a county road near Kalaeokaea Point and reported as being destroyed. Site 15 is a *heiau* located on a bluff at the south side of a rocky cove between Alaeloa and Papaua points. It was described as:

> Small rectangular enclosure measuring 50 x 66 ft. Has rough stone walls about 3 ft. high with an opening at the west end. In the S.W. corner is what appears to be a platform of small stones and pebbles. Use unknown. Several people thought it was a cattle pen. (Sterling 1998:52)

Archaeological Research Center Hawaii, Inc. (Griffin et al. 1977) surveyed the Honoapi'ilani Highway corridor, which extended through Mahinahina, Honokowai, Kahana, Mailepai, and 'Alaeloa *ahupua'a*. Sites 217 and 218 were recorded in Mahinahina Gulch. Site 217 was a cultural deposit exposed in the north face of the main channel of Mahinahina Gulch. It measured approximately 5 m long, and consisted of midden and charcoal. Site 218 was a cultural deposit exposed in the north bank of the northern fork of Mahinahina Gulch. This deposit also consisted of midden and charcoal. Charcoal from these deposits were radiocarbon dated, and yielded an age range between 1150 to 1778 A.D.

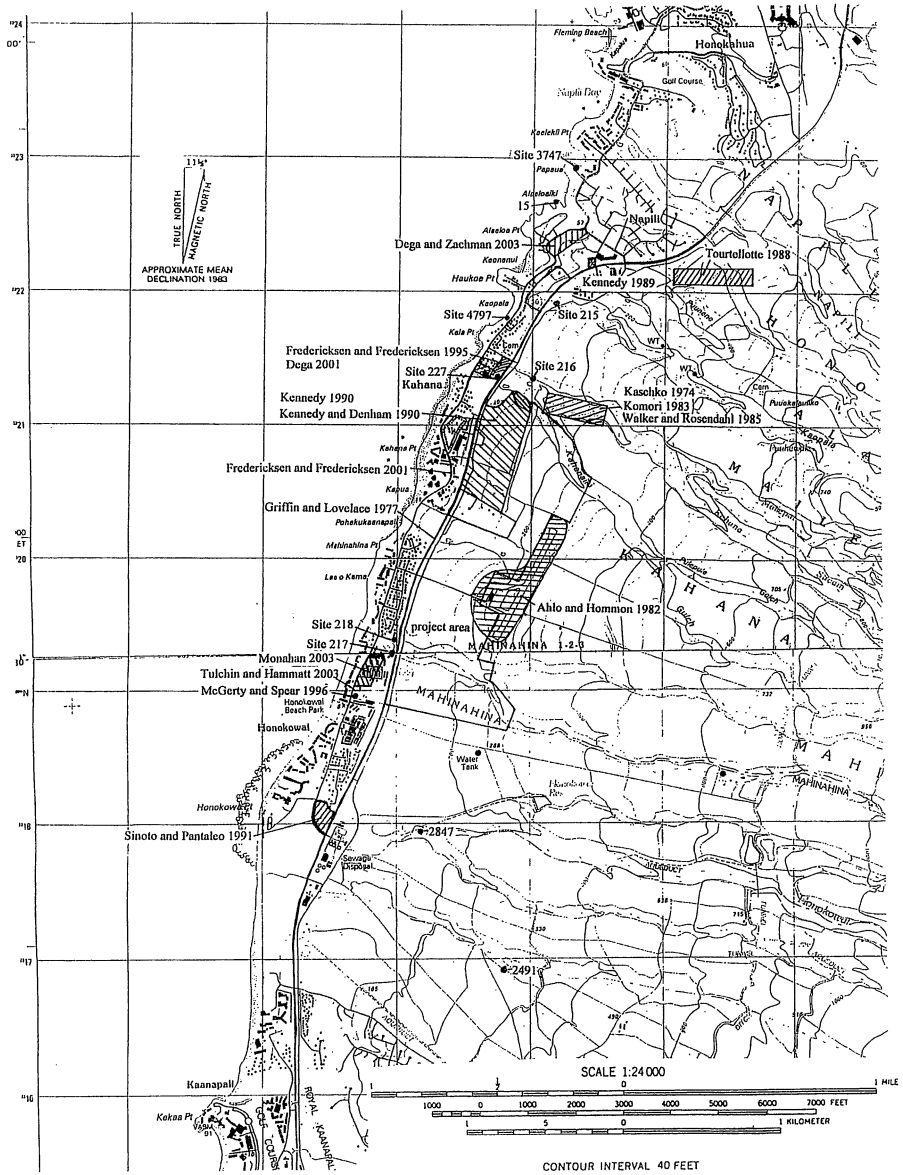

Figure 10. Previous Archaeological Work

Sites 216 and 227 were recorded in Kahana. Site 216 was a low wall along the boundary of Kahana and Mailepai *ahupua'a*, and Site 227 was a retaining wall along the bank of Kahananui Stream. Both sites were thought to be prehistoric, but of marginal archaeological value.

Scientific Management Inc. (Ahlo et al. 1982) conducted an archaeological reconnaissance survey at the proposed airstrip at Mahinahina, located adjacent to the east of the current project area. No sites were encountered during the survey.

Bishop Museum (Komori 1983) conducted an archaeological survey at Kahana Gulch for the Kahana desilting basin. A total of seven sites (1741-1747) were recorded. Site 1741 included an overhang shelter and terraces; Site 1742 included three terraces and a rectangular platform; Site 1743 included a wall segment, a rock alignment, and a rectangular enclosure; Site 1744 included wall segments and terraces; Site 1745 included an alluvial flat area partially enclosed by walls and terraces; Site 1746 included walls; and Site 1747 included an overhang shelter with an *'ulu maika* and associated terraces. Sites 1741 and 1747 were initially interpreted as prehistoric, Sites 1744 to 1746 were probably associated with historic ranching activities, and Sites 1742 and 1743 were initially interpreted as historic.

Paul H. Rosendahl Inc. (Walker et al. 1985) subsequently conducted archaeological testing of cultural remains in the Kahana desilting basin project area. Results of testing, together with ethnographic evidence, suggested that Sites 1742 through 1744 were remains from sweet potato cultivation during late pre-Contact to early historic periods.

Tourellotte (1988) conducted an archaeological inspection of the Rainbow Ranch in Honokea. No archaeological sites were identified during this study.

Archaeological Consultants of Hawaii, Inc. (Kennedy 1989) conducted an archaeological walk-through reconnaissance of the proposed Napili fire station. No surface cultural remains were encountered during the survey.

Archaeological Consultants of Hawaii, Inc. (Kennedy 1990) conducted an archaeological inventory survey on a 50-acre parcel, located adjacent to the west of the current project area. Site 2878, a two-tiered platform, and Site 2879, a petroglyph, were recorded. Denham et al. (1992) subsequently conducted testing at Site 2878. Results of testing revealed human skeletal remains at

215 cm below the surface of the upper tier. Upon discovery of the human remains, all work was halted and the test unit was backfilled. No further interpretation or age determination was conducted. Site 2879 was a petroglyph of a human figure measuring approximately 1 foot long. It was pecked into a 1.0 m diameter basalt boulder.

Jensen (1991) conducted an archaeological inventory survey for the Honoapi'ilani Highway Realignment Project. Sites 2847 and 2491 were recorded during this survey. Site 2847, located along a narrow ridge in Honokowai Stream, includes a possible reservoir and boundary walls associated with sugarcane activities. Site 2491, located approximately 20 m west of Puukolii Cemetery, includes two agricultural terraces.

The State Historic Preservation Division (Griffin 1994) responded to a call regarding human skeletal remains exposed at Papaua Place, Napili. The remains were assigned State Site 50-50-01-3747.

Aki Sinoto Consulting (Sinoto et al. 1991) conducted an archaeological inventory survey of TMK 4-4-01:2, 11, 12, in Honokowai, Lahaina. No surface structural remains or areas of exposed subsurface features were encountered. The lack of cultural remains is probably due to extensive previous disturbances in the area. No further archaeological work was recommended.

Xamanek Researches (Fredericksen et al. 1995) conducted an archaeological inventory survey for the Kahana Ridge Residential Subdivision in Kahana *ahupua'a*. Site 4069, two remnant bridge footings and stream erosion containment wall sections probably associated with the Pioneer Railroad system, was recorded.

Scientific Consultant Services, Inc. (McGerty et al. 1996) conducted an archaeological inventory survey of a 3.3-acre parcel in Mahinahina 4 *ahupua'a*. A total of seven sites (4215 through 4221) were recorded. Site 4215 was a single alignment of limestone and waterworn basalt cobbles and boulders; Site 4216 was a low wall of limestone and waterworn basalt cobbles and boulders; Site 4217 included a terrace, rock alignments, a rock mound, a low wall with a rock mound, and a well; Site 4218 was a historic cemetery; Site 4219 was a soil-surfaced platform and two rock-faced terraces; Site 4220 was a rock-faced terrace and three alignments, and Site 4221 was a small rock-faced, soil-surfaced terrace with associated alignments.

Xamanek Researches (Fredericksen et al. 1999) conducted an archaeological inventory survey of the lower Honoapi'ilani Road Improvements Corridor. Site 50-50-03-4797, a coastal habitation area associated with marine exploitation, was recorded during this survey. Additional archaeological inventory level work was conducted by Xamanek Researches (Fredericksen et al. 2001) at Site 50-50-03-4797. Site 4797 was deemed significant under Criteria A, C, and D, and further data recovery was recommended prior to construction activities.

Scientific Consultant Services, Inc. (Dega 2001) conducted an archaeological inventory survey of a 3-acre parcel along Honoapi'ilani Highway. Sites 50-50-01-4069, and 50-50-03-4997 and 5101 were recorded. Site 4069 included bridge footings and stream erosion prevention; Site 4997 was an earthen railway easement; and Site 5101 included soils indicating the presence of cultivation.

Cultural Surveys Hawaii, Inc. (Tulchin et al. 2003) conducted an archaeological assessment of a 0.2-acre parcel and waterline in Mahinahina 4 *ahupua'a*. No cultural remains were identified on the surface, and no cultural remains or deposits were encountered during subsurface testing.

Scientific Consultant Services, Inc. (Dega et al. 2003) conducted an archaeological inventory survey on a parcel in Napili, Aleole *ahupua'a*. No cultural remains were found on the surface during the survey, and no cultural remains or deposits were encountered during backhoe testing.

Scientific Consultant Services, Inc. (Monahan 2003) conducted an archaeological assessment on a 3.054-acre parcel in Mahinahina 4 *ahupua'a*. No cultural remains were identified on the surface, and no cultural remains or deposits were encountered during backhoe testing.

SITE EXPECTABILITY

Initial settlement on Maui Island is postulated to have occurred between A.D. 300-600 along the windward regions (Kirch 1985, Cordy and Athens 1988), including Wailuku on the windward isthmus between East and West Maui, and Hana on the windward coast of East Maui (Klieger 1995). These areas provided abundant rainfall and fertile soil to support intensive agriculture. Population expansion into the drier, leeward areas likely took place by A.D. 1000-1200 when population growth and polity expansion forced agricultural expansion into marginally productive areas (Kolb 1991).

Information obtained from previous archaeological and historical studies in the vicinity indicates that prehistoric and historic remains may be located along the coastal areas of Mahinahina 1, 2, 3, Mahinahina 4, and Kahana *ahupua'a*, and in Mahinahina 1, 2, 3, Mahinahina 4, and Kahanaiki gulches. However, due to previous disturbances from pineapple cultivation, no prehistoric surface remains are expected on the plateau area of the project area. Based on the results of previous archaeological work in the vicinity, sites expected in the gulches include features associated with prehistoric and historic agricultural and habitation. Types of prehistoric sites include terraces, walls, platforms, and cultural deposits. Historic remains expected in the gulches include features associated with ranching and agricultural activities including walls and terraces.

METHODS

Archaeological and historical background researches were conducted at the State Historic Preservation Division (SHPD) library at the Department of Land and Natural Resources (DLNR) in Kapolei, University of Hawaii Hamilton Library, and the Bureau of Conveyances and Land Management Branch of DLNR in Honolulu.

Since the majority of the project area is cultivated in pineapple, the survey concentrated on the slopes and bottomlands of Mahinahina 1, 2, 3, Mahinahina 4, and Kahanaiki gulches. The surface survey was conducted by walking systematic transects spaced at 5-10 meter intervals when feasible throughout the project area. However within existing pineapple fields, the intervals varied with the size of the clear rows between cultivation areas. Potential features were cleared of vegetation and inspected. Standard archaeological methods and procedures were followed to obtain sufficient information to determine significance of the remains.

Results of the surface survey revealed no significant surface cultural manifestations with the exception of the flume in Mahinahina 1, 2, 3 Gulch and isolated surface artifacts. In consultation with Dr. Kirkendall of SHPD-DLNR (Pers. Com., 2004), backhoe trenching is not required in large tracts of cultivated lands with no previously identified sites. However, due to the presence of isolated surface artifacts, together with significant sites in the vicinity and a LCA in the project area, limited subsurface testing was deemed appropriate to determine presence/absence of subsurface cultural remains and source of the surface artifacts, and examine the general nature of the stratigraphy.

The ensuing subsurface testing employed two backhoes with 12" and 24" buckets. Twenty backhoe trenches were placed in selected localities to allow representative sampling of the entire project area. The backhoe excavations were undertaken with the supervision of an archaeologist and terminated when sterile subsoil was reached. Roadways in between existing pineapple fields, major access and peripheral roads, and fallow pineapple fields were tested.

The location of each trench was plotted onto the project area map. A stratigraphic profile of a representative column on a trench sidewall was recorded for each trench. A color photographic record on APS format was obtained for each trench and soil colors were described in reference to Munsell color designations. Project area overviews were also photographically recorded.

All field notes, maps, and photographs generated in connection with the current project were curated and deposited at the Archaeological Services Hawaii office in Wailuku, Maui.

RESULTS OF FIELDWORK

Site 50-50-03-5553, a flume, and Site 50-50-03-5641, a historic bottle scatter, were recorded during the current investigation. Site 5553, a flume, is located in Mahinahina 1, 2, 3 Gulch near the southeastern boundary of the project area where Mahinahina Gulch forks to Mahinahina 1, 2, 3 Gulch to the north and Mahinahina 4 Gulch to the south (Fig. 11). The flume, constructed in 1898 by Pioneer Mill Company to transport water to the sugarcane fields, extended across and along the slope of the gulch. It was constructed of semicircular galvanized iron and wooden braces and trestles (Figs. 12 and 13). By 1917, the flume had deteriorated and was replaced with tunnels (Wilcox 1996). The flume is no longer in use.

Site 5641 is a historic surface bottle scatter located along the edge of a cut slope below the pineapple fields in the north central portion of the project area (Fig. 11). Sparse amounts of glass fragments from beer bottles and unidentified fragments were identified in the scatter. Two intact medicine bottles were collected from this scatter. Artifact #1 is a complete clear glass, fully automatic, medicine bottle with a cork closure. It measured 113.3 mm high, 43.7 mm wide at the base, 20.1 mm in diameter at the opening, and 27.8 mm thick at the base, and weighed 83.38 g. It was embossed with "44" and "U.S.A.", and a maker's mark of a triangle with the letters "WT" on the base. The Armstrong Cork Company, Glass Division, manufactured this bottle in 1944. Armstrong Cork Company purchased the Whitall-Tatum and Company in 1938 and continued manufacturing bottles between 1938 to 1969 using the Whitall-Tatum trademark.

Artifact #2 is a complete clear glass, fully automatic, medicine bottle with a thread screw closure. It measured 100 mm high, 32 mm wide at the base, 15.5 mm in diameter at the opening, and 24.5 mm thick at the base, and weighed 59.55 g. It was embossed with 30 c.c. on the base. This type of bottle was manufactured after 1930.

An isolated basalt hammerstone was found on the surface of a pineapple field access road in the southeastern portion of the project area. It measured 47 mm in diameter and 26.8 mm in thickness, and weighed 87.39 g. This discoidal-shaped hammerstone exhibited battering around the perimeter edges and polished surfaces. This artifact may have had a dual function as an *'ulu maika*.

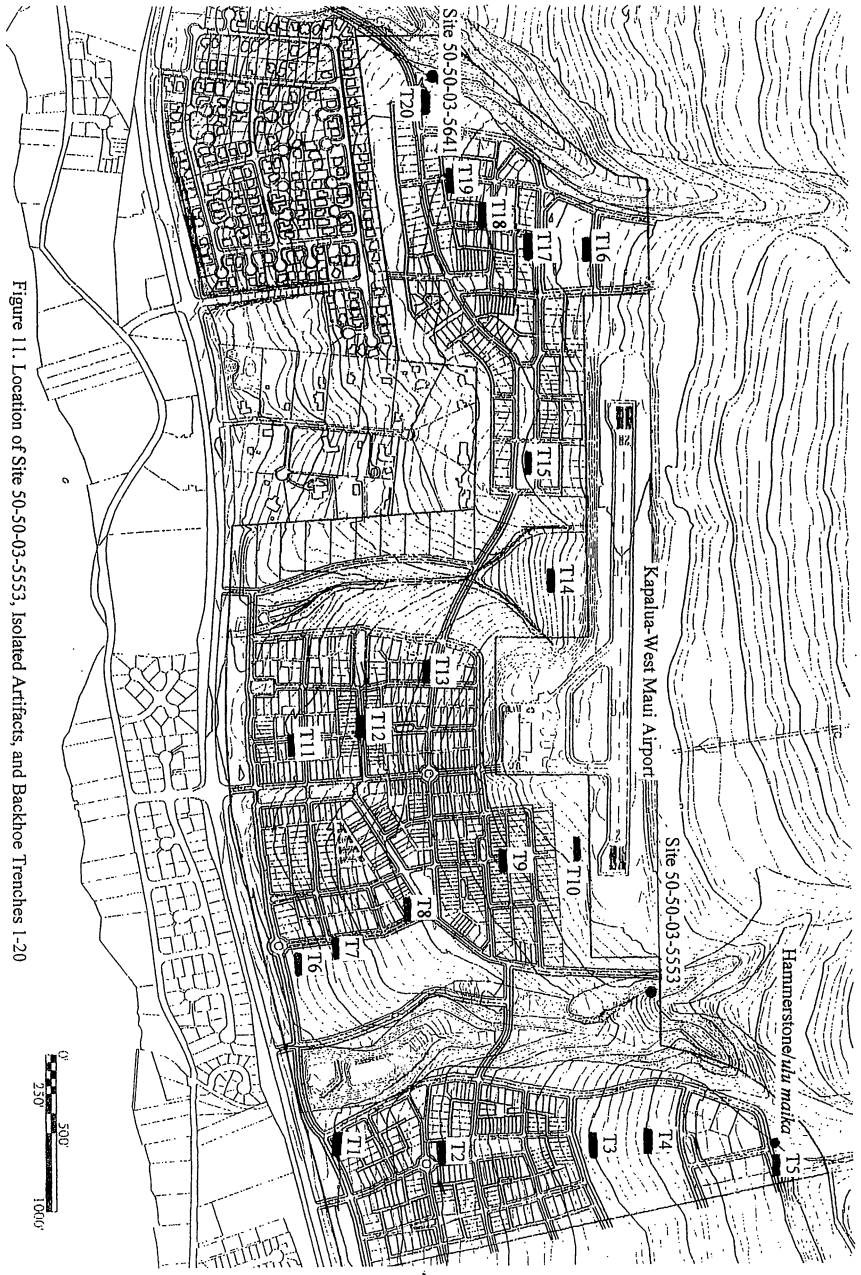

Figure 11. Location of Site 50-50-03-5553, Isolated Artifacts, and Backhoe Trenches 1-20

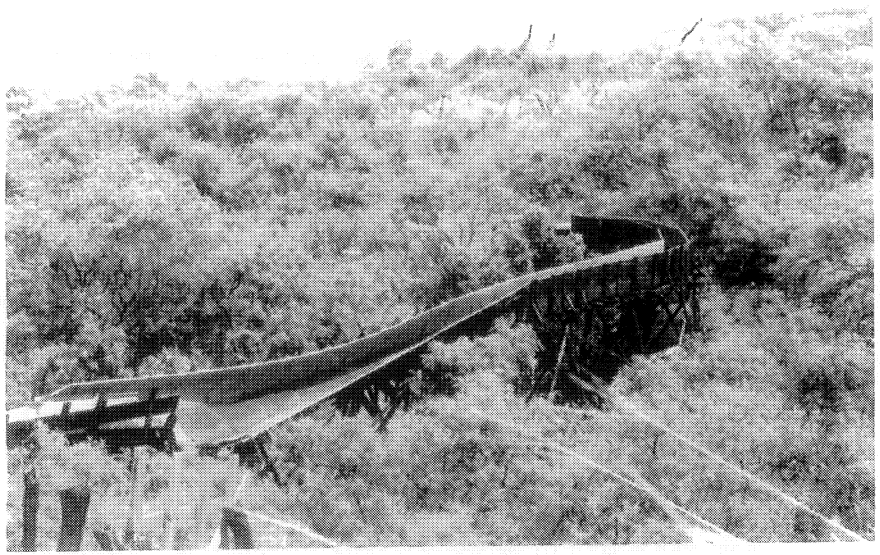

Figure 12. Overview of Site 50-50-03-5553, View to Northwest

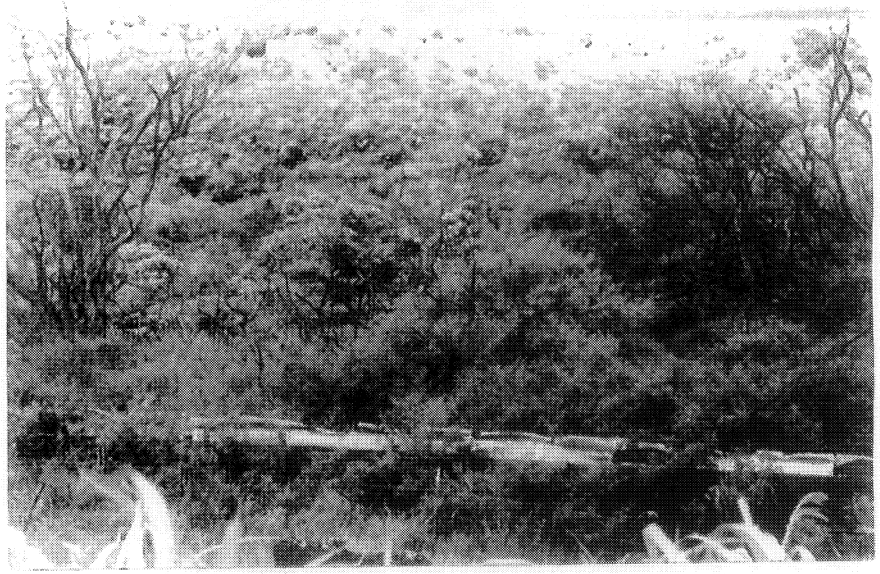

Figure 13. Site 5553, Flume, View to West

Due to extensive previous disturbances from pineapple cultivation, backhoe trenching was conducted to determine presence/absence and extent of subsurface cultural remains. A total of 20 backhoe trenches (T1 through T20) were excavated in selected areas throughout the parcel (see Fig. 11). Backhoe Trench 5 (T5) was excavated in the vicinity of the hammerstone, and Backhoe Trench 20 (T20) was excavated in the vicinity of the Site 5641 to determine the source of these artifacts. Table 1 presents dimensions and stratigraphic information for each trench. Representative stratigraphic columns are depicted on Figure 14. Figures 15-22 show photographic overviews of selected trenches.

Trenches 1-5 were placed south of Mahinahina 1, 2, 3 Gulch along roadways in between pineapple fields. T5 was located in the vicinity of the hammerstone. T6-10 were placed in a fallow pineapple field between Mahinahina 1, 2, 3 Gulch and Akalele Street, and T11-14 were placed in a fallow pineapple field between Akalele Street and existing pineapple fields. T15-20 were placed south of Kahanaiki Gulch along roadways in between pineapple fields. T20 was located near the historic surface artifact scatter.

No cultural remains or deposits were encountered in any of the trenches. Generally, two to three stratigraphic layers were observed in the trenches. Basalt outcrop was exposed in T20. The stratigraphic component in all trenches were:

Layer I (0.2-1.0 m thick) was the pineapple till zone consisting of dark reddish-brown (2.5YR 2.5/3, 2.5/4, 3/3, 3/4), fine grain, loose, moist, slightly sticky, non-plastic, non-cultural, silt with moderate amounts of roots/rootlets and no rocks, and black sheeting and irrigation lines from pineapple cultivation.

Layer II (0.22-1.1 m thick) was a dark red (2.5YR 3/4, 2.5/3, 2.5/4, 3/6), homogenous, fine grain, compact to slightly compact, moist, slightly-sticky, non-plastic to slightly plastic, non-cultural, silt to clayey silt.

Layer II (1.1 m thick) in T9 was fill material consisting of a dark red (2.5YR 3/4), fine grain, sticky, non-plastic, silt. A PVC pipe was exposed at 1.3 m below surface.

Layer III (0.1-1.1 m thick) was dark red (2.5YR 3/6) to dark reddish-brown (2.5YR 2.5/3, 2.5/4) to red (2.5YR 4/6), moist, compact, fine grain, sticky, plastic, non-cultural, silty clay with abundant rocks and saprolitic rock.

Layer IV (10+ cm thick) in T20 was basalt outcrop.

Table 1. Dimensions and Stratigraphic Information for T1 through T18

T	Length	Width	Depth	Orient.	Layer I	Layer II	Layer III	Layer IV	Cultural
1	6.0m	1.0m	1.6m	358/178	till zone	clayey silt			none
2	5.5m	1.0m	1.5m	360/180	till zone	clayey silt			none
3	5.0m	1.0m	1.7m	360/180	till zone	clayey silt			none
4	6.5m	1.0m	1.7m	360/180	till zone	clayey silt	silty clay		none
5	6.5m	1.0m	1.8m	360/180	till zone	clayey silt			none
6	5.5m	1.0m	1.8m	10/190	till zone	silt	rocky silt		none
7	5.5m	1.0m	1.9m	360/180	till zone	clayey silt	rocky silt		none
8	5.5m	1.0m	1.6m	360/180	till zone	clayey silt			none
9	5.5m	1.0m	1.9m	352/172	till zone	fill	silty clay		none
10	5.0m	1.0m	1.8m	360/180	till zone	clayey silt	silty clay		none
11	5.5m	1.0m	1.4m	355/175	till zone	clayey silt	silty clay		none
12	5.5m	1.0m	1.7m	195/15	till zone	clayey silt	silty clay		none
13	5.5m	1.0m	1.4m	200/20	till zone	clayey silt	silty clay		none
14	5.5m	1.0m	1.8m	200/20	till zone	clayey silt			none
15	6.0m	1.0m	2.0m	200/20	till zone	clayey silt	clay		none
16	5.5m	1.0m	2.0m	200/20	till zone	clayey silt	clay		none
17	5.5m	1.0m	1.9m	200/20	till zone	clayey silt	silty clay		none
18	5.5m	1.0m	1.9m	200/20	till zone	clayey silt	clay		none
19	5.5m	1.0m	1.9m	200/20	till zone	clayey silt	clay		none
20	6.5m	1.0m	1.2m	200/20	till zone	silt	silty clay	outcrop	none

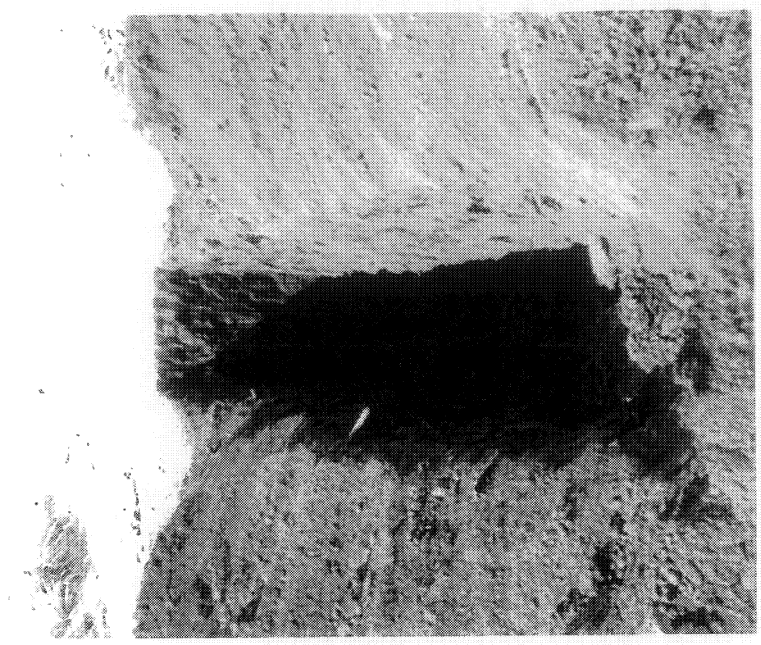

Figure 15. Overview of T1, View to North

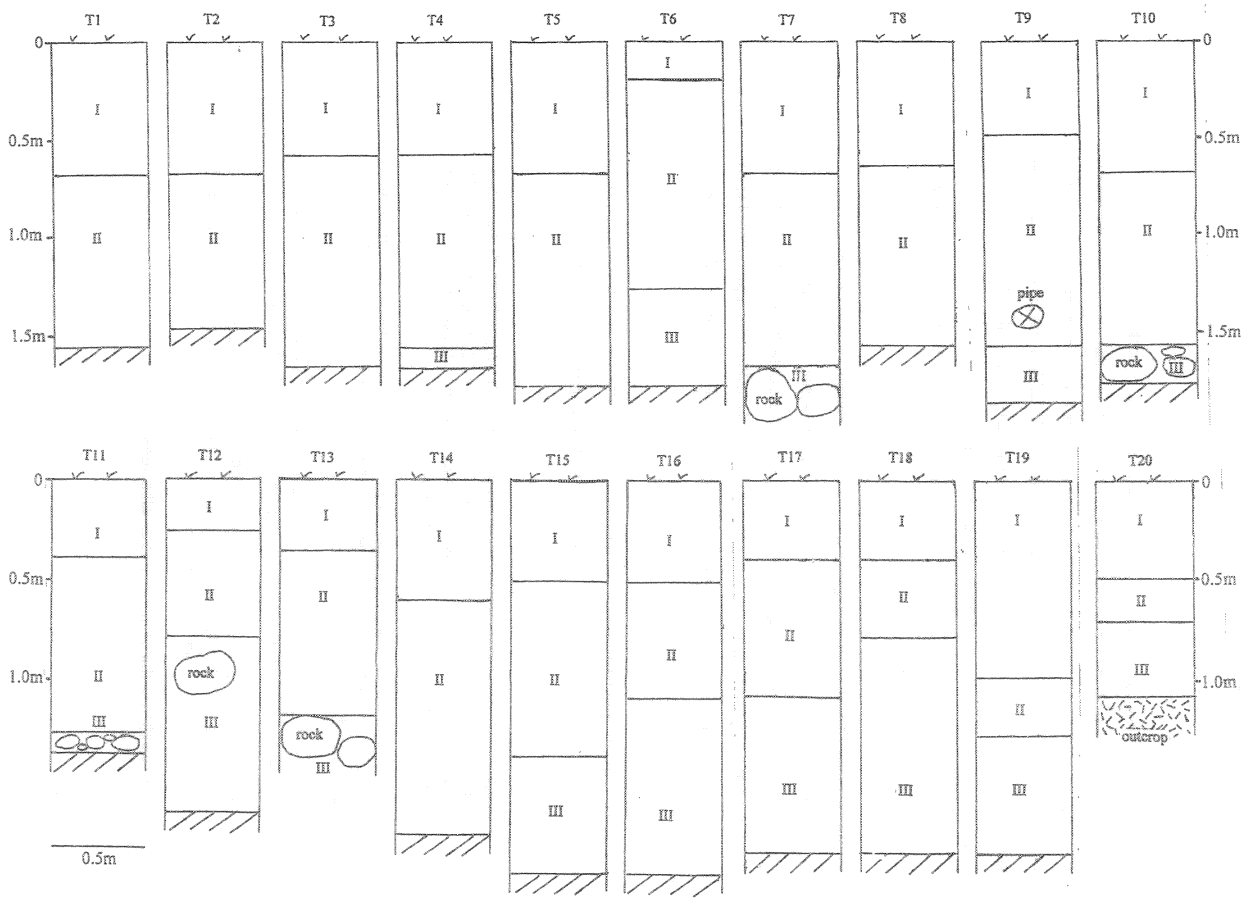

Figure 14. Representative Stratigraphic Columns

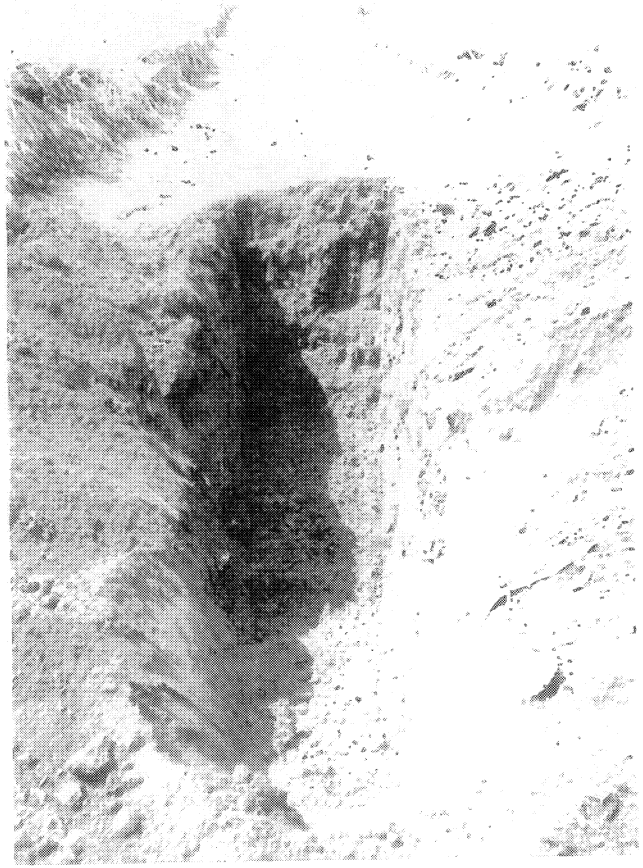

Figure 16. Overview of T2, View to North

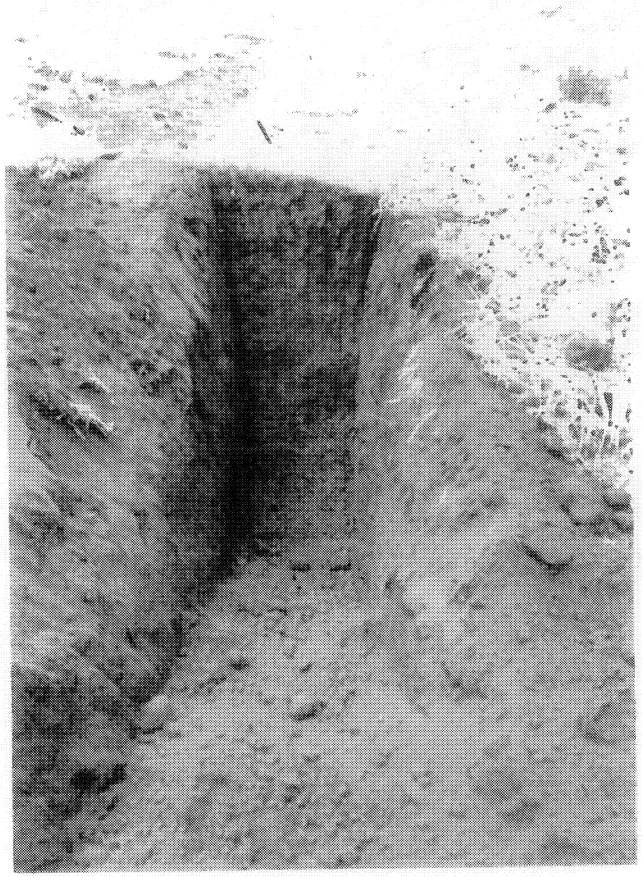

Figure 17. Overview of T8, View to North

Figure 18. Overview of T10, View to Southeast

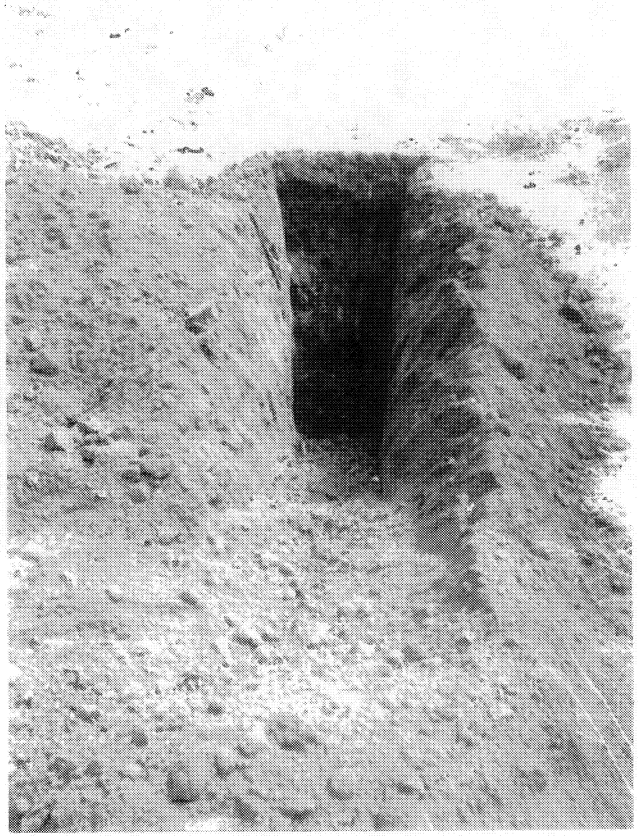

Figure 19. Overview of T11, View to South

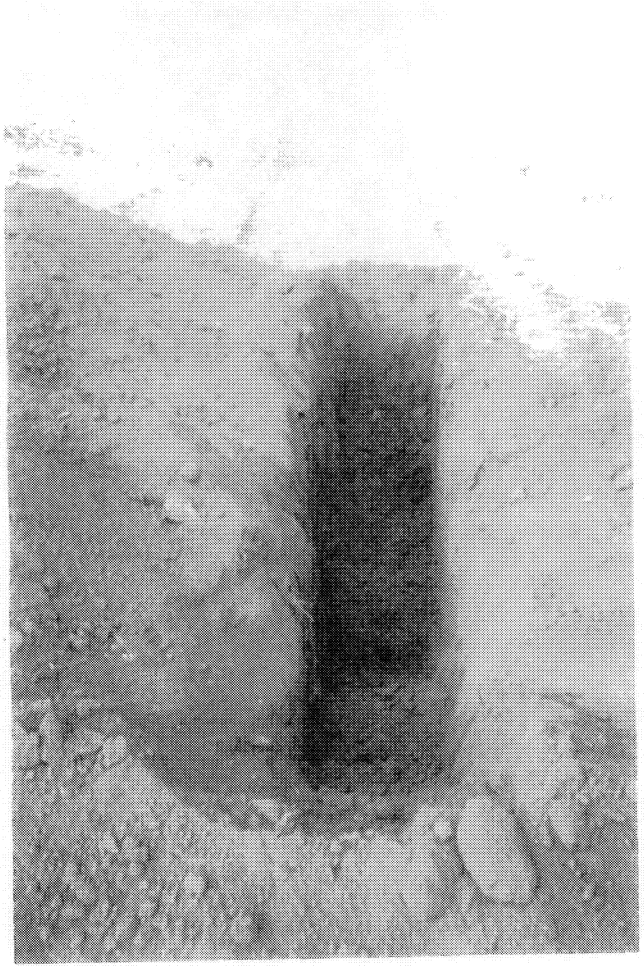

Figure 20. Overview of T13, View to South

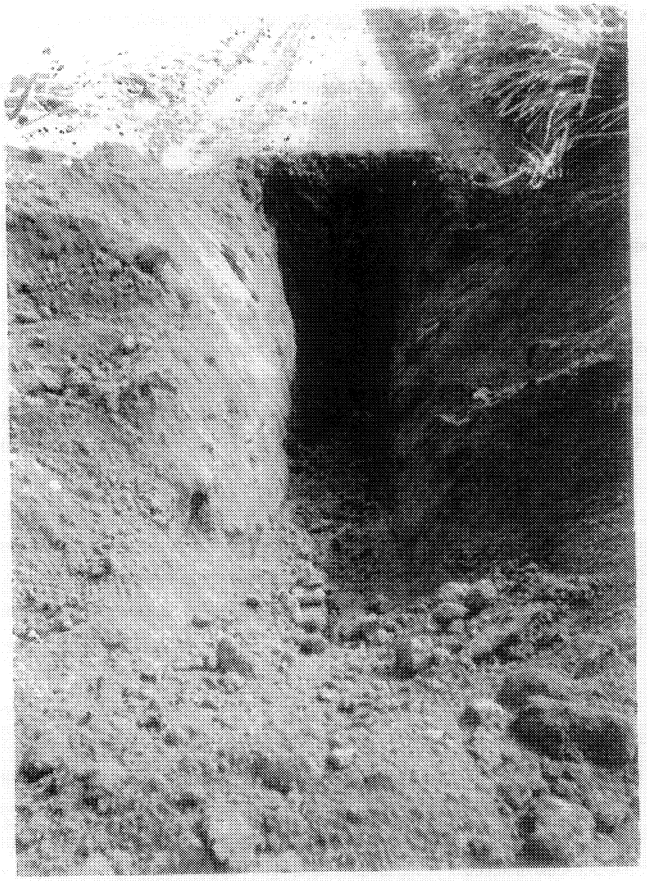

Figure 21. Overview of T17, View to Southwest

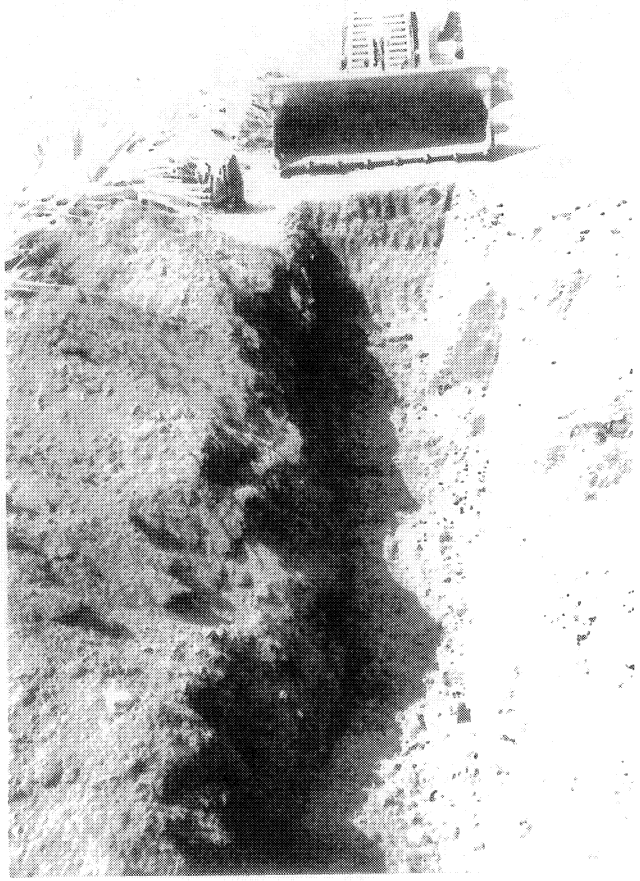

Figure 22. Overview of T20, View to Southwest

DISCUSSION

Remnants of a flume constructed in 1898 by the Pioneer Mill Company to transport water to its sugarcane fields extends through the southeastern portion of the project area in Mahinahina 1, 2, 3 Gulch. The flume, assigned State Site 50-50-03-5553, was constructed of semicircular galvanized iron and wooden braces and trestles. This flume was apparently abandoned in 1917 due to deterioration and replaced by tunnels. A portion of the flume extends across Mahinahina 1, 2, 3 Gulch at the fork of Mahinahina Gulch 1, 2, 3 and Mahinahina 4 Gulch.

Site 50-50-03-5641 was a historic bottle scatter located along a steep cut slope below existing pineapple fields in the north central portion of the project area. Included in the historic scatter were glass sherds from beer and unidentifiable bottles, and two intact clear glass medicine bottles that dated to the mid-1940s. The scatter may be associated with worker's camps in the area including Mahinahina Camp to the east.

No other significant surface or subsurface cultural remains were encountered during the inventory survey. Extensive modifications were observed along the *makai* (western) portions of Mahinahina 1, 2, 3 and Kahanaiki gulches, including construction of desilting basins, culverts, and access roads. The plateau area between gulches was extensively altered from pineapple cultivation and construction of the Kapalua-West Maui Airport.

The results of the limited subsurface investigations produced no evidence for sedentary cultural activities during the prehistoric or early historic periods in the subject project area. However, based the presence of LCA 75 and Grant 1166 in the project area, together with the historical background research and an isolated hammerstone/*ulu maika*, smaller permanent settlements occurred along the coastal portions of Mahinahina 1, 2, 3, Mahinahina 4, and Kahana *ahupua'a* to exploit marine resources and cultivate taro and sweet potato in the streams to the north and south.

From the 1850s until about 1910, Mahinahina and Kahana were used exclusively for the grazing of livestock, and around 1912 onward, Mahinahina and Kahana, including the current project area, was planted in pineapple, but never in sugarcane.

INITIAL SIGNIFICANT ASSESSMENTS

Initial significance has been assessed for Sites 50-50-03-5553 and 5641. This assessment is based on the criteria outlined in the Hawaii Register of Historic Places significance evaluation criteria. A site may be considered significant is it meets one or more of the following criteria:

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; represents the work of a master; or possesses high artistic value;

Criterion D: have yielded, or is likely to yield, information important for research on prehistory or history; and

Criterion E: have an important traditional cultural value to the native Hawaiian people or to another ethnic group of the state due to associations with traditional cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events, or oral accounts; these associations being important to the group's history and cultural identity.

Based on the above criteria, Sites 50-50-03-5553 and 5641 are considered significant under Criterion D. These sites have yielded or have the potential to yield more information significant to our understanding of the history of this region and Maui Island.

RECOMMENDATIONS

Site 5553 in Mahinahina 1, 2, 3 Gulch is situated outside the proposed development area and will not be impacted during the current project. Thus, no further work is recommended for this site. Sufficient information was obtained during the current investigation for Site 5641; thus, no further work is recommended.

Based on the negative results of the limited subsurface testing in the parcel, together with evidence for previous disturbances in the subject project area from pineapple cultivation, no further inventory-level archaeological work is recommended. However, due to the presence of isolated surface artifacts, archaeological monitoring is recommended during initial construction activities concentrating in the vicinity of the surface artifacts to determine source of the artifacts and document any subsurface cultural remains or deposits underlying the till zone. Prior to commencing any construction activities, a monitoring plan shall be prepared for approval by SHPD.

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Cultural Impact Study/Assessment

Cultural Impact Study/Assessment
Pulelehua Community
Ahupua`a of Māhinahina, District of Kā`anapali
Maui Island, Hawai`i

Prepared for
Maui Land & Pineapple
PBR-Hawaii

By Maria E. Ka`imipono Orr
June 14, 2004
Revised-January 26, 2005

Cover Page: A Variety of Pineapple Specimen in Field 2.
All photos unless otherwise cited are by the author.

EXECUTIVE SUMMARY

At the request of PBR-Hawaii and Maui Land & Pineapple, a Cultural Impact Study and Assessment of the proposed Pulelehua Community project lands in the Ahupua`a of Māhinahina, Maui was undertaken as part of a larger Environmental Assessment. The purpose of a cultural impact study and assessment is to gather information about traditional cultural practices and pre-historic and historic cultural resources that may be affected by the implementation of an undertaking.

This study is in compliance with Act 50 SLH 2000 (HB 2895 H.D.1) as it amends the State of Hawaii Environmental Impact Statement law [Chapter 343-2, HRS], and the Office of Environmental Quality Control [OEQC] *Guidelines for Assessing Cultural Impacts* (1997). To this end, the targeted "audience" of this report are the people who will be reviewing it. Therefore, it was written with this in mind and includes an overview of the history of the *ahupua`a* or traditional land division of Māhinahina. The literature review included *mo`olelo* or Hawaiian stories and legends of the vicinity, ethnohistoric works from the 19th and early 20th centuries and other pertinent archival material.

The *level of effort* of this study included three interviews and a broad, but limited literature review. The project lands were previously sugar cane fields leased by Pioneer Mill Company for at least fifty years, then in the 1980s the lease reverted back to Maui Land & Pineapple and pineapple was cultivated on the projects lands.

It is evident from the history that at one time the lands of Māhinahina-Kahana, which include the Pulelehua lands, were part of an ancient Hawaiian life system. Previous archaeological surveys of the region revealed evidence of possible burials, hearths, temporary habitation shelters (Kahana Gulch) and cultural deposits (Māhinahina Gulch), indicating a multi-use of the lands in the vicinity of the proposed Pulelehua Community. A cultural practice of these lands at one time was growing sweet potato, a staple for the ancient people of this area, as well as cultivating bananas, olonā, *hala* and possibly dry land taro. There are no traces of these plants now in the project area. Traditionally, Hawaiians also gathered the flora that grew in the gulches, valleys and mountains, such as *kukui, `ohia*, fungus, and *lama,* for medicines, food, crafts, and lumber. These resources are still sought after today. However, other than a few *kukui* trees in the gulches, none of these flora exist today on Pulelehua Community project lands; therefore there will be no adverse impact to any cultural resources on Pulelehua lands. An exception to this could be if there are any changes within the gulches.

The pig (*Sus scrofa*) was brought to Hawaii by the early Polynesians. Some of them managed to escape from pens and later inter-mixed with domestic species who also managed to escape. These are known today as feral pigs. The cultural practice of hunting these animals continues today, both for sustenance and for sport. While there are no cultural practices on Pulelehua Community lands to be adversely impacted, there is potential that access to gathering and hunting practices in the upper gulches/mountains may be compromised during the construction phase of the proposed Pulelehua Community project. However, concerns regarding access to upper gulches/mountain resources would be mitigated upon completion of the project and the subsequent dedication of the project streets as public thoroughfares.

According to the consultants interviewed, the most significant cultural practices in the vicinity of the Pulelehua Community project area are the fishing and sea-gathering (i.e., *limu*/seaweed, *`opihi, wana*/sea urchins, and sea cucumber) practices that continue today. While these resources are outside of the project lands, the consultants feel that runoff from any construction activity that

occurs on project lands could adversely affect or impact these resources. The consultants also feel that there is reasonable potential for these fishing practices being adversely impacted by uncontrolled private use of pesticides and fertilizers, in the way of groundwater seepage, if a large number of people with yards move into the Pulelehua Community.

ACKNOWLEDGEMENTS

This project could not have been completed without the *mana`o* of my ethnographic consultants: Mr. Wesley Nohara; Mr. Kenneth Sadang; Mr. James "Bobo" Nalei`eha; and "Pohaku" who wished to remain anonymous.

A special *mahalo* to Ms. Leilani Pulmano, Development Coordinator for Kapalua Land Company; Mr. Wesley Nohara, Plantation Manager of Maui Pineapple Company, Ltd.; and Ms. Barbie Dofa, Administrative Planner, Honolua Plantation Office, Maui Land and Pineapple; for all their *kokua*--from opening the gate so I could access the project lands for a field visit, to providing archival material/information about Honolua Ranch/Plantation, Kapalua Land Company and Maui Land and Pineapple.

Additional *mahalo* also goes out to SHPD archaeologists Sara Collins and Muffet Jourdane for their continuing help with accessing archaeological reports at the SHPD Library.

And last but certainly not least, a big *MAHALO* to Mr. Tom Schnell of PBR-Hawaii for giving me the opportunity to do this project and to Ms. Gwen Hiraga for recommending me for this study.

MAHALO !

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INTRODUCTION

This Pulelelua Cultural Impact Study/Assessment [CIS] was undertaken as part of an Environmental Assessment conducted by PBR Hawai`i for Maui Land & Pineapple and Kapalua Land Development. The purpose of this cultural impact study and assessment was to gather information about traditional cultural practices, ethnic cultural practices and pre-historic and historic cultural remains that may be affected by the implementation of the development project. This study is in compliance with Act 50 SLH 2000 (HB 2895 H.D.1) [Appendix A] as it amends the State of Hawai`i Environmental Impact Statement law [Chapter 343-2, HRS] to include:

> *effects on the cultural practices of the community and State. Also amends the definition of "significant effect" to include adverse effects on cultural practices.*

This report is organized into five parts. Part I describes the project area in terms of location, in the context of *ahupua`a*, district and island, as well as a generalized description of the natural environment [geology, fauna, flora]. Part II explains the methods and constraints of this study. Part III summarizes the review of the traditional and historical literature in the context of the general history of Hawai`i, the island of Maui, the district of Kā`anapali , and the local history of Māhinahina-Kahana as it pertains to cultural resources, land, water and marine resources and use in the project area and vicinity. Part IV presents the analysis of the ethnographic survey. Part V summarizes the findings of this cultural impact study and assessment.

SCOPE OF WORK

The scope-of-work (SOW) [Appendix B] was based on the recommendations in the Office of Environmental Quality Control (OEQC) *Guidelines for Assessing Cultural Impacts* (1997) [Appendix C] and focuses on three cultural resource areas (traditional, historical and archaeological), conducted on two levels: archival research (literature review) and ethnographic survey (oral histories). Since another independent contractor has conducted an archaeological inventory survey for this project, this study will only include brief overviews of previous archaeological studies and Land Commission Awards (LCA).

The research for this cultural impact study and assessment was conducted within the broader context of the *ahupua`a* (traditional land division) and *moku* (traditional district), as well as the history of the agricultural industry in the area. The *level of effort* of this study included three interviews and a broad, but limited literature review. The project lands were previously sugar cane fields leased by Pioneer Mill Company for a few decades; then in the 1980s the lease reverted back to Maui Land & Pineapple and pineapple was cultivated on the projects lands.

Research on traditional resources entailed a review of the literature of Hawaiian *mo`olelo* or stories/legends, late nineteenth and early twentieth century ethnographic works and interviews with knowledgeable consultants who met the following consultant criteria:

- Had/has Ties to Project Area
- Known Hawaiian Cultural Resource Person
- Referred by PBR Hawaii and/or Kapalua Land Development Staff
- Referred By Other Cultural Resource People

Historic research focused on Land Commission Awards (LCA), the sugar and pineapple plantation industries, and missionary influences. Literature from the following institutions were reviewed: University of Hawai`i-Manoa Hamilton Library-Hawaiian and Microfiche Collections; Bishop Museum Archives; maps from State Survey Division of Board of Land & Natural Resources (BLNR); Bailey House Museum/Maui Historical Society Archives: Waihona `Aina Corp.; information from State Bureau of Conveyances; Internet searches and personal library.

Archaeological research entailed a limited review of reports located in the DLNR State Historic Preservation Division (SHPD) library; and the Bishop Museum Archives.

PART I: PROJECT AREA

Project Location

The Pulelehua Community project area (TMK: 2-4-3-01:31 por) [Figures 1 & 2] is located on the island of Maui, in the *moku* or traditional district of Kā`anapali, in the *ahupua`a* of Māhinahina and the borders of Kahana Iki [Figure 3]. The survey area covers 300 acres of agricultural lands, between Honoapiilani Highway (*makai*) and Kapalua-West Maui Airport (*mauka*); Kahana Iki Gulch (north) and borders a portion of DHHL lands just south of Māhinahina Gulch.

Environment.

The project area consists of lands previously associated with the sugar [Figure 4] and pineapple industries [Figure 5]. The majority of the project lands are currently fallow pineapple fields. There is a small section south of Māhinahina Gulch that is currently planted with pineapple and appears to be a rotund crop.

Photo 2. Fallow pineapple fields of project lands.

Photo 3. Rotund fields south section of project lands.

Geology.

The island of Maui is 77 kilometers long and 42 kilometers wide, 1,902 square kilometers, with 240 kilometers of shoreline. The highest points on the island is Mt. Haleakalā (Red Hill) at 3,055 meters or 10,023 feet above sea level and Pu`u Kukui of Mauna Kahalawai or the West Maui mountains at 1,764 meters or 5,788 feet above sea level (Macdonald et al 1983:3; Juvik & Juvik 1998:308). The island of Maui consists of two major volcanoes; the older Mauna Kahalawai (1.3 million years) and younger Haleakalā (.75 million years) or East Maui. The volcanic rocks of West Maui are comprised of the oldest Wailuku Volcanic Series, the Honolua Volcanic Series, and the Lahaina Volcanic Series.

The most important soils for traditional agriculture were the alluvial deposits along permanent streams that extended from the mountains to the coast (Earle 1978:25). Coastal plains were particularly critical for subsistence farming; it was a zone where large irrigation and dry-land farm systems were located (Kolb 1990:33).

> Of secondary importance were the areas of coral sandy soils found along the coast. These were the well drained soils excellent for several crops and were the preferred areas for habitation sites and many *heiau* temples. Larger *heiau* were placed along the physiographic divisions between the coast and the upland mountain slopes, usually along ridges and on hilltops (Kolb 1990:33).

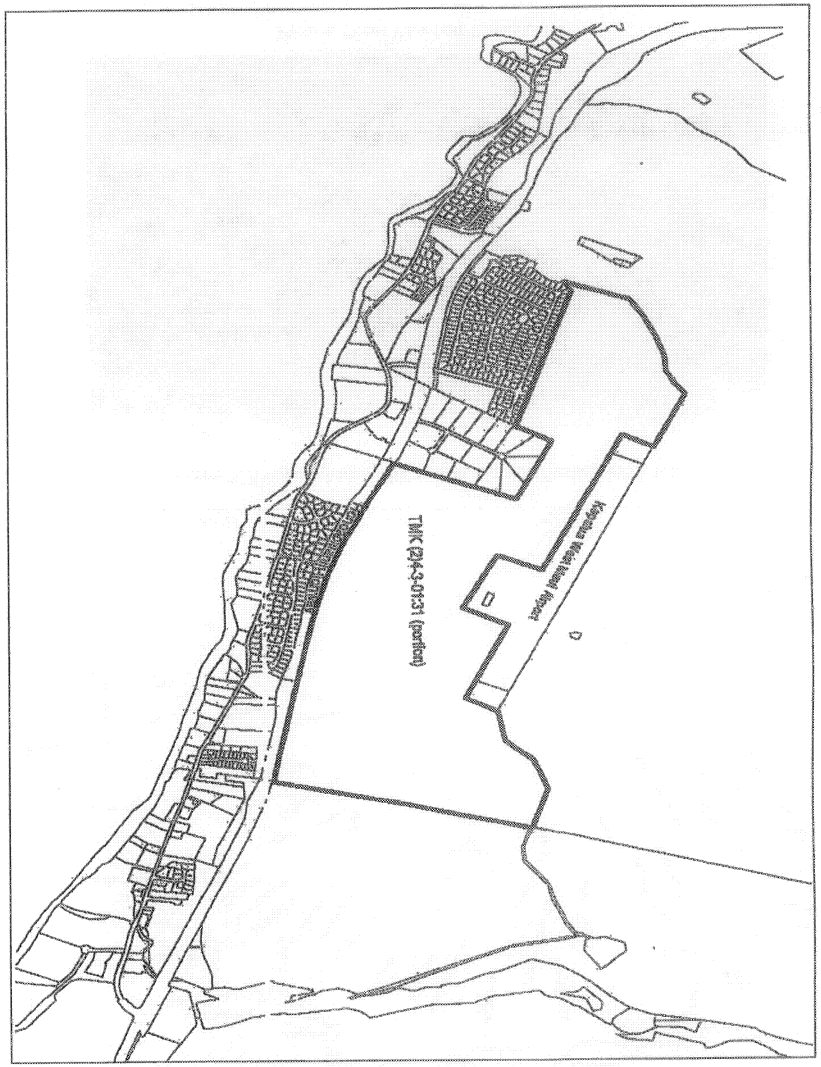


Figure 1. TMK Map of Project Area (PBR-Hawaii 2004)

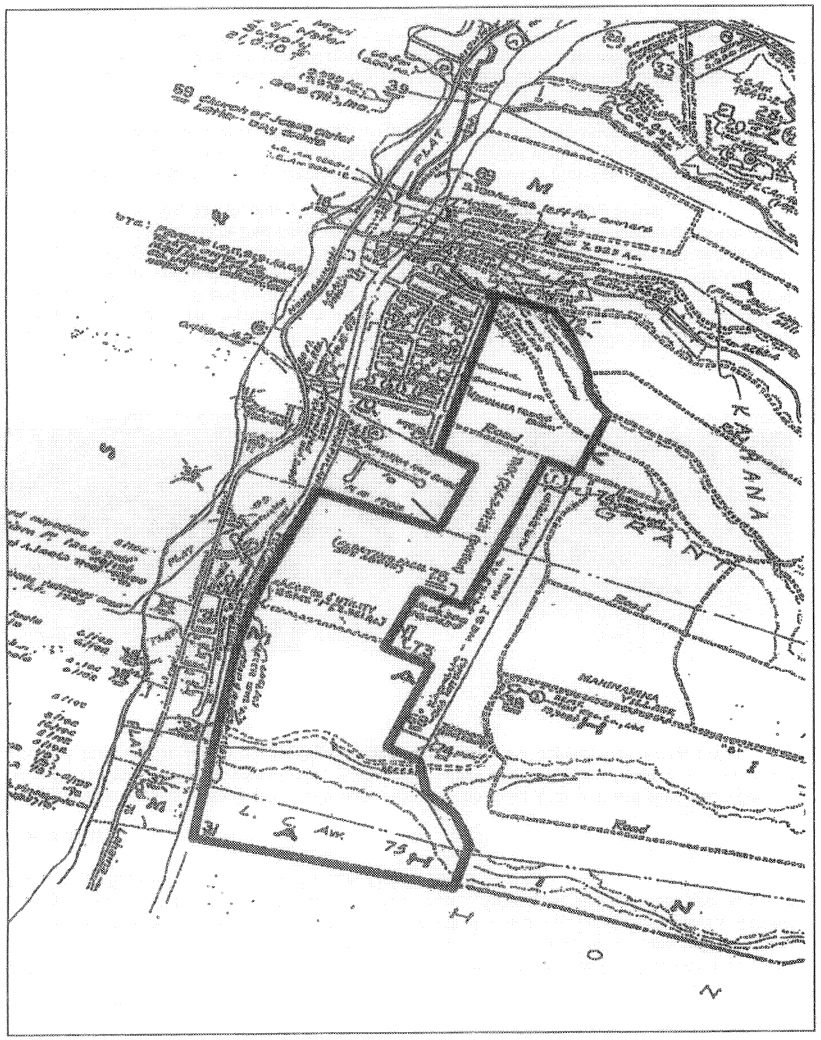


Figure 2. Detailed TMK Map of Project Lands (PBR-Hawaii 2004)

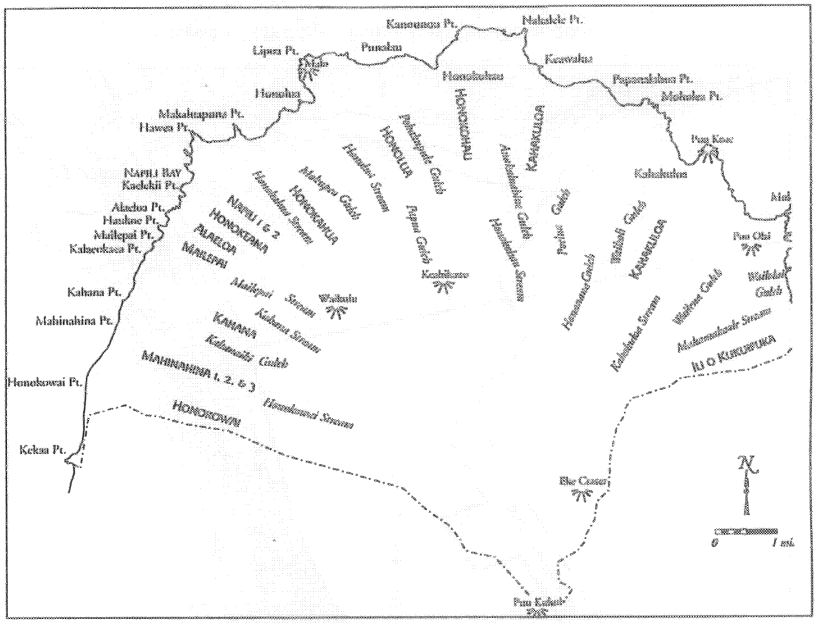


Figure 3. Ahupua`a Map of Kā`anapali District (Sterling 1998:46).

Photo 4. Ocean View from Project Lands.

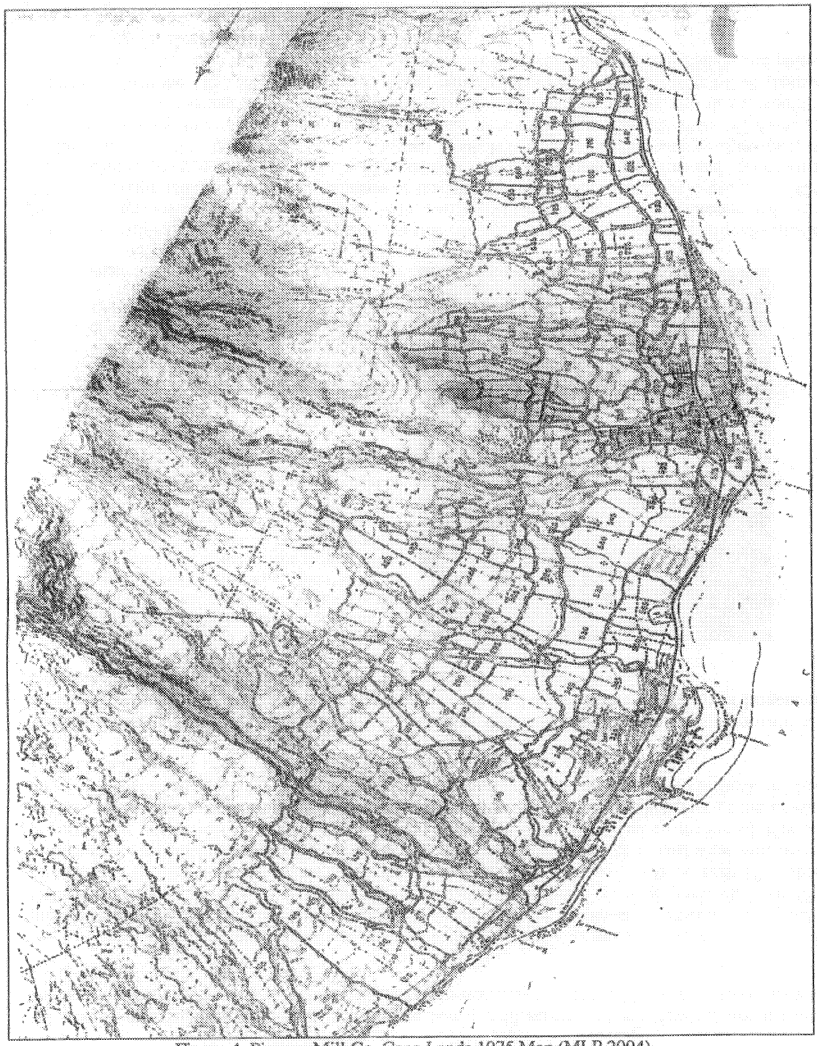


Figure 4. Pioneer Mill Co. Cane Lands 1975 Map (MLP 2004)

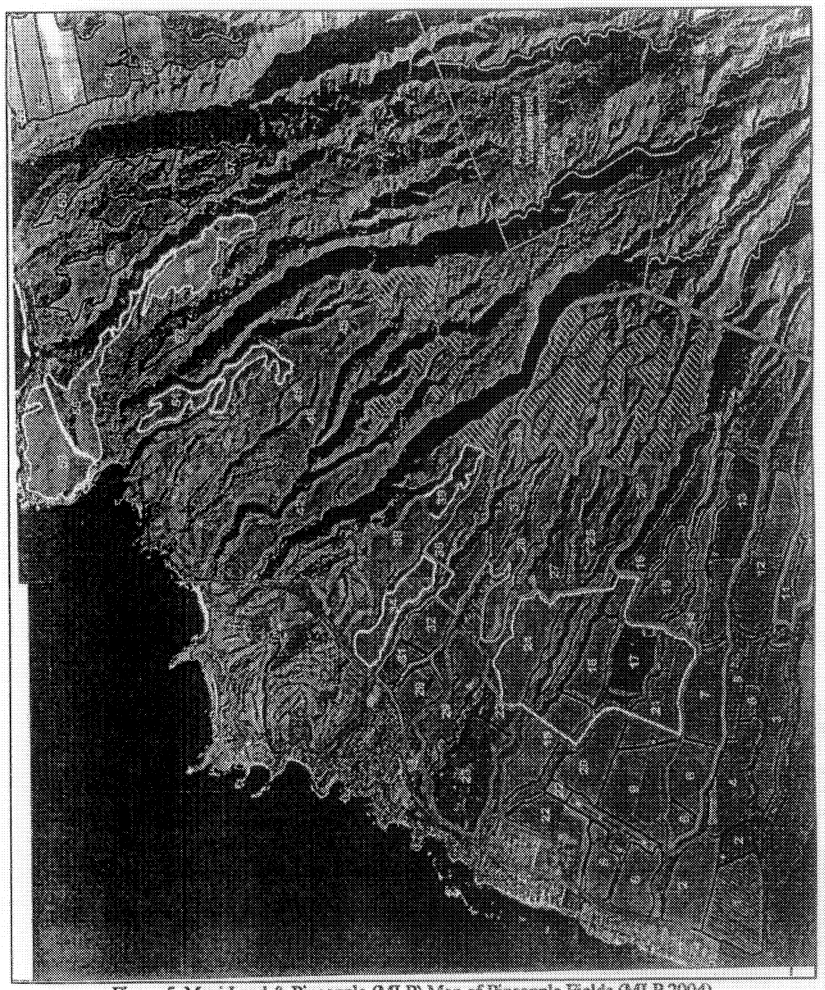


Figure 5. Maui Land & Pineapple (MLP) Map of Pineapple Fields (MLP 2004)

Flora.

The native ecosystem of the project area [before human settlement] was once lowland dry and mesic forest, woodland, and shrubland. Today it is has been completely transformed by human activity (Juvik & Juvik 1998:122, 123)

Parts of these lands may have once been covered with open, dry woodlands of native trees; now alien grasses, *kiawe* (*Prosopis pallida*) and other exotic species are the dominant vegetation in the gulches. Other vegetation in the coastal area would have been *naupaka-kahakai* (*Scaevola sericea*), *`ilima* (*Sida fallax*), *naio* (*Myoporum sandwicense*), *`akulikuli* (*Sesuvium portulacastrum*), *`aki`aki* grass (*Sporobolus virginicus*) or sedge (*Fimbristylis cymosa*), and *hala* (Pandanus spp). Much of coastal areas were densely populated in ancient Hawaiian times and coastal vegetation was "important in traditional Hawaiian culture, providing medicines, *lei* materials, and other resources." The dry environment of the *Lowland Dry Shrubland and Grassland* was "ideal for burial and storage caves" (Pratt and Gon In Juvik and Juvik 1998:128-129).

The following excerpts E.S. C. Handy (1940) indicates that taro and sweet potatoes were cultivated during pre-contact era of West Maui. He says that although he did not explore the valleys of Honokōwai, Honokohau, Honolua and Kahana, D. T. Fleming responded to his inquiries:

> In all three valleys which you mention—Honokowai, Honokohau and Honolua, as well as Kahana, there was considerable taro raised in olden times; as a matter of fact, a great deal was raised in Honokowai, where there must have been 30 or 40 acres under cultivation at one time. A detailed map of the *kuleanas* in that valley is available, and a fairly accurate estimate of the area could be made from that (Handy 1940:106 in Sterling 1998:46).
>
> I am told that in ancient times there were numerous settlements on western Maui, between Honokohau and Kahaulоa.... Settlements in these localities imply planting of sweet potatoes on the lower *kula* (Handy 1940:160 in Sterling 1998:47).

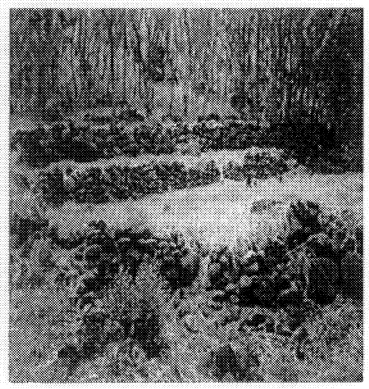


Photo 5. Taro terraces in Honokōwai Valley

Māhinahina flora. In the Land Commission Awards (LCA), which was part of the land re-distribution process established by the *Great Mahele* of 1848, native (NT) and foreign (FT) testimonies and native (NR) and foreign (NR) registers give glimpses of the lands of Māhinahina 4 (LCA #75 and LCA #4248 *Mahele Claims* www.Waihona.com). LCA #75 claimant Cocket states that Paki came and "cut down all the lau[h]ala" (Cocket 1846: FR 87-89v1; Caswell 1848: NT 323v3). In other native testimonies, the lands were referred to as "*kula*" lands and wood houses were built on it (Caswell 1846: NT 67-69v2). Later testimony stated that in 1843 the "land had become a grazing pasture" but also that it would be cultivated (Hoonoho 1852: NT 111-112v10). Other parts of Māhinahina 1 & 2 (LCA #4248 claimant Kekalohe) were also *kula* lands and house lot (Kaukau for Kekalohe 1848: FT 279-280v7) and pasture lands (Kaukau for Kekalohe 1848: NT 144-145v5).

Hala-kahiki or Pineapple. Much of Māhinahina is or has been cultivated in *hala-kahiki* or pineapple in the last twenty years. Pineapple was first discovered on the island of Guadeloupe by Columbus in 1493. It

was supposedly first recorded in Hawai`i by Don Francisco de Paula y Marin, a Spanish horticulturist and advisor to Kamehameha I. The most dominant commercial pineapple variety in Hawaii was the *Smooth Cayenne* (*Ananas comosus*) imported from Jamaica in the 1886 (C&CF 1973a: 1; HAPCO 1930:2; PGAH 1977:14; C&CF 1973b: 2) by Capt. John Kidwell (Clare & Morrow 1930:54), whose ancestor came from Cayenne, French Guinea and crossed with a South American variety (n. a. 1930:2). However, Taylor (1976) writes that "Captain Cook found pineapple in Hawaii when he 'discovered' the islands in 1778, indicating that the Polynesians had brought it with them when they arrived (Taylor 1976:162).

Photo 6. Pineapple Plant.

Fauna. In almost all of the elevation zones, alien animals such as feral pigs, goats, sheep, cattle and horses damaged native vegetation. Terrestrial fauna in pre-colonized Hawai`i consisted of only one endemic mammal, the hoary bat (*Lasiurus cinereus*), thousands of endemic insects [i.e., damselflies (*Ischnura ramburii* and *Ischnura posita*) found around reservoirs and streams], and about 100 species of endemic birds such as the Hawaiian honeycreeper (*Drepanididae spp*) (Berger, 1972:7, Kirch, 1985:28). Early Polynesian introduced animals included the Southeast Asian pig (*Sus scrofa*), jungle fowl (*Gallus gallus*), dog (*Canidae*), and the Polynesian rat (*Rattus exulans*).

There are over fifty species of the Hawaiian Honeycreeper. Amid these species is the I'iwi. It feeds on the nectar from the lehua blossom of the `ohi'a tree. The I'iwi can be found in the upper forests of Maui. The I'iwi often imitates other birds. The popular endangered Hawaiian Honeycreepers with their brilliant colors were one of the many native birds that were killed to make the chiefs' cloaks (Enriques et al 2004).

Photo 7. I'iwi found in upper forests (Enriques et al 2004)

The Pueo, also known as the Hawaiian Owl or short-eared owl, preys on rodents and insects. It builds its nest in the grass on the ground and is active during dusk and dawn. In ancient Hawaiian times, the *pueo* was often worshipped as a family god or an *`aumakua* (Enriques et al 2004; Pang 2004). The *pueo* as *`aumakua* was famous for being a protector from harm and even from death (Pang 2004)

Photo 8. Hawaiian owl, *pueo* (Pang 2004)

**Pu`u Kukui Preserve.** In 1992 Maui Land & Pineapple (MLP), the parent company of Kapalua Land Company, dedicated 8,661 acres of native forest to The Nature Conservancy of Hawai`i, thereby creating the Pu`u Kukui Preserve, the largest private preserve in Hawai`i. It is the home of three native bird species, the *I`iwi, apapane,* and *`amakihi;* five extremely rare snail species, and twelve types of native natural communities. The Preserve is the habitat of twenty percent of Hawai`i's rare native plants--eighteen of them are endemic to West Maui and not found anywhere else such as rare violets, silverswords, sandalwood and *Lobelia Gloria montis* (KR 2003:E-3).

PART II: METHODS

The Pulelehua Cultural Impact Study/Assessment was conducted between the months of May to June 2004. The study consisted of three phases: (1) ethnographic survey (oral history interviews), transcribing interviews, analysis of ethnographic data and CIS/A Summary; (2) cultural and historical archival research (limited literature review); and (3) report writing.

Personnel. The personnel consisted of the principal investigator who has a masters degree in Anthropology, with a graduate curriculum background in the archaeology track as well as anthropology theory, cultural resource management, ethnographic research methods, and public archaeology; an undergraduate curriculum background that included Hawaiian History, Hawaiian Language, Hawaiian Archaeology, Pacific Islands Religion, Pacific Islands Archaeology, Cultural Anthropology, as well as a core archaeology track, Geology, and Tropical Plant Botany; and ethnographic field experience that includes over 175 interviews to date.

Level of Effort. The level of effort for the ethnographic survey was 3 interviews and limited archival research. The primary effort was to produce a Summary report in a limited period of time. Several fishermen were also talked to at Kahana and Māhinahina areas.

Theoretical approach. This study is loosely based on *Grounded Theory,* a qualitative research approach in which "raw data" [transcripts and literature] are analyzed for concepts, categories and propositions. Conceptual labels or codes are generated by topic indicators [i.e., agriculture, flora, burials, fishing]. Categories are generated in a similar manner by forming groupings such as "Land Resources & Use," "Water Resources & Use" or "Cultural Resources & Use." Since this was a semi-focused study, categories were pre-selected as part of the overall research design. However, it is not always the case that these research categories are supported in the data. In the *Grounded Theory* approach, theories about the social process are developed from the data analysis and interpretation process (Haig 1995; Pandit 1996). This step was not part of this cultural impact assessment as the research sample was too small.

Archival Research. Compiling data took a few weeks of intermittent archival research. The majority of the archival research [primary and secondary sources] came from the State Historic Preservation Division library; Hawaiian Collections of the University of Hawai`i Hamilton Library (Manoa Campus; the Bishop Museum Archives; Hawai`i Children's Mission House archives; Maui Historical Society Archives at Bailey House Museum; Waihona `Aina Corp.; information from State Bureau of Conveyances; personal library; and Internet searches. Primary source material included Land Court records, maps, visitor journals, genealogies, oral histories and other studies. Secondary source material included translations of 19th century ethnographic works, historical texts, indexes, archaeological reports, and Hawaiian language resources [i.e., proverbs, place names and dictionary].

Consultant Selection. The selection of the consultants was based on the following criteria:

- Had/has Ties to Project Location(s)
- Known Hawaiian Cultural Resource Person
- Referred by PBR Hawaii and/or Kapalua Land Development Staff
- Referred By Other Cultural Resource People

Interview Process. The interview process included a brief verbal overview of the study. Then the consultant was provided with an informed consent or agreement to participate form to review, which was drafted for the edification and protection of each consultant (Appendix D). An ethnographic research instrument (Appendix E) was designed to facilitate the interview, a semi-structured and open-ended

method of questioning based on the person's answers to questions ('talk-story' style). Each interview was conducted at the convenience (date, place and time) of each consultant. A *makana* or gift was given to each consultant in keeping with traditional reciprocal protocol.

Ethnographic Interview Procedures. Interviews were conducted at various places, at the request of the consultants, using an audio-cassette tape recorder. Notes were also taken as needed, but more attention was given to listening intently to each consultant. One interview was conducted at a business place of the consultant; one interview was conducted at the home of the consultant; and one interview was conducted in a hotel setting.

Transcribing Process. The taped interviews were transcribed verbatim using a Sony Dictator Transcriber (BM-87DST). Each consultant was given a hard copy of the interview transcripts along with a *mahalo* letter that explained the transcript review process, and a self-addressed, stamped envelope for return of the edited transcripts. This allowed for corrections (i.e., spelling of names, places), as well as a chance to delete any part of the information if so desired. Consultants were also given a "Release" form to sign when they were satisfied with the transcript information/revisions.

Analysis Process. The analysis process followed a more traditional method, as a qualitative analysis software program was not necessary. The interview was manually coded for research thematic indicators or categories (i.e., personal information; land, water, marine and cultural resources and use; site information-traditional and/or historical; and anecdotal stories). For the purpose of this study, it was also not necessary to go beyond the first level of content and thematic analysis, as this was a more focused study. However, sub-themes or sub-categories were developed from the content or threads of each interview [i.e., agriculture, camps, *kahawai,* fishing].

Research Problems. A typical constraint for most studies is not enough time for archival research as there is a lot of material to review. Another typical constraint is not being able to interview people in one block [three days] of time due to prior commitments; changes in schedules; did not return calls.

Several unforeseen circumstances prevented a few interviews from taking place.

- One potential consultant was informed that the interviewer was on Maui, he said he would call back to confirm an interview, but never did;
- One potential consultant said he was tied up and deferred to his younger brother.
- One potential consultant could not be reached by telephone; the interviewer was told where to find him every day, however, this did not work out due to the lack of time (only during daylight hours).
- Two other potential consultants were left several messages, but did not return calls.

One consultant opted not to use his name for the interview and a pseudo name was picked out. All references to his ohana name was deleted from the transcripts.

PART III: CULTURAL & HISTORICAL BACKGROUND REVIEW

The Cultural and Historical Background Review entailed a broad search of primary and secondary source literature. The majority of this research material came from the State Historic Preservation Division library, State Survey Division; the Bishop Museum Archives; Hawaiian Collections of the University of Hawai`i Hamilton Library (Manoa Campus); Maui Historical Society Archives at Bailey House Museum and the researcher's private library. Primary source material included Land Court records, maps, newspaper articles, visitor journals, genealogies, oral histories and other studies. Secondary source material included translations of 19th century ethnographic works, historical texts, indexes, archaeological reports, and Hawaiian language resources (i.e., proverbs, place names and Hawaiian language dictionary). A review of the archival material is presented in this section, along with an overview of the chronology of the *moku* (district) of Kā`anapali and *ahupua`a* of Māhinahina and adjacent *ahupua`a* of Kahana and Honokōwai, within the context of the broader history of the *moku `āina* (island) of Maui, and Greater Hawai`i.

A. Models of Hawaiian Chronology.

Models of Hawaiian Chronology such as Cordy (1974/1996), Hommon (1976/1986) or Kirch (1985) provide a temporal view of settlement patterns as well as cultural changes through time, from initial settlement through first contact with the western world. Cordy's (1974) first model of a cultural development sequence looked at Initial Settlement Period, New Adaptation Period and a Complex Chiefdom Period. He has since modified this model (1996). Hommon's (1976) model of sociopolitical development sequence included four phases: Phase I AD 500-1400; Phase II AD 1400-1550; Phase III AD 1550-1650; and Phase IV AD 1650-1778. This model was later modified (1986) to three phases: Phase I AD 400-1400 Exploration and Settlement; Phase II AD 1400-1600 Expansion; and Phase III AD 1600-1778 Consolidation. Kirch (1985) believed that initial settlement occurred much earlier than AD 600. His cultural-historical sequence model has four phases: Phase I Colonization Period (AD 300-600); Phase II Developmental Period (AD 600-1100); Phase III Expansion Period (AD 1100-1650); and Phase IV Proto-Historic Period (AD 1650-1795) (Kirch, 1985:296-308; Kolb, 1991:205).

For this cultural impact assessment, Kirch's (1985) model will be used with the following addition: Early Historic Period (AD 1795-1899), Territorial History (AD 1900–1949), and Modern Historic Period (post AD 1950). The reasoning behind Kirch's model is the belief of many native Hawaiian people that based on oral histories or legends, the migrations of their Polynesian ancestors to Hawai`i took place prior to AD 700. According to Fornander (1917: IV: II: 406), there are seventy-five generations from Wakea to Kamehameha I who born was around AD 1753. If just eighteen years were allotted to each generation (typically a generation is twenty years) that would make the time of Hawaiian progenitors Wakea and Papa Haumea (who settled in Nu`uanu, O`ahu) approximately AD 403. [McKinzie (1983:12) gives thirty years per generation.]

It should be noted that a relatively recent study (Tuggle & Spriggs 2001) refutes the 'early colonization' supposition. For decades, the consensus among Hawaiian archaeologists was that evidence from Bellows, O`ahu and Ka`u, Hawai`i Island, supported early Polynesian colonization dates of AD 300 to AD 600 (Tuggle 1979; Kirch 1985). However, Tuggle and Spriggs (2001) have since studied new data and re-evaluated past dates and dating methods and have concluded that acceptable early dates fall within AD 700-1100. These dates appear to coincide with data that eastern Polynesia was settled much later than previously thought (Rolett 1989).

The following overview encapsulates cultural changes over time and highlights significant events and people. More corroborating details follow this overview section with traditional *mo`olelo* and *mele,* historic works and various studies.

B. An Overview of Human Impact, Settlement and Socio-economic Development of Maui in the context of Greater Hawai`i

B-1. Colonization Period. First voyager dating is scanty at best, however, based on early site dates from Bellows, O`ahu and South Point, Hawai`i, Kirch (1985) estimated that the Colonization Period of the Hawaiian Islands was somewhere between AD 300-600. These first Polynesian voyagers to Hawai`i "followed the tracks of migratory birds. Mainly they traveled by the stars... [and] on a voyage of migration; sixty to a hundred persons could exist for weeks on a large canoe, which might be a hundred feet in length" (Day 1992:3). This feat was "remarkable in that it was done in canoes carved with tools of stone, bone, and coral; lashed with handmade fiber; and navigated without instruments" (Teruia 1995: vii).

Reconstructing the cultural sequence for the Kā`anapali district and other places in Hawai'i during the colonization period would involve the 'founder effect' and time necessary to adjust and adapt to a new environment. The colonizers were not able to bring all of the gene pool or cultigens from their homeland, so their new culture consisted of what survived the journey, what was remembered and what could be applied to the new environment (Kirch 1985:285-6). Although early Hawaiians were farmers and felt spiritually tied to the *'aina* (land) in many ways (Waters, n.d.), when they first arrived they had to modify both their subsistence practices and the land. Faunal remains analyses indicate that early Hawaiian subsistence depended on fishing, gathering, bird hunting (extinct fossil remains, see Olson and James, 1982), as it took time to clear the forests, plant their crops, breed their animals, and construct suitable living quarters. Creation chants such as the *Kumulipo* depict a very deep philosophical bond with the land and nature and "the respectable person was bound affectionately to the land by which he was sustained" (Charlot 1983: 45, 55). Ancient sites of various *ko'a* (fishing and bird shrines) also imply a spiritual respect for their sustenance.

> Nanaula, a distinguished chief, was the first to arrive from the southern islands. It is not known whether he discovered the group [Hawai`i] by being blown northward by adverse winds, or in deliberately adventuring far out upon the ocean in search of new lands. In either event, he brought with him his gods, priests, prophets and astrologers, and a considerable body of followers and retainers. He was also provided with dogs, swine and fowls, and the seeds and germs of useful plants fro propagation. It is probable that he found the group without human inhabitants.
>
> During that period--probably during the life of Nanaula--other chiefs of less importance arrived with their families and followers either from Tahiti or Samoa. They came in barges and double canoes capable of accommodating from fifty to one hundred persons each. They brought with them not only their priests and gods, but the earliest of Polynesian traditions. It is thought that none of the pioneers of the time of Nanaula ever returned to the southern islands, nor did others immediately follow the first migratory wave that peopled the Hawaiian group (Kalākaua 1887/1990:19-20).

It is the latter part of this period or early part of the Development Period that massive burials were interred at Honokahua. Based on radiocarbon dating, the earliest dates for Kā`anapali are AD 600 in Honokahua (Donham 1989 in Jensen & Mehalchick 1992:7) This implies that West Maui or more specifically, this area, was settled very early.

B-2. Developmental Period. During the Developmental Period, AD 600-1100, as the founding groups grew, they fissioned into subgroups referred to as ramages, with the senior male of the original ramage as chief of the conical clan, although hierarchical ranking was not just relegated through the patrilineal line of descent (Kirch 1985:31). Bellwood refers to these groups as tribal and related by blood (Bellwood 1978:31). In *Ka Po'e Kahiko* Kamakau refers to Hawaiian ranking in the following passage:

> For 28 generations from Hulihonua to Wakea, no man was made chief over another, and during the 25 generations from Wakea to Kapawa, various noted deeds are mentioned...Kapawa was the first chief to be set up as a ruling chief...from then on the group of Hawaiian Islands became established as chief-ruled kingdoms - Maui from the time of Heleipawa, son of Kapawa...this was the time that records (oral) began to be kept of the chiefs (Kamakau 1964:3).

Changes occurred bringing about a uniquely Hawaiian culture, documented by the material culture found in archaeological sites. These include quadrangular adze, bone fishhook variations, *'ulu maika* (a game piece) stones, *lei niho palaoa* (necklace of bone or ivory and human hair worn by high ranked chiefs) and evidence of shifting cultivation. The evidence also indicates that the "ancestral pattern of corporate descent groups" were still in place (Kirch 1985:302-3). The early culture evolved as the population grew, and many of the changes were related to significant socio-economic changes.

> For thirteen or fourteen generations the first occupants of the Hawaiian Islands lived sequestered from the rest of the world, multiplying and spreading throughout the group. They erected temples to their gods, maintained their ancient religion, and yielded obedience to their chiefs. The traditions of the period are so meager as to leave the impression that it was one of uninterrupted peace, little having been preserved beyond the genealogies of the governing chiefs (Kalākaua 1887/1990:20).

> In about A.D. 1025 or perhaps a little earlier, the people of the group were suddenly aroused from their long dream of six centuries by the arrival of a large party of adventurers from Tahiti. Their chief was Nanamaoa. Their language resembled that of the Hawaiians and their customs and religions were not greatly at variance. They were therefore received with kindness, and in a few years their influence began to be felt throughout the group. They landed at Kohala, Hawaii, and Nanamaoa soon succeeded in establishing himself as an influential chief. His sons secured possessions on Maui and O`ahu, and on the latter island one of them--Nanakaoko--instituted the sacred place called Kukaniloko, in the district of Ewa, where it was the desire of future chiefs that their sons should be born.... This became the sacred birth-place of princes', as `Īao, in Wailuku valley, on the island of Maui, became their *taboo* spot of internment. It was at Kukaniloko that Kapawa, the son of Nanakaoko, was born. His principal seat of power was probably on Hawaii, although he retained possessions on Maui and O`ahu (Kalākaua 1888/1990:70-71).

> But stronger leaders were soon to follow from the south. Among the first was the high-priest Paao, from Samoa [some say it was Society Islands]. He arrived during the reign of Kapawa, the grandson of Nanamaoa, or immediately after his death. The people were in an unsettled condition politically, and Paao, grasping the situation, either sent or returned in person to Samoa for Pili, a distinguished chief of that island. Arriving with a large following, Pili assumed the sovereignty of the island of Hawaii and founded a new dynasty. Paao became his high priest, and somewhat disturbed the religious practices of the people by the introduction of new rites [*luakini* or human sacrifice] and two or three new gods [Kūka`ilimoku] (Kalākaua 1887/1990:20-21).

> The Paumakua family, which became so influential in Hawaii and Maui, arrived during the early part of the reign of Pili, in about A.D. 1090. A large party accompanied the family, and they brought with them their gods, priests, astrologers and prophets. They first landed and secured possessions on Maui, but the sons and other relatives of Paumakua were brave and ambitious, and soon by conquest and marriage secured as almost sovereign footing both in Maui and Hawaii.... At that time, a powerful chief of the ancient native line of Nanaula, held sway over the island of Molokai (Kalākaua 1888/1990:71-72).

B-3. Expansion Period. The Expansion Period, AD 1100-1650, is significant for a number of reasons. Communication between the Hawaiian groups and southern groups suddenly ceases and oral histories don't offer any explanations. With the exception of Molokai and a portion of O`ahu who were of the Kamuela and Maweke families from the Nanaula lines, all the others were of the southern chiefs and their descendants (Kalākaua 1887/1990:20-21). Most of the "ecologically favorable zones," the windward and

coastal areas of all major islands, were now settled, and the more marginal leeward areas were being developed.

This was also the period of the greatest population growth, the development of large irrigation field system projects, and dry land farming. The uniquely Hawaiian invention, the *loko* or fishpond aquaculture, was developed in the fifteenth century or the later half of this period (Kirch 1985: 303). There are several *mo`olelo* or stories about significant personalities from this time period; from Pa`ao to the brothers Kakae (great-grandfather of Pi`ilani) and Kaka`alaneo and his son Ka`ulula`au from Lele and Keka`a, to Liloa and Umi of the Big Island, and Kawaukaohele and his son Pi`ilani, both ruling chiefs of Maui.

Maui's history becomes more visible in the literature during this period with the legends of the infamous King Hua in the early part of this period, and the activities of the Pi'ilani line of chiefs (Youngblood 1983:35-7) towards the end of this period. Monumental *heiau* building flourished in this Period, as "religion" became more complex. During the last 200 years of the Expansion Period, the concept of *ahupua'a* was established, as well as class stratification, territorial groupings, powerful chiefs and *"mo'i"* or king (Kirch 1985:303-6).

The Pa`ao/Pili influence created a major shift in "religion" and socio-economic patterns. Pa'ao brought with him the Kū practice of human sacrifice, used in monumental *luakini heiau* or war temples. Pili started a line of *ali'i nui* that would continue to the Kamehameha "dynasty." The evolution of the *luakini heiau* is difficult to place archaeologically, and although the arrival of Pa'ao may have been a real event; the uniqueness and complexity of *heiau* were most likely a local (Hawaiian) development (Kolb 1989:3).

Legends reveal that during the 12th century, several Hua chiefs reigned on Maui. They are discussed further in the *mo`olelo* section of this report. Huanuikalalailai is the grandfather of Haho [Haho is the son of Paumakua who is buried in `Īao; Haho also founded the *Aha-alii* (Kalākaua 1888/1990:84-85)]; Haho is the grandfather of the famous Hāna twins Hanala`anui and Hanala`aiki who become the progenitors of the *ali`i nui* of Hawai`i Island, Maui, Molokai, Lāna`i, as well as O`ahu and Kaua`i (McKinzie 1983: *xx*).

> Haho is one of the first chiefs mentioned in the oral histories of Maui. Haho ruled in Wailuku district circa AD 1228 or 1338 (20 or 25 years per generation respectively), and he was one of the first of the noble councilors (*aha ali`i*). The number and size of polities on Maui is unknown, however polity would have been comprised of at least a single proto-district (*maka`ainana*).... The *maka`ainana* was ruled by a high chief and a series of subordinate community chiefs. This period of history was punctuated by small scale military raids, and minor chiefly rivalries and conflicts (Hommon 1976 in Kolb 1990:65).

A legend (Skinner 1902:212-216) tells about a Japanese vessel wrecking on Maui in the 1200s. The captain and his sister marry into *ali`i nui* families, but what is most significant about this story is the metal sword that the Captain had. During this period the *ali`i nui* of Hawai`i Island was Kalaunui who in AD 1260 had subdued O`ahu and Molokai and on Maui a great fight ensued. In the battle the Captain fought bravely with his sword, but was finally struck down by a warrior named Kaulu, son of Waahia, a seer of great renown. Rather than turn the sword over to the Hawai`i king, Kaulu buried it on the spot. He later retrieved it and put it into his mother's (Waahia) care before the Hawai`i contingency headed for battle on Kaua`i. The Hawai`i warriors were overcome and defeated before they could even land their canoes by the sling stones and javelins of the Kaua`i warriors. The Hawai`i king Kalaunui was taken prisoner and the kings of Maui, Molokai and O`ahu who were hostages of Kalaunui were set free. Kaulu escaped with a remnant force only to be accused by the queen of cowardice. In the negotiations for the release of Kalaunui, the queen offered several things: a fleet of canoes with many spears; twenty feather cloaks with stone axes, ivory and whalebone; but these were all rejected. The last resort was to offer her daughter in matrimony to the king of Kaua`i. This too was rejected. After three years and unsuccessfully trying to get an army together, the queen was ready to give up. This is when Waahia asked for an audience at court. She explained that she alone could rescue the king, but that the court had to grant

whatever her wish was when they returned. They agreed and Waahia left Hawai`i Island with a single oarsman for Kaua`i. They arrived during Makahiki festivities and Waahia got an audience in court. Her offer was the Japanese sword "that was harder than stone, that broke spears like reeds, that gave its owner supreme fortune and supreme command." The offer was accepted. Before the release of Kalaunui, Waahia had him agree that his release was contingent on him giving his daughter to her son in marriage. This too was agreed on.

> By AD 1500, the politics of Wailuku and Hāna expanded into separate multi-district territories. Oral traditions document that East Maui (Hamakualoa, Hamakuapoko, Ko`olau, Hāna, Kīpahulu, and Kaupō districts) was now ruled by a line of independent *ali`i nui* circa AD 1428-1553 or AD 1498-1598. Evidence suggests that another level in the chiefly hierarchy was added during this time. Each polity was now ruled by an *ali`i nui* and a series of district chiefs. Conflict and competition between these two polities became more frequent. The *ahupua`a* were becoming the primary geographical units as competition between chiefs led to a reorganization of regional power. Absolute ranking was beginning to replace relative ranking as chiefs found it necessary to compete for resources and power (Kolb 1990:67).

One of Maui's most famous *ali`i nui* during this period was Pi`ilani (ca. Late 1500s to Early 1600s) who's ancestors made Hāna their home. Pi`ilani lived about twenty-two generations after the twins, and twenty-four generations after Haho. As a ruler, Pi`ilani spent time at Hāna, but "kept his court 'out there' in Lele/Lahaina and Wailuku (Youngblood 1992:38). He was well known for his peaceful rule of Maui, Molokai and Lāna`i. While he ruled there were no wars between chiefdoms and island polities. Several *mele, `ōlelo no'eau,* and *mo`olelo* mention that Maui, Molokai and Lāna`i and all the bays of West Maui that begin with 'Hono' were in the realm of Pi`ilani. This included Honokōhau, Honolua, Hononana, Honokahua, Honokeana and Honokōwai. Honokōhau, Honolua, Honokahua and Honokōwai were known to have villages.

Pi`ilani met his second son Kiha-a-Pi`ilani in Lahaina. Kiha (ca. Early 1600s) was raised on O`ahu (Waikiki) with his mother's family. However, as a young adult he grew tired of listening to his uncles and wanted to meet his father. The *mo`olelo* indicate that from the moment he met his father, Kiha was never satisfied with being a junior son to his older brother, Lono-a-Pi`ilani, who primarily kept court in Wailuku. After the death of Pi`ilani in Lele, friction between the brothers escalated. Kiha went to the Big Island to solicit the help of his sister Pi`ikea and her husband, Hawai`i *ali`i nui* `Umi-a-Liloa. After a year of building an army to challenge Lono-a-Pi`ilani, Kiha and Umi traveled to Maui to find that Lono had recently died, presumably from fear of doing battle with his brother and brother-in-law.

> When the ruler, Lono-a-Pi`ilani, heard that `Umi-a-Liloa, Kiha-a-Pi`ilani, the chiefs, warriors, and the fleet of war canoes from Hawai`i were on their way, that the fortress of Kau`iki was taken, and Ho`olae-makua [father-in-law of Kiha-a-Pi`ilani] was killed up at Kawaipapa, he was filled with dread and fear of death. Lono was afraid that he would be tortured like Ho`olae-makua, his great war leader. If Ho`olae who committed less was tortured by Kiha-a-Pi`ilani, how much more would he be who had committed more! Lono-a-Pi`ilani trembled with fear of death, and died. The war party had not reached Wailuku when Kiha-a-Pi`ilani heard of Lono's death, and so he hastened to Wailuku. When Kiha-a-Pi`ilani and `Umi-a-Liloa arrived in a war canoe, Lono's corpse was gone.... A prophet on Kaua`i was sent for to tell on which land it was buried. The prophet said that it was in Wailuku in a land called Pa`uniu. It was taken away again to be hidden, and so the bones of Lono-a-Pi`ilani vanished completely. The men of Hawai`i hunted, searched, delved, and sought, digging about the lands of Wailuku and Pa`uniu, but the bones were not found (Kamakau 1992:31-32).

Kiha-a-Pi`ilani eventually took control of the Maui domain. He is credited with many public works, one of which was to finish the Hono-a-Pi`ilani highway that his father started. Remnants of this monumental feature can still be seen today in various parts of Maui.

Legends mention a few times where foreigners ship-wrecked or landed on the shores of various Hawaiian Islands. One story takes places during the reign of Kealiiokaloa, son of `Umi-a-Liloa, who reigned about A.D. 1525-30. A vessel was wrecked at Keei, South Kona at a place now called Kulou, the captain and his sister reached shore in safety. They intermarried with the natives. Centuries later it was learned that on October 31, 1527 three vessels fitted out by Spaniard Cortez, conqueror of Mexico, left Zacatula for the Moluccas. About 1,000 leagues from port they were separated by a severe storm and two smaller vessels never made it to their destination. Later in 1555 the Spanish navigator Juan Gaetano discovered these islands; and ancient manuscript chart in Spanish archives indicates a group of islands in the same latitude as the Hawaiian Islands, but over ten degrees longitude too far east. In June 1743 a British warship captured a Spanish galleon near the Philippine Islands and found a manuscript chart on board with the same group of islands charted the same as the 1555 chart in the archives (Wisecarver 1993:11).

Mo`olelo* about events that took place in the early to mid 1600s were revealing in that they illustrate that many of the battles of this period were relatively quickly contained by the opposing *ali`i [see *History of Kualii* (Kualii ca. 1630-1660s) in Fornander 1917:IV: II: 364-434]. These stories also illustrate the on-going inter-relationships between the people of the various islands. In the *History of Kualii*, the exploits of Kualii (great-great grandson of Kakuhihewa, *ali`i nui* of O`ahu) take him to every island and he eventually unites all the islands "from Hawai`i to Ni`ihau" (Fornander 1917: IV: II: 406). Kualii lives in the time of Maui *ali`i nui* Kamalalawalu and Kauhi, son of Kauhiakama, the younger brother of Kamalalawalu (Fornander 1917:416, 418, 424), sons of Kiha-a-Pi`ilani (Kamakau 1992:56).

B-4. Proto-Historic Period. The Proto-Historic Period, AD 1650-1795, appears to be marked with both intensification and stress. Many wars took place during this time between intra-island chiefdoms and inter-island kingdoms. However, it was during this period that the *Royal Kolowalu Statute* or Kuali`i's Law was enforced. Kualii Kuniaakea Kuikealaikauaokalani lived for an extremely long time, was said to sometimes have supernatural powers, and was the first to "unite" all the islands. This *ali`i nui* of O`ahu died at Kailua in Ko`olaupoko in AD 1730, supposedly at the age of one hundred and seventy five.

> It (Kuali`i's Law) was strict, unvarying and always just. It was for the care and preservation of life; it was for the aged men and women to lie down in the road with safety; it was to help the husbandmen and the fishermen; to entertain (morally) strangers, and feed the hungry with food. If a man says, "I am hungry for food," feed (him) with food, lest he hungers and claims his rights by swearing the *Kolowalu* law by his mouth, whereby that food becomes free, so that the owner thereof cannot withhold it; it is forfeited by law. It is better to compensate.... A transgressor or one who is about to die, is, under the application of this law exonerated of his death or other penalty... (Fornander 1917: IV: II: 432).

In 1736, Maui *ali`i nui* Kekaulike died. He chose his *nī`aupi`o* son Kamehameha-nui to be his heir, though Ka`uhi`aimoku-a-Kama was the oldest; he was of a slightly lower rank.

> Ke-kaulike had many children by his wives (*wahine*) and female retainers (*haia wahine*). Ka-uhi-`aimoku-a-Kama by Kaha-walu was the first born; Manu-ha`a-ipo, Ke-hau-hiwa-moku and Ka`eo [kulani] were the children of Holau; Kamehameha-nui, Ka-lola, Ka-hekili and Ku-ho`oheihei-pahu, of Ke-ku`i-apo-iwa-nui; Na-mahana and Ke-kua-manoha` of Ha`alo`u.... When Ke-kau-like heard that the ruling chief of Hawai`i was at Kohala on his way to war against Maui, he was afraid and fled to Wailuku in his double war canoe named Ke-aka-milo. He sailed with his wives and children...his officers, war leaders, chiefs, and fighting men, including warriors, spearmen, and counselors.... The fleet landed at Kapa`ahu at the pit of `Aihako`ko in Kula. Here on the shore the chiefs prepared a litter for Ke-kau-like and bore him upland to Haleki`i in Kukahua. There Ke-kau-like died, and the sound of lamentation for the dead arose. Then fearing the arrival of Alapa`i bent on war, the chiefs cut the flesh from the bones of Ke-kau-like in order to lighten the load in carrying the body to `Iao (for burial) (Kamakau 1992:69).

> Alapa`i sailed from Kohala on Hawai`i with a great company of chiefs of Hawai`i, his war leaders, warriors, and the district chiefs of the island...but when he landed at Mokulau in Kaupō and heard

> that Ke-kau-like was dying, he gave up all thought of war and wished only to meet Ke-kau-like and his (half) sister Ke-ku`i-apo-iwa-nui. He heard that Kamehameha-nui had been chosen ruler over Maui and he had no desire to make war upon his sister's child (Kamakau 1992:70).

In 1737 and 1738 a couple of great battles took place in the districts of Lahaina and Kā`anapali. Kauhi-`aimoku-a-Kama (Kauhi), oldest son of Ke-kau-like rebelled against his younger brother, Kamehameha-nui. "Near the house of David Malo is a breadfruit tree on which the first victim of the battle was laid. There the fighting men of Kamehameha-nui were slaughtered." This prompted Kamehameha-nui to flee to his uncle's canoe, big island *ali`i nui* Alapa`i-nui-a-Ka-uaua (Alapa`i), who took him to Hawai`i island where they spent a year preparing for war. Alapa`i was the half-brother of Kamehameha-nui's mother (Kamakau 1992:73-74).

When Ka-uhi heard that Alapa`i was heading back to Maui, he enlisted the help of his uncle, Pele-io-holani, Kaua`i *ali`i nui,* ruling chief of O`ahu, son of Kualii, father of Kalaniopu`u and Keoua (warrior chiefs of Alapa`i), and cousin of Alapa`i. Alapa`i attacked Maui (1738), drying up the streams of Kaua`ula, Kanaha and Mahoma near Lahainaluna, destroying the taro patches. His men kept guard over the streams of Olowalu, Ukumehame, Wailuku and Honokawai (sic). "When Pele-io-holani heard that Alapa`i was in Lahaina he gathered all his forces at Honokahua and at Honolua. At Honokawai (sic) an engagement took place between the two armies, and the forces of Alapa`i were slaughtered and fled to Keawawa." Pele-io-holani had 640 men to Alapa`i's 8,440. The cousins once again came face to face in Pu`unene and decided to once more opt for peace between the families. Kamehamehanui ruled Maui in peace; Pele-io-holani retired to Molokai, and Alapa`i went back to rule Hawai`i (Kamakau 1992:74).

Years later, around AD 1759, High Chief Kalani'opu'u from the Island of Hawai`i made war on East Maui and conquered Hāna from *ali'i nui* Kamehameha-nui, brother of Kalola, Kalani'opu'u's wife. Kalani'opu'u took control of Hāna's prominent Pu'u Kau'iki as his fortress. He appointed one his chiefs, Puna, as "governor" of Hāna and Kīpahulu (Kamakau 1992:81-82). Kamehameha-nui relinquished Hāna and lived in peace in West Maui with his wife and half-sister, Namahanaikaleleonalani. In 1766 the peaceful Maui *ali'i nui* died. After ruling Maui for 29 years, Kamehamehanui was taken ill at Kawaipapa, Hāna on a journey about the island. While still in Hāna Kamehamehanui ceded his lands to his younger brother Kahekilinui'ahumanu (Kahekili), a fierce warrior and "manipulator" (Kamakau, 1992:82-84; Kame'eleihiwa 1992:47).

But according to Kalākaua (1990:353) Kamehamehanui "died very suddenly at Wailuku, which had been his favorite place of residence." During the period of mourning for him, his successor and younger brother, Kahekili "removed his court to Lahaina." It was while there that they were visited by an *ali`i* from Hawai`i Island. The visitor was Ke`eaumoku, son of Keawepoepoe, who was the son of Lonoikahaupu (sovereign of west Kaua`i) and Kalanikauleleaiwi (half sister/wife of Keawe, once *moi* of Hawai`i Island). After the death of his uncle Alapa`inui [Hawai`i Island *moi*], in AD 1754, Ke`eaumoku was discontent with the rule of his cousin Keaweopala so he joined forces with Kalaniopu`u of Ka`u and defeated Keaweopala in Kona, making Kalaniopu`u, grandson of Keawe, the new *moi* of Hawai`i Island. Ke`eaumoku fortified himself in Kohala and later (1765) incurred the wrath of Kalaniopu`u and was attacked by him. Ke`eaumoku escaped and spent some time on Lāna`i before heading to Maui just after the death of Kamehamehanui. To the displeasure of Kahekili, Ke`eaumoku promptly won the heart of Namahana [I], the widow of his brother (Kalākaua 1888/1990:353-356), and also his half-sister [Kekaulike was their father but they had different mothers]. After the couple settled in Waihee (Namahana's lands), Kahekili decided to re-locate his court to Wailuku.

> In the midst of this semi-royal gayety and splendor Kahekili quietly crossed the mountains and temporarily established his court at Wailuku, but a few miles from Waihee. He had heard of Keeaumoku's royal style of living, and desired to learn from personal observation whether it was inspired by an innocent love of display or designs more ambitious...and a week's stay at Wailuku, during which reserved courtesies had been exchanged between them, convinced him that Ke`eaumoku was a dangerous subject (Kalākaua 1888/1990: 356-357).

With the help of his nephew Kahahana, who was also a land-holder of Waihee, Kahekili contrived to find cause to battle Ke`eaumoku. To this end he was successful, causing Ke`eaumoku, Namahana, her mother, two brothers and a considerable following of chiefs and retainers to flee to Molokai. This did not stop Kahekili who invaded Molokai with a large force, and once again defeated Ke`eaumoku. Barely escaping, Ke`eaumoku, Namahana and their entourage fled to Hāna which was still under the control of Hawai`i Island. There he was forgiven by Kalaniopu`u and given shelter by Mahihelelima, governor of the Hāna district (Kalākaua 1888/1990:357-358).

While in Hāna, Namahana (I) gave birth to Ka`ahumanu in 1768 (Kalākaua 1888/1990:359) in a cave at the base of Pu'u Kauiki; she would later play a pivotal role in the history of Hawai`i.

In 1775 Kalani'opu'u, son of Ka-lani-nui-I-a-mamao (whom the *Kumulipo* was composed for) and his forces in Hāna raided and severely destroyed the neighboring Kaupō district, before continuing several more raids on the islands of Molokai, Lāna`i , Kaho'olawe and parts of West Maui. He returned again in 1776 and for several years later, raiding and treating the *maka'āinana* cruelly.

The Alapa, the fierce fighting men of Kalani`opu`u, were defeated; only two men escaped. The chiefs and fighting men of Kalani`opu`u wanted to continue; "tomorrow we will drink the waters of Wailuku and rest in the shade of Hekuawa." Ka-hekili prepared for the "great battle" which took place on the sand hills between Waikapu and Wailuku; Ka-hahana, ruling chief of O`ahu and Molokai came to his aid.

> When Ka-lani-`opu`u saw that the forces of Hawai`i were surrounded by Ka-hekili's men he said to Ka-lola his chiefess, "O Hono-ka-wai-lani! We shall all be killed. Do go up to your brother Ka-hekili to sue for peace." Ka-lola answered, "It will not do any good for me to go, for we came to deal death.... Our only hope lies in Ka-lani-kau-i-ke-aouli Kiwala`o...we will send Ka-hekili's half brothers with him...." [Kalākaua 1990:359, says they were the half brothers of Ke`eaumoku] As Kiwala`o advanced...endowed with the tabu of a god and covered with the colors of the rainbow, down fell the fighting men of both sides prostrate to the ground because of his divine rank as a *ni`aupi`o* and the severe tabu which demanded prostration to avoid facing the sacred back of a chief. The soldiers of Maui wished to ignore the tabu, regretting the cessation of the fighting, but Kiwala`o continued to Wailuku. Ka-hekili had not come to the battle in person but was at the chief's house in Wailuku where he gathered together the old men and women, the children, and a great host (Kamakau 1992:88).

Kahekili stopped that war and made peace at the request of his sister Ka-lola, but a few years later Kalani`opu`u once again sailed to ravage the lands of Maui and Lāna`i. It was during this war that Kamehameha I, nephew of Ka-lani-`opu`u was noticed as a great and brave warrior by both sides.

In January 1778 Cook landed in Waimea, Kaua`i and the culture of old Hawai`i began its spiraling change (see Day 1992). Cook left Hawai`i for several months, but returned later in the year. Kalani'opu'u was fighting Kahekili's forces in Wailua, Maui on November 19, 1778 when Cook's ship was sighted on his return trip to the islands. Kalaniopu'u visited Cook on the *Resolution,* while Kahekili visited Clerke on the *Discovery* (Kuykendall and Day 1976:16). When Cook sailed into Kealakekua Bay on January 17, 1779, Kalani'opu'u was still fighting Kahekili on Maui. At this time Kahekili's brother, Kaeo was ruling chief of Kaua`i; Kahekili's nephew Ka-hahana of O`ahu and Molokai; Kalaniopu'u of Hawai`i and Hāna [eastern Maui]; and Kahekili of western Maui, Lāna`i and Kaho`olawe (Kamakau, 1992:84-86, 92, 97-98). On January 25th Kalaniopu'u visited Cook again at Kealakekua Bay, presenting him with several feather cloaks. By February Cook's scheme to kidnap Kalaniopu'u as a hostage were thwarted and Cook was killed following a skirmish over a stolen cutter (Kuykendall and Day 1976:18).

The warring between the Hawai`i and Maui forces continued. On his way to Kona from Ka`u, Kalani`opu`u was taken ill. He went instead to Ka`iliki`i at Waio`ahukini in Pakini where he died in January 1782. In 1781 a few months before the death of Kalani'opu'u, when Kahekili heard how ill

Kalaniopu`u was, he split his forces and sent them through the south-eastern Kaupō Gap and the north-eastern Ko`olau Gap into Hāna. After damming and diverting the supply of spring water to Pu`u Kau'iki, the Hawai`i chiefs were finally defeated, and the Maui *ali'i nui* regained control of Hāna in 1782 (Kamakau, 1992:84-86; 110, 115-116; Fornander 1900: Vol II 146-7, 150, 216).

> But what became of Ke`eaumoku and his family [wife Namahana and daughter Ka`ahumanu], whose home for years had been the hills of Hāna? Learning of the meditated invasion of the district, and unwilling to trust himself to the mercy of Kahekili, Ke`eaumoku fled with his family to the almost barren island of Kahoolawe, where he lived in seclusion until after the fall of Kauwiki and death of Kalaniopuu, when he boldly returned to Hawai`i, quietly settled on his old and inalienable estates at Kapalilua, in South Kona, and awaited the development of events, which he perceived were rapidly and irresistibly tending toward wide-spread revolution and disorder. For more than fifteen years he had heard the clash of arms only at a distance, and he yearned for the shouts of battle and the music of marching columns (Kalākaua 1888/1990:361).

Kahekili reclaimed Hāna, then through war and trickery went on to gain control of all the islands except Hawai`i (Kamakau 1992:116, 128-141).

> The O`ahu chief [Ka-hahana, foster son of Kahekili] was living in Nu`uanu Valley above Honolulu when he received word that Ka-hekili had landed on the beaches with a large fleet of war canoes and was gathering his warriors about him for an attack on the defenders of O`ahu. In January 1783, a decisive battle was fought. Ka`-hekili's wife, Kau-wahine, who was also a noted fighter, took part in this battle.... Confusion seized the ranks; the warriors of Ka-hahana were dispersed while he and his wife fled to the forest. Thus, O`ahu and Molokai were taken by Ka-hekili.... [However] fighting erupted on his home island of Maui among minor chiefs... [along with] the growing threat from Hawai`i.... Kahekili's son and designated heir, Ka-lani-ku-pule, was dispatched to Wailuku to prepare for the coming attack. Ka-lani-ku-pule took with him Maui's war leaders and Ka-hekili's best warriors, the battle-scarred veterans of the war on O`ahu (Speakman 2001:40-41).

In early 1790 when Captain George Vancouver made his first stop in the Hawaiian Islands he was told that Kalaniopu`u was dead; Hawai`i was ruled by Keoua Kuahu`ula (half-brother of Kiwala`ō), his uncle Keawe-mau-hili, and Keoua's cousin, Kamehameha (Day 1984:77). Vancouver went on to trade with Kalanikūpule in Waikīkī. He then found that the ruling chief of Kaua`i, Ka-umu-ali`i, was a mere child; his father Ka`eo was on Maui with Kahekili. Vancouver also noted a decrease in the population and the number of chiefs since the arrival of Cook (Kamakau 1992: 162-163).

In spite of the on-going battles, the foreign explorers and merchants were not deterred; foreign vessels continued to come to the islands.

> By 1790 several other foreign ships also visited the islands, helping to establish them as a "familiar resort for the fur traders" and as a "port of call and wintering place . . . for those engaged in the more general trade which grew up between Asia and the west coast of North and South America." [21] These voyagers included English Captains Portlock, Dixon, and Meares (seeking commercial development), and French naval vessels under the command of La Perouse.... Because of their excellent harbors and strategic location nearly equidistant from the coasts of the Orient and North America, the Hawaiiān Islands quickly became a primary stop ōn the Pacific trade routes. These islands contained more cultivated land than most of the other Pacific islands, forming "an oasis in the ocean desert" (Greene 1993: Chap II).

By 1790 Kamehameha I had gained enough control of the island of Hawai`i from his uncles and cousins that he could leave to join the war parties on Maui. His canoe fleet "beached at Hāna and extended from Hamoa to Kawaipapa" to battle Kalanikūpule, son of Kahekili (who now ruled from O`ahu). After several battles along the East Maui coast, Kamehameha's forces reached Wailuku where the "great battle" took place. This would be the beginning of the end of independent ruling chiefs because of the inequity

of battle strategy and weaponry. Kamehameha had brought a cannon from the *Eleanora* along with her captain, Isaac Davis, and crewmember John Young, who were now his *aikane punahele* (favorites) and advisors (Kamakau 1992:147-148). This battle of 1790 was known as the *Battle of Kepaniwai* where the bodies of fallen warriors dammed `Ī`ao Stream in Wailuku or "water of destruction" (Engebretson 2000:2).

> The bay from Kahului to Hopukoa was filled with war canoes. For two days there was constant fighting in which many of the most skilful warriors of Maui took part, but Kamehameha brought up the cannon, *Lopaka*, with men to haul it and the white men, John Young and Isaac Davis, to handle it; and there was great slaughter. Had they fought face-to-face and hand-to-hand, as the custom was, they would have been equally matched. But the defensive was drawn up in a narrow pass in `Ī`ao, and the offensive advanced from below and drew up the cannon as far as Kawelowelo`ula and shot from there into `Ī`ao and the hills about, and the men were routed. The victors pursued them and slew the vanquished as they scrambled up the cliffs.... No important chief was killed in this battle [mostly commoners]..."The damming of the waters" (Kapaniwai).... During the fight Ka-lani-ku-pule, Koa-lau-kani, Ka-mohomoho, the other chiefs escaped to O`ahu. Ke-ku`i-apo-iwa, Ka-lani-akua, and Ke-opu-o-lani were taken over the pass in `Ī`ao Valley to Olowalu, where they met Ka-lola's party and sailed to Molokai (Kamakau 1992:148).
>
> While Kamehameha was at Wailuku with his followers he heard of Ka-lola's being on Molokai with her daughters and granddaughter and he sent word by Kikane for her not to proceed to O`ahu as he was coming to escort her to Hawai`i. He sailed with a great company, among them Ke`eaumoku, Keawe-a-heulu, Ka-me`e-ia-moku, and Ka-manawa, the brothers of Ka-lola, and landed at Kaunakakai. They met Ka-lola at Kalama`ula and, when Kamehameha saw how ill she was and of an incurable disease according to kahuna's diagnosis, he asked, "Since you are so ill and perhaps about to die, will you permit me to take my royal daughter and my sisters [Ke-opu-o-lani, her mother Ke-ku`i-apo-iwa and aunt Ka-lani-hau-io-kikilo] to Hawai`i to rule as chiefs?" Kalola answered, "If I die, the girl and the sisters are yours." Then Kamehameha and all the chiefs waited until the death of Ka-lola [widow of Ka-lani-`opu`u; sister of Kahekili and highest ranking *ali`i*] (Kamakau 1992:149).

While Kamehameha was on Molokai waiting for the passing of Kalola, *kapu* chiefess of Maui, he sent two messengers to O`ahu; one to Kahekili and one to find the Kaua`i *kahuna* Kapoukahi of the *kahuna* order Hulihonua, as he was skilled in the art of reading omens and signs. It was he who advised that if Kamehameha wanted to rule over all the islands that he should build a great *heiau* at Pu`ukohola at Kawaihae (Kamakau 1992:149-150). The messenger to Kahekili threw down two *maika* stones, a black one and a white one. Kahekili asked if Kamehameha was coming to O`ahu to wage war and the messenger said yes. Kahekili then asked him where he would land. The messenger told Kahekili of the landing places that where advised and who advised Kamehameha. After commenting on each suggestion, Kahekili imparted a message for Kamehameha:

> Go back and tell Kamehameha to return to Hawai`i and watch, and when the black tapa covers Kahekili and the black pig rests at his nose, then is the time to cast stones. Then, when the light is snuffed out at Kahiki that is the time to come and take the land (Kamakau 1992:150).

While on Molokai Kamehameha heard that his cousin Keoua Kuahu`ula, Ka`u chief, had waged war on other chiefs of Hawai`i Island and had killed Keawe-ma`u-hili, the Hilo chief who had aided Kamehameha in the Maui battle, in spite of an agreement with Keoua that he wouldn't "fight the sons of Kahekili." Keoua took over Hilo then went on to Waipi`o where he destroyed the fishponds and plundered the taro patches and robbed the people from Waipi`o to Waimea, then went on to ravage Kohala. Kamehameha returned to Hawai`i Island from Molokai and proceeded to wage war on Keoua. Several battles later, both sides could not gain an upper hand. Although Keoua's warriors seized the muskets of Kamehameha, they didn't have the powder to make them work. It took an act of nature or the goddess Pele to turn the tide as Keoua's army was annihilated by a volcano eruption (Kamakau 1992:151-152).

In the meantime, Ka`eokulani, ruling chief of Kaua`i and brother of Kahekili heard what happened to his nephew Kalanikūpule on Maui; how they narrowly escaped death. And "how the waters of `Iao had been choked with the bodies of the slain in this war." He was so upset that he decided to wage war against Kamehameha (Kamakau 1992:148, 159). The shift in style of warfare that Kamehameha started during the *Battle of Kepaniwai* in Wailuku, Maui continued.

> [Ka-`eo-ku-lani] set out with [nephew] Pe`ape`a, son of Kamehameha-nui, his counselor of war, Ki`ikiki`i, Kai-`awa, and chiefs, warriors, and paddlers, all well armed with muskets and weapons of all kinds, and with his two man-eating dogs. (He also took with him) Maka`eha and Mr. Mare Amara [foreigner], a man skillful in the use of arms who acted as his gunner (Kamakau 1992:159).

On O`ahu Ka`eo met up with his brother Kahekili, ruling chief of O`ahu, Maui, Molokai and Lāna`i and persuaded Kahekili to join him in the war against Kamehameha. Kahekili left his son Kalanikūpule in charge of O`ahu and left for Molokai.

> The war party landed at Kaunakakai on Molokai, and when the Kaua`i chief saw for the first time, by the ovens they had left, the size of the camp which Kamehameha had occupied he said, "Where a big squid digs itself a hole, there crab shells are heaped at the opening." Upon their reaching Maui...the army camped at Wailuku and of Waiehu the Kaua`i chief remarked, "Here is the land of the warrior to whom Kamehameha owes his kingdom (alluding to Ke`eaumoku whose wife Namahana, brought him the land of Waiehu).... Waiehu fell to Ki`iki`i and it was, alas! The Kaua`i people who ate the poi of Waiehu.... Kahekili gave some of the land of Maui to the ruling chief of Kaua`i to be divided among his men, and Waiehu fell to Ki`iki`i. This caused discontent among the chiefs of Maui, who had thus to lose some of their land, and they rose against the Kaua`i chief. A battle was fought at Paukukalo adjoining Waiehu while some of the people were out surfing (Kamakau 1992:159-160).

It is not clear what happened right after that battle because what follows is Kahekili leaving Maui with his warriors from Kaupō; while Ka`eo sails for Hawai`i with his warriors from Hāna. However, they both land in Waipi`o and Ka`eo keeps his vow and "wantonly destroyed everything in Waipi`o" including the sacred places and the tabu threshold of Liloa...not even Keoua who has passed through there the year before and destroyed the land and the food, had made such wanton destruction" (Kamakau 1992:160). Kahekili in the meantime goes on to Halawa in Kohala where fighting occurs, then sails from Halawa and joins Ka`eo in Waipi`o. When Kamehameha hears about Ka`eo and Kahekili, he sails with John Young and Isaac Davis and meets up with Ka`eo and Kahekili at Waimanu cliffs. The battle of 1791 called *Kepuwaha`ula*, was a stand-off with loss to both sides. Kahekili left and returned to Maui (Kamakau 1992:161-162).

Kamehameha decided to take the advice of the Kaua`i kahuna Kapoukahi and build a *heiau* at Pu`ukohola. Kamehameha personally helped to construct the heiau Pu`u Koholā in the summer of 1791, to assure his victory over his cousin, Keoua Kuahu`ula, son of his father's older brother. Messengers were sent to Keoua to ask him to come to the *heiau* so that there would be peace between the cousins. Keoua left Ka`u with a fleet of twenty-seven canoes. As he sailed into Kawaihae Bay at Mailekini, Ke`eaumoku thrust a spear at Keoua, which he dodged, snatched and thrust back. Suddenly muskets were fired from the shore, leaving Keoua and all the others from his canoe dead. The rest of Keoua's warriors were spared when Kamehameha declared the law of the broken paddle [*Mamalahoa*] (Day 1984:77; Kamakau 1992:154-157).

Vancouver returned to Hawai`i Island in February 1793 to find all the chiefs wanting guns and powder. Instead he gave Kamehameha a bull and heifer from California and asked that all the chiefs stop fighting. In March he sailed to Lahaina and saw Kahekili who was an old man. He also asked Kahekili to stop the fighting. Kahekili said that "it was not right for the chiefs of Hawai`i to raid Maui and rob and pillage without cause." He told Vancouver he should stay and guard him against further wars. Vancouver went

on to O`ahu to see Kalanikūpule, then to Kaua`i before going to North America. It was the last time Vancouver saw Kahekili who died later that year at the age of eighty-seven, after becoming ill and returning to Waikīkī, O`ahu. His bones were carried by his twin brothers Ka-me`e-ia-moku and Ka-manawa and hidden in a secret cave in Kaloko, North Kona. His gods were Ku-ke-olo-ewa, Kuho`one`e-nu`u, Kalai-pahoa, Ololupe, Kameha`ikana, Kala-mai-nu`u, Kiha-wahine, Haumea and Wali-nu`u (Kamakau 1992:164-166).

On Vancouver's third visit to the islands in 1794, Kamehameha I was ruling chief of Hawai`i; Ka`eo was ruling chief of Maui, Molokai and Lāna`i; Kalanikūpule of O`ahu and Kau`muali`i of Kaua`i. Then Ka`eo got tired of Maui and wanted to go back to Kaua`i. Not knowing what his uncle's plans were Kalanikūpule prepared for war. A few skirmishes and reconciliations took place that year on O`ahu, but as Ka`eo prepared to embark to Kaua`i from West O`ahu he discovered a conspiracy among some of his chiefs who were planning to throw him overboard in mid-ocean. He dismantled his canoe and proceeded to make war on Kalanikūpule. Ka`eo won a couple of skirmishes, but in the end was defeated in Ai`ea by Kalanikūpule who was aided by foreign vessels in Pearl Harbor, guarding the shores with guns and cannons. Ka`eo died in mid-December 1794 (Kamakau 1992:168-169).

The captain and some of his crew of the foreign vessels were then tricked and killed. Kalanikūpule confiscated the vessels and munitions with the intention of sailing to Hawai`i to overtake Kamehameha. Just one day out they all got seasick and had to return to Waikīkī with Kalanikūpule and his wife still on board. The foreigners sailed off during the night, but put Kalanikūpule and his wife aboard a canoe and let them go back to O`ahu. The foreigners then sailed for Hawai`i Island to tell Kamehameha what happened and to give him all the munitions on board (Kamakau 1992:170-171).

Demographic trends during the Proto-Historic Period indicate a population reduction in some areas, yet show increases in others, with relatively little change in material culture. There was a continued trend in craft and status material, intensification of agriculture, *ali`i* (chief) controlled aquaculture, upland residential sites, and oral records which were rich in information. The Ku cult, *luakini heiau,* and the *kapu* (restriction or regulation) system were at their peak, although western influence was altering the cultural fabric of the islands (Kirch 1985:308, Kent 1983:13). By 1794 American, English, Irish, Portuguese, Genoese, and Chinese foreigners were living in the islands (Day 1992:23-25).

B-5. Early Historic Period. The Early Historic Period (AD 1795-1900) is marked by very significant events. Kamehameha left Hawai`i Island in early 1795 and landed in Lahaina, taking over all the food patches and cane fields before leaving for Molokai where the "whole coast from Kawela to Kalama`ula was covered by canoes. There on Molokai he awaited for the proper time to sail for O`ahu, where the chiefs and warriors of Kalanikūpule were slaughtered; by the *Battle of Nu`uanu* O`ahu, Molokai, and Lāna`i were conquered (Kamakau 1992:170-171). Kamehameha took Keku`iapoiwa Liliha and Kalanikauiaka`alaneo to O`ahu to witness the Battle of Nu`uanu Pali and the defeat of O`ahu. It was during this trip that Kalanikauiaka`alaneo was given the name Ke`ōpūolani (Klieger 1998:21).

When Kamehameha conquered O`ahu and Maui (with the help of western advice and technology), and subsequently unifying the Island Kingdom (Kent 1983:16), it marked the end of the Proto-Historic Period. In 1802 and 1803, Kamehameha I and his court resided in Lahaina where he had a two-story brick house built (Alexander 1953:63). Lahaina became the capitol of the islands (except for Kaua`i). This was short-lived, however, as Kamehameha I moved to Honolulu in 1803 (Klieger 1998:22). In 1802 on the island of Lāna`i a Chinese man named Wong Tze Chun is believed to have been the first person to mill sugar cane (WSC 1962:7); he came to Hawai`i as part of the sandalwood industry. In 1803 the first horses landed in Hawai`i from California (WSC 1962:7).

Hawai`i's culture and economy continued to change radically as capitalism and industry established a firm foothold. In 1810, Kaua`i *ali`i nui* Kaumuali`i ceded his kingdom of Kaua`i, Ni`ihau, Lehua and Ka`ula to Kamehameha. At this time the sandalwood trade in Hawai`i was flourishing; the Fijian and

Marquesan supply of sandalwood was exhausted. Sandalwood came under the personal control of Kamehameha I, who had become "a fervent consumer of high-priced western goods." The sandalwood industry was thriving to the point where the subsistence levels declined, as farmers and fishermen spent most of their time logging, causing famine to set in (Kent 1983:17-20). Hawai`i became known as "Tan Heong Shan" or the "sandalwood mountains" to entrepreneurs of Southern China, who first came as early as 1794 in search of this prized wood (WSC 1962:41).

On October 1819, seventeen Protestant missionaries set sail from Boston to Hawai'i. Earlier that year, on May 8, 1819, Kamehameha I died at Kamakahonu, Kailua, Hawai`i Island. Following his death, his son and heir Liholiho banished the *kapu* system at the advice of his queen mother Keōpūolani and Ka`ahumanu (Kamakau, 1992:210, 222). The missionaries arrived in Kailua-Kona on March 30, 1820, to a markedly changed culture; one with a "religious" void, and a growing appetite for western products. They quickly started missions on all of the islands. In 1820 Lahaina was proclaimed the capital of Hawai`i; this lasted until 1845 (Wisecarver 1983:18) when the court moved to Honolulu.

Ka`ahumanu, the *kuhina nui* of Kamehameha II (Liholiho) was not automatically a convert to Christianity, however, when she finally embraced it, it was with tremendous zeal. Missionary Bingham (1847:162) wrote an entry in his journal in 1822:

> Kaahumanu with husband made tour of windward islands with a large retinue, including sister Namahana [II], her brother-in-law Laanui.... and while on this pleasure-seeking tour, searched out and destroyed many idols. On the 4th of June, she sent for Kalaipahoa, the so-called poison deity, and caused it to be publicly burnt, with nine other images. On the 26th of the same month, one hundred and two idols, collected from different parts of Hawai`i, where they had been hidden 'in the holes of the rocks and caves of the earth,'... [were] committed to flames.

During this period, "between one hundred and two hundred foreigners lived in the islands.... Hardly a ship touched without leaving a deserter or two behind.... A white man automatically ranked as a chief, although he could not own land in fee simple or build a permanent house...[and] they took Hawaiian wives" (Day 1992:25). Kamakau comments on the influence of the missionaries on Maui in the following excerpt:

> The island of Maui, the "haven of Pi'ilani," is famous as the place where the word of God was first accepted as the guide to good conduct.... At the haven of Pi'ilani was the word of God first used to protect the laws and to punish wrong doing and law breaking. At the haven of Pi'ilani laws were proclaimed and enforced against adultery, prostitution, liquor drinking, stealing, taking life and other misdeeds.... There were too many petty laws made at this time at the haven of Pi'ilani, such as laws against smoking, tattooing, knocking out teeth (Kamakau, 1992:353).

In the 1820s and 1830's other industries such as whaling, merchandising and sugar crept into Hawai`i. "For the first time Hawaiian masses were drawn to a cash economy as workers and producers." In 1823 the first sugar mill, Hungtai at Wailuku, Maui was started by two Chinese men, Ahung and Atai (Dorrance and Morgan 2001:15). However, the first sugar plantation was established on Kaua`i in 1836 (Kent 1983:22, 23, 29). By 1825 most of the powerful chiefs/cheifess' had become Protestant Christians. In 1926 C. Brewer & Co., Ltd. Was founded by Captain James Hunnewell; Captain Charles Brewer established the company on a permanent foundation so the company bears his name. It was the oldest business west of the Rocky Mountains and included hides, skins and the whaling industry (Wisecarver 1983:19), soon to be followed by the sugar industry.

Hawai`i also became the principal stopover base for the whaling industry, and Lahaina, Maui became one of the leading whaling towns. In 1831, the Sandwich Islands Mission set up a school on a hill above Lahaina, Maui, "to educate young Hawaiians as teachers and preachers" (Day 1992:47), on land given to missionary Lorrin Andrews by Kalakua, a.k.a. Hoapili-wahine, mother of Kamamalu, wife of Kamehameha II (Alexander 1953:65, 69). In 1835 Governor Hoapili of Maui issued an edict that required all children over the age of four to attend school (Wisecarver 1983:21).

The 1840s also heralded other changes as well. The Hawaiian government, with the aid of the missionaries, encouraged the sugar industry as well as other enterprises such coffee, cotton, rice, potatoes, and silk worms (Speakman 2001: 93).

> Many of the earliest Chinese residents in Hawai`i were knowledgeable in sugar production, the *tong see* (sugar masters), establishing successful plantations on Maui and Hawai`i (Speakman 2001:90).... In 1840, on Maui, several Chinese had mules in operation and made sugar on shares. The *Sandwich Island Mirror* for May-June 1840 stated that "the sugar made at Maui is said to be of much better quality than at O`ahu and Kaua`i (Speakman 2001:92).

In1846 there were only eleven mills in Hawai`i manufacturing sugar and molasses; two on Kaua`i, three on Hawai`i Island and six on Maui (WSC 1962:10). The whaling industry was at its peak between 1846 and 1860 with almost 600 ships reaching Hawai`i ports in one year. But the late 1850s saw a decline in the whaling industry with the discovery of oil in Pennsylvania, the Civil War, and the sinking of at least forty whale ships by the Union to block the harbors; as well as the early freeze in the Bering Strait in 1871 which trapped thirty-three ships. Although the crews escaped, five hundred Hawaiian sailors returned home penniless (Speakman 2001:88-89).

In the mid-1840s a political act of the Hawaiian Kingdom government would change forever, the land tenure system in Hawai`i and have far-reaching effects. The historic land transformation process was an evolution of concepts brought about by fear, growing concerns of takeovers, and western influence regarding land possession. King Kamehameha III, in his mid-thirties, was persuaded by his *kuhina nui* and other advisors to take a course that would assure personal rights to land. One-third of all lands in the kingdom would be retained by the king; another one-third would go to *ali`i* as designated by the king; and the last one-third would be set aside for the *maka`ainana* or the people who looked after the land. In 1846 he appointed a Board of Commissioners, commonly known as the Land Commissioners, to "confirm or reject all claims to land arising previously to the 10th day of December, AD 1845." Notices were frequently posted in *The Polynesian* (Moffat and Kirkpatrick, 1995). However, the legislature did not acknowledge this act until June 7, 1848 (Chinen 1958:16; Moffat and Kirkpatrick 1995:48-49), known today as *The Great Mahele*. In 1850, the Kingdom government passed laws allowing foreigners to purchase fee simple lands (Speakman 2001:91).

Disease had a devastating affect on the population and the landscape, killing *ali'i* and *maka'ainana* alike; measles epidemics in 1848 and 1849, was followed by the horrendous smallpox epidemic in 1852/1853. Ten thousand people are said to have died of this disease in Hawai`i (Kamakau, 1992:411, 418). "On Maui there was approximately a one-third fatality among the local population" (Wisecarver 1983:25). John Papa `I`i in *Fragments of Hawaiian History* (1984) talks about the impact of this disease and as *kahu* or guardian of several young *ali`i*, he had to take several of them off of O`ahu island. They just kept sailing from island to island and usually were not allowed to land as O`ahu was thought to be the source of the smallpox. On one part of their journey they came to west Maui.

> Passing Honokohau and Kaanapali, they saw a white flag at Lahaina where people from Oahu were not allowed to land because of the smallpox. They went from the ship to the fort, where they remained apart until the Sabbath and where their prayer meeting was held (`I`i 1984:171).

By 1858 at least 2,119 foreigners lived in Hawai`i. Many were merchants who traded with whalers, while the missionaries lived in various locations throughout the islands. The foreigners also included one hundred and eighty Chinese contract laborers from Hong Kong. The first contract field laborers to arrive on Maui were Chinese; mostly Hakka from Kwangtung Province (Speakman 2001:109). Some "foreigners engaged in agricultural pursuits with the idea of reaping a profit from the land, in contrast with the Hawaiians, who carried on...subsistence agriculture" (Coulter 1971:11).

The U. S. Civil War of the 1860s brought about a boost for the sugar industry in Hawai`i as sugar plantations in the South were boycotted or destroyed. Sugar enterprises all over Maui emerged

(Speakman 2001:91, 94, 96). At least two sugar ventures (Parson's sugar mill and Dickenson's Lahaina Sugar Company plantation) where in operation in Lahaina prior to 1860. James Campbell, Henry Turton and James Dunbar formed a partnership in 1860 and started the Lahaina Mill on lands deeded to them by Benjamin Pittman. They too, milled sugar cane supplied by independent local sugar planters. Dickenson went bankrupt in 1863 and sold out to the partners.

The rise in the number of plantations brought about a radical change in both the population in general, and the number and ratio of foreigners to native Hawaiians. As more and more labor was needed to accommodate the expanding industry, plantations sought laborers from several countries.

> Statistics...show that far from being unsuited to plantation labor, or considered inefficient workers, Hawaiian labor was considered the best obtainable by many planters. As late as 1869 some plantations employed Hawaiian labor exclusively.... 'The true reason why there is a dearth of Hawaiian labor is the increase of the planting interests from some 2,000,000 of pounds in nine or ten years to 18 or 20,000,000, requiring from eight to ten times as many men now as then.' This source found more Hawaiians employed in such labor than ever before, and statistics for that year (1873) showed that out of 3,786 laborers employed on thirty-five plantations, 2,627 were Hawaiian men and 364 were Hawaiian women.... Nevertheless, the population decline was palpable and became a matter of public concern for the kings and their advisors, of the Hawaiian legislature, and of the sugar planters.... Immigration of labor from China and Japan [filled] the population and labor gap...it was from these two countries that the largest contingents of immigrants came, though supplemented by Caucasians, including Portuguese, and Filipinos, Koreans, Puerto Ricans, Germans, Pacific Islanders and many others.... In that period the population rose from 55,500 in 1876 to 154,000 in 1900. The following table shows the changes in percentages (Speakman 2001:107-108):

	1876	**1900**
Hawaiian & Part-Hawaiian	89.2%	26.0%
Caucasian	6.3%	17.5%
Oriental	4.5%	56.5%

In the mid-1870s the Lahaina Mill partners, Campbell, Turton and Dunbar, bought out the plantation formed by Lot Kamehameha and others. The plantation agent for the partners was the firm Walker & Allen, but they were replaced by a German outfit, H. Hackfeld and Company in 1877 (Conde 1973:252 in Jensen & Mehalchick 1992:9). The Lahaina Mill apparently changed hands and was incorporated in 1885 and 1895 by C.F. Horner and Paul Isenberg as Pioneer Mill Company, Ltd. (Goodwin & Leineweber 1997:23). [During WWI (ca. 1918), H. Hackfeld and Company was acquired by an American entity and the name was changed to American Factors, Limited or Amfac, Ltd. More on Pioneer Mill Company elsewhere in this report.]

There were eighteen sugar plantations on Maui in the 1890s: `Ulupalakua, Kīpahulu, Hāna, Reciprocity [Makaalae], Huelo, Ha`ikū, Hāmākua Poko, Pā`ia, Paliuli (now Makawao Union Church and the site of the mill where Baldwin lost his arm), Hawaiian Commercial & Sugar Company [HC&S Co.], Kihei, Waihe`e, Waikapū, Wailuku, Olowalu, Pioneer Mill, Grove Ranch, and East Maui Plantation (WSC 1962:54). The Overthrow of the Hawaiian Kingdom in 1893 and the subsequent annexation to the United States in 1898 (Daws 1974:289-290) heralded even more radical changes to the Hawaiian culture and to the local landscapes.

B-6. Territorial History (AD 1900-1959). In 1900 Hawai`i had a population totaling 154,000 of whom only 29,799 were pure Hawaiians, 7,857 part-Hawaiians and the rest of 116,244 consisting of many other races (Wisecarver 1983:13). This period saw Native Hawaiians running for Congress (Daws 1974 297); and much of the lands being sold in fee simple. The Organic Act was effective on June 14, 1900 and Hawai`i became a Territory of the United States; in 1901 the first Territorial Legislature convened and passed the first income tax law (WSC 1962:26). Two World Wars during this period were to have far reaching effects in west Maui. Pioneer Mill Company manager L. Weinzheimer was asked to resign in

1918 due to his open patriotic sympathies with his homeland, Germany during World War I (Hamilton 2001:71). In the 1940s, World War II also had some lasting influence on lives and industries as young men left the islands by the hundreds, for the front lines abroad.

B-7. Modern History (AD 1950-). Post World War II brought about an influx of people and industries to Hawai`i, allowing the tourism industry and offshoot enterprises to flourish. Along with the rise of the tourism industry, and competing sugar markets abroad, the sugar companies saw a sharpening decline in business (the Sugar Acts of 1934 and 1937, and ILWU Strike of 1946 didn't help). 1950 marked the introduction of radiocarbon analysis which shifted the focus of study in archaeology to excavation as a primary method of data recovery, with a research focus on settlement patterns, subsistence, land and marine use. The 1950s and 1960s were the bleakest years for the sugar industry and it was becoming apparent that the sugar industry was beyond salvage (Kent 1983:107-108). More changes were soon to take place on the landscapes of Hawai`i.

In the 1960s, various federal and state environmental and historic preservation laws and regulations were passed, mandating surveys and impact studies of the landscape, prior to development. An interesting story regarding these land changes involves American Factors (Amfac) a member of the 'Big Five,' giants of the sugar plantation and pineapple era. In the late 1950s a company director "was urging the sale of some land to help finance the development of a resort." Another director informed him that "we in the Islands don't sell land."

> This had been essentially true for American Factors and others of the Big Five for many decades. Having acquired land, they held it.... But what worked satisfactorily in the second half of the nineteenth century and the first half of the twentieth was not necessarily good business in the changing times that came upon Hawaii with such things as the land boom, statehood, and the era of conglomerates and multinational corporations. Whether American Factors and the rest of the Big Five initially wanted to or not, they found that they had to get involved in land sales, and land development, on a large scale (Cooper & Daws 1985:208).

Amfac's Pioneer Mill Company "owned immensely important lands in west Maui, in and around Lahaina, on which Amfac later built the Island's first and most successful destination resort, Kaanapali" (Cooper & Daws 1985:211). The world class Kā`anapali Resort development was launched in 1960. Also in the 1960s, various federal and state environmental and historic preservation laws and regulations were passed, mandating surveys and impact studies of the landscape, prior to development. Technology and mechanization initiated in the 1950s to 1970s helped to bring about the decline of plantation camps and lifestyles, yet in 1959 "one out of twelve people employed in Hawaii was in the sugar industry" (Vorfeld 2002:1). However, technology could not save the sugar industry, which could not compete with unfavorable sugar markets and higher costs. By the 1990s most of the sugar plantations reluctantly closed down operations. The vacant lands soon gave way to various development projects and the need for more Environmental Impact Studies (EIS). However, the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA) and its implementing regulations (43 CFR Part 10) shifted the focus of study to include a greater interaction with indigenous peoples, and a lesser focus on invasive methods of study. In 1999, after almost 140 years in the sugar industry, Pioneer Mill Company ceased harvesting cane (Speakman 2001:106). In 2000 Hawai`i Legislature passed an EIS amendment resolution which the governor signed as Act 50. This legislation has broadened the scope of environmental impact studies to include cultural impact studies to assure that traditional Hawaiian and other ethnic cultural practices are not adversely impacted, as vacant sugar fields give way to the ever-growing populations and expanding tourist and real-estate industries.

C. Traditional Literature

The ethnographic works of the late 19th and early 20th century contribute a wealth of information that comprise the traditional literature--the *mo'olelo, oli,* and *mele*--as well as glimpses into snippets of time, and a part of the Hawaiian culture relatively forgotten. The genealogies handed down by oral tradition and later recorded for posterity, not only give a glimpse into the depth of the Hawaiian culture of old, they provide a permanent record of the links of notable Hawaiian family lines. The *mo'olelo* or legends allow *ka po'e kahiko*, the people of old, the *kupuna* or ancestor, to come alive, as their personalities, loves, and struggles are revealed. The *oli* (chants) and the *mele* (songs) not only give clues about the past, special people, and *wahi pana* or legendary places, they substantiate the magnitude of the language skills of *na kupuna kahiko* (the people of old).

Several snippets of the *mo`olelo* and *mele* have already been used as references or chronology markers in the 'Overview of Human Impact, Settlement and Socio-economic Development...' above. The following sections give a little more detail and explanation of the traditional literature.

C-1. Genealogies. *Po'e ku'auhau* or genealogy *kahuna* (masters) were very important people in the days of old. They not only kept the genealogical histories of chiefs "but of *kahunas*, seers, land experts, diviners, and the ancestry of commoners and slaves.... An expert genealogists was a favorite with a chief." During the time of 'Umi genealogies became *kapu* (restricted) to commoners, which is why there "were few who understood the art; but some genealogists survived to the time of Kamehameha and even down to the arrival of the missionaries" (Kamakau 1992:242).

Surviving genealogies illustrate that the ruling families of each island were interrelated quite extensively. The chiefs of O`ahu, Kaua`i, Hawai`i, Maui and Molokai had one common ancestry. Families branched out, but conjoined several times in succeeding generations (Kamakau in McKinzie, 1983: xxv). Not only were the chiefs or *ali'i* related to each other, they were also related to the commoners. In *Ruling Chiefs,* Kamakau states that "there is no country person who did not have a chiefly ancestor" Kamakau (1992:4). In the following passage Kamakau (1992) explains how some of the *ali'i* were connected.

> It is said that the chiefs of Hawai'i island were from Maui and from O`ahu and Molokai between the times of 'Aikanaka and Hanala'anui. Thus 'Aikanaka was the chief of Koali and Mu'olea in Hāna; Hema, the chief of Ka'uiki in Hāna; Kaha'i, the chief of "Īao in Wailuku; Wahieloa, the chief of Papauluana in Kīpahulu. Laka the chief was born at 'Alae in Kīpahulu, Maui; he ruled in Ko'olaupoko, O`ahu; the site of his house, Hale'ula, was at Waikane, O`ahu (Kamakau, 1991:101).

Malo (1971) also wrote about the connection between the *maka'ainana* and the chiefs. "Commoners and *ali`i* were all descended from the same ancestor, Wakea and Papa" (Malo, 1971:52). This is evident in the genealogies. Genealogies were very important to the chiefs, because ranking was very important. The genealogies not only indicated rank, they ascertained a link to the gods. The following excerpt explains the idea and importance of rank and the role of genealogies:

> Position in old Hawai`i, both social and political, depended in the first instance upon rank, and rank upon blood descent—hence the importance of genealogy as proof of high ancestry. Grades of rank were distinguished and divine honors paid to those chiefs alone who could show such an accumulation of inherited sacredness as to class with the gods among men...a child inherited from both parents.... The stories of usurping chiefs show how a successful inferior might seek inter-marriage with a chiefess of rank in order that his heir might be in a better position to succeed his parent as ruling chief...a virgin wife must be taken in order to be sure of child's paternity—hence the careful guarding of a highborn girl's virginity (Beckwith: 1990:11).

One could defend and/or prove their rank by knowing or having one's genealogist recite one's genealogy. "To the Hawaiians, genealogies were the indispensable proof of personal status. Chiefs traced their genealogies through the main lines of 'Ulu, Nana'ulu, and Pili, which all converged at Wakea and Papa (Barrere, 1969:24). Two well-known genealogy chants are the *Kumuhonua* and the *Kumulipo.*

C-1-a. Kumuhonua. The *Kumuhonua*, first published by Fornander in 1878, in *The Polynesian Race* Vol. I, was based on information from Kamakau and Kepelino. Kumuhonua, the man, was of the Nanaulu line, and the older brother of Olopana and Moikeha (McKinzie 1986:14-15). However, the birth chant *Kumuhonua* has been a subject of controversy as noted in following *Preface* by Kenneth P. Emory:

> We have become painfully aware that the Kumuhonua 'legends' are not ancient Hawaiian legends, nor is the genealogy which accompanies them a totally authentic genealogy...in his second volume (1880) when he relates events from the period of the arrival in Hawai`i of migrant chiefs from Tahiti to the time of Kamehameha, in these writings he is dealing with relatively untampered, authentic Hawaiian traditions and genealogies...we must ever be on guard against the effects of this impact in what was recorded subsequently about the pre-contact period..... The world of the Polynesian began to be transformed overnight by Western influence." (Barrere, 1969: i).

Some of the *Kumuhonua* legends were recorded by Kamakau and Kepelino between the years 1865 and 1869, however, the 'genealogy' of the *Kumuhonua*, published by Fornander, was given to him "to provide credibility to the legends...this 'genealogy' (was) constructed from previously existing genealogies--the *Ololo* (*Kumuhonua*) and the *Paliku* (*Hulihonua*) which are found in the *Kumulipo* chant (see Beckwith 1951:230-234) and interpolations of their own invention" (Barrere, 1969:1).

C-1-b. Kumulipo. A better example is the famous Creation Chant *The Kumulipo.* Feher (1969) has several notable Hawaiian scholars write passages in his *Kumulipo: Hawaiian Hymn of Creation-Visual Perspectives by Joseph Feher.* In the *Introduction* Momi Naughton states "The Kumulipo belongs to a category of sacred chants known as *pule ho'ola'a ali'i,* 'prayer to sanctify the chief,' which was recited to honor a new-born chief (Feher, 1969:1).

In her passage, Edith McKinzie states:

> "The *Kumulipo* is a historical genealogical chant that was composed by the court historians of King Keaweikekahiali'iokamoku of the island of Hawai'i about 1700 AD in honor of his first born son Ka-lani-nui-'I-a-mamao. This important chant honors his birth and shows the genealogical descent of both the *ali'i* (chiefs) and the *maka'ainana* (commoners) from the gods, in particular Wakea...." (Feher, 1969:1).

In a passage by Roger T. Ames, he corroborates this idea and states that "what is of particular humanistic interest is the way in which the *Kumulipo* as a repository of cultural authority served Hawaiian society in transmitting its cultural legacy and organizing its community. In doing so, it combines both a linear sense of temporal development and the richness of one particular moment in time" (Feher, 1969:3).

C-1-c. *Hawaiian Genealogies.* Edith McKinzie completed the first volume of *Hawaiian Genealogies* in 1883, based on genealogy articles translated from 19th Century Hawaiian newspapers such as *Ka Nonanona* and *Ka Nūpepe Kū`oko`a* in the late 19th century and early 20th century. These articles were in response to a call to preserve the Hawaiian heritage. Some of the information came from Malo's (1838) *Hawaiian History*, and in Fornander's (1880), *The Polynesian Race* (Book I) (McKinzie, 1983:1).

The ruling chiefs of the various islands came from combinations of genealogies or branches. Most of the people in the Maui Line below are in a loose chronological order, however, the multiple unions of a particular person is not necessarily in a chronological order, as much of that information was not provided in most cases. These Tables are not by any means inclusive as many lesser unions (mates and offspring) were not listed or recorded in official genealogies.

The following Table 1a & 1b of the Maui Line are extracted from McKinzie's works (1983, 1986) as well as other sources such as Kamakau (1992). They illustrate the various family connections.

Table 1a. Maui Line, genealogies extracted from McKinzie (1983, 1986); and Kamakau (1992).

Kane	Wahine	Keiki
Hanuli`aiki	Kapukapu`	Mauiloa (14 generations before the following)
Kaulaheanuiokamoku 1	Kapohanaupuni	Kakaalaneo
"	"	Kakae
Kakaalaneo	Kaualua	Kaihiwalua (also had Kaululaau)
Kaihiwalua	Kahekilimanuahumanu	Luaia
Piliwale (Ewa--O`ahu *ali`i nui)*)	Paakanilea (Lihue, Kaua`i)	Kukaniloko
"	"	Kohepalaoa (Pi`ilani's mother)
Luaia (Maui *mo`i*)	Kukaniloko (O`ahu)	Kalanimanuia
Kakae (`Iao /Olowalu-Maui mo`i)	Kapohauola	Kahekilinuiahumanu 1
Kahekili 1	Haukanuimakamaka	**Kawau**kaohele (Pi`ilani's father)
"	"	**Kelea**nuinoho`ana`api`api (Pi`ilani's wife's ma)
Kawaukaohele (Kawaokaohele)	**Kepalaoa**	**Pi`ilani**
Pi`ilani	Kunuunuikapokii	Kalamakua
Kaloanui (Waikiki)	Kaipuholua	Kalamakua-a-Kaipūhōlua
Kalamakua (Waikiki Chf)	**Kelea**nuinohoanaapiapi	**Laielohelohe** (B/R on O`ahu)
Pi`ilani	Mokuahualeikea	Kauhiiliulaapiilani
Pi`ilani (Cousins)	**Laielohelohe**	**Lonoapiilani**
"	"	**Pi`ikea**
"	"	Kalaaiheana 2--.De Fries Family
"	"	**Kihapiilani**
"	Kumunuikapokii	Nihokela → W.C. Lunalilo
"	Kuamookea	Kauhiiliulaapiilani
Lonoapiilani	Kealauawauli	Kaakaupea
Umi-a-Liloa	Piikea	Aihakoko
"	"	Kumalaenuiaumi→Lili`uokalani
Hoolae (Kauiki Chief)	Kaululena (Waiakea Chfs)	Koleamoku
Kihapiilani	Kumaka (Hāna)	Kamalalawalu (Maui Chief)
"	Koleamoku	Kauhiokalani→Aea family p 89
"	Umahauuleiohua	Kapuiholani Kuaimanuu →Luahine Family
"	Hilima	Keaweau
"	"	Moemoe→ Heleluhe family
(Kumalaenuiaumi	Kunuunuipuawalau	Makua)
Kauhiokalani	Kauamanu	Makaku
Kamalalawalu	Pi`ilaniwahine(Hilo/O`ahu)	Kauhiakama (k)
"	"	Umikalakauchuakama (k)→ Kawaihae line
"	"	PaiKalākauaakama (k)
"	"	Piilanikapu/Piilanikapokulaniokama (w)
"	"	Ka`unohohoikapelapuokakae (w)
"	"	Kekaikuihalaokeku`imanano (w)
Kauhiakama	Kapukini-2	Kalanikaumakaowakea (Maui king)
Kalanikaumakaowakea	Kaneakauhi	Lonohonuakini
"	Makakuwahine	Umialiloa-2
Lonohonuakini	Kalanikauanakinilani	Kaulaheanuiokamoku
Kaulaheanuiokamoku	Papaikaniau	Kekauliki (Father of Kahekili 2)
Kalanikauleleiaiwi	Kekuiapoiwa Nui	("Kekaulike, King of Maui of the bays of Pi`ilani.")
Kekaulike	Kahawalu	Kauhiaimokuakama
"	Holau	Manuhahipo
"	"	Kakauhiwamoku
"	"	Ka`eokulani (Kaua`i rulingchf/father/Ka`umualii)
"	?	Kuhoohiehie

Table 1b. Continued, Maui Line.

Kane	Wahine	Keiki
Kekaulike	Haalou	Namahanaikaleleonalani→ Ka`ahumanu
"	"	Kekuamanoha
Kekaulike (sibs)	Kekuiapoiwa Nui	**Kamehameha Nui** (king of Maui)
"	"	Kalola
"	"	**Kahekili**nuihumanu 2 (Iron king of Maui)
"	"	Ku
"	"	Naaiakalani
"	"	Manuailehua
"	?	Kaeokulani (King of Kaua`i)
"	?	Manuhaaipo (Queen of `Iao)
"	?	Ahia
"	?	Nahulanui
Kamehameha Nui (sibs)	Kalola (Maui)	Kalaniakuaiokikilo/Kalaniwaiakua (Kapu)
" (Cousins)	**Namahana**ikaleleonalani	Pele-io-holani [?]
"	"	**Kuakini**lokalani
Keeaumoku	"	**Ka`ahumanu** (b Ka`uiki, Hāna)
"	"	Opiia
"	"	Kaheiheimalie
"	"	Kahekili Keeaumoku 3
"	"	Kuakini
"	Kamaka`imoku	Keoua
"	Namahana	?
Keeaumoku	"	Ka`ahumanu
k = kāne; w = wahine		

Youngblood (1992) found that he could draw on both Fornander and Beckwith's translations of *The Kumulipo* to sketch a socio-political history of Hawai`i (Youngblood, 1992:34). In his re-creation he found that stemming from Wakea and Papa are two major Hawaiian genealogies/branches: the *Nana'ulu* and the *'Ulu*. The *Nana'ulu* was the wellspring for the *ali'i* of O`ahu and Kaua`i, while the *'Ulu* line supplied the chiefs of Maui and the Big Island.

Using thirty years to account for one generation, McKinzie determined that Wakea was born in AD 190; Umi-a-Liloa in 1450; Keawekehahialiiokamoku in 1650, Kalanihuiikupuapaikalanui Keoua in 1710; and Kamehameha I in 1740" (McKinzie, 1983:12). Volume Two of *Hawaiian Genealogies* was published in 1986 and consists of information extracted from genealogical lists published in thirteen Hawaiian language newspapers from 1858 to 1920. It compliments genealogies found in other works, such as Fornander's (1880) *An Account of the Polynesian Race...* and David Malo's *Hawaiian Antiquities* (McKinzie, 1986: v).

The following excerpt is from Kamakau's article in *Ka Nūpepe Kū`oko`a* October 7, 1865, and was translated by McKinzie (1986). It illustrates some of the mid-19th century sentiment regarding genealogies:

> *I na makaainana, he mea waiwai `ole, no ka mea ua papa ko lakou mau makua o hoohalikelike, a hoohanau keiki o ke kuaaina a pii aku i na li`i. Nolaila ia ao ole ia ai na keili a na makaainana, ma kahi makuakane a makuahine, a kupuna aku no.... Ia kākou i ka po`e o kēia wa, `a`ole waiwai o kēia mea he mo`o ali`i `a`ole a kākou mau kuleana nui i loko. Aka, ma ko kākou noonoo iho he waiwai nui. Ua komo kākou i loko, ua waiwai na`li`i i na kūpuna; a ua waiwai pu kākou i ko`o kākou ike ana. No ka mea, ua kapu i ka maka`āinana` a`ole e ike i ke `ai mea. Aka, no ka pi`i ana i ka na`auao a me ke akamai o na keiki a na maka`āinana; no laila, ua noa na wahi kapu, ua pi`i waleia. O ke koeana mai o na kupuna oia kahi waiwai.*

To the commoners, a genealogy was of no value because their parents forbad (sic) it lest comparisons should occur and country children be born and rise up as chiefs. Therefore, the children of the commoners were not taught beyond father, mother, and perhaps grandparents.... To us, the people of this time, there is no value of this thing of a chiefly lineage; we have no great interest in it. But in our thoughts it is of great value. We have entered into discussion of it; the chiefs valued the chiefs and ancestors; and we also value our knowledge of it. Because it was forbidden to the commoners, they were not to know this. However, due to the rise of wisdom and skill of the children of the commoners, therefore, all of the ranking privileges were no longer restricted; it was only lifted. What remains of the ancestors is something of value (McKinzie 1986:18-19).

C-2. Mo'olelo. Legends, stories or *mo'olelo* are a great cultural resource as well as entertaining. Leib and Day (1979) state in their annotated bibliography of Hawaiian legends, that legends "are a kind of rough history." They noted Luamala's idea of the value of legend and myth in the serious study of a culture and her following quote. "To a specialist in mythology, a myth incident or episode is as objective a unit as an axe, and the differences and similarities of these units can be observed equally clearly and scientifically." Leib and Day also expressed concern about authenticity, and sometimes found it difficult to determine if a legend was a primary or secondary source. The following definitions of terminology, including the Hawaiian classification of prose tales--*mo'olelo* or *ka'ao,* come from their work (Leib and Day 1979: xii, 1):

Tradition	used to refer to that which is handed down orally in the way of folklore
Folklore	a rather inclusive term, covering the beliefs, proverbs, customs, and literature (both prose and poetry) of a people
Myth	a story of the doings of godlike beings
Legend	deals with human beings and used interchangeably with 'myth'... because the collectors and translators of the tales often failed to make the strict distinction
Ka'ao	"pure fiction"
Mo'olelo	deals with historical matters and somewhat didactic in purpose... included tales of the gods, as well as tales of historical personages... many have recurring patterns, plots, and types of characters

C-2-a. History of Mo'olelo Collecting. According to Leib and Day (1979) a substantial number of legends were collected and written in Hawaiian, during the century following Cook's arrival in Hawai`i. A few accounts of the mythology were printed in the journals of missionaries and travelers, and a few of the Hawaiian lore were printed in languages other than English. The following synopses are excerpts from the works of Leib and Day (1979), and gives an overview of the first collectors and compilers of Hawaiian myths and legends.

The first printed narrative legend of any importance is the epic "Song of Lono" in Byron's *Voyage of H.M.S. Blonde to the Sandwich Islands* (1826), credited by Byron to the American missionaries. Byron had hoped that the missionaries 'will obtain a correct knowledge of the creed and traditions of the Islanders.' Unfortunately, the missionaries were at first more anxious to supplant the native beliefs with new ones than to perpetuate the old ones, with the result that a good many of the legends became altered or were lost. However, the missionaries did a more thorough job of writing down the legends than did the explorers and voyagers (Leib and Day 1979:5). William Ellis, who toured Hawai`i in 1823, is credited as "chronologically the first important source of Hawaiian mythology. Although (Ellis) deplored the content of the legends, they showed that the Hawaiians had mental powers which might later be 'employed on subjects more consistent with truth' (Leib and Day 1979:6).

About 1836 a movement was started under the influence of Reverend Sheldon Dibble, to write down in Hawaiian some of the material dealing with the native legendary history, customs, and other lore. Results of the research were published at the Lahainaluna press in 1838. A partial translation made by Rev. Reuben Tinker was issued serially in 1839 and 1840---the first four

installments appearing in ***The Hawaiian Spectator*** and the last four in ***The Polynesian.*** In 1841 the Royal Hawaiian Historical Society was formed at Lahainaluna. Some of their research and the earlier *Ka Moolelo Hawaii* were incorporated into Dibble's *History of the Sandwich Islands* (1843). After his death in 1843 his work was carried on principally by two of his outstanding native pupils, David Malo and Samuel M. Kamakau. Malo wrote his own *Moolelo Hawaii* about 1840 at the request of Rev. Lorrin Andrews, which was later translated by Emerson as *Hawaiian Antiquities.* In 1858 the Rev. John F. Pogue of Lahainaluna printed a third *Moolelo Hawaii,* based on the 1838 history, but included additional material. Kamakau did not print any of his material for thirty years (Leib and Day 1979:7, 8, 9).

The increase in the amount of Hawaiian lore appearing in the native press in the 1860's and thereafter was at least in part the result of an organized effort to collect and preserve such material. At Kamakau's instigation a Hawaiian society was formed in 1863 to collect material for publication in the native press at the time, and also to aid Fornander's research. Fornander was the greatest collector of Hawaiian lore. He credits as sources, several natives whom he sent on tours of the Hawaiian Islands to collect all available Hawaiian lore, as well as Kalākaua, Lorrin Andrews, Malo, Dibble, Dr. John Rae, Kamakau, Naihe, S.N. Hakuole, Kepelino, and Remy. The culmination of this effort was Fornander's (1880) *An Account of the Polynesian Race: Its Origin and Migrations and the Ancient History of the Hawaiian People to the Times of Kamehameha I.* Fornander's collection remains the most important single source of Hawaiian legends (Leib and Day 1979:9, 12, 13).

In June 1865 Kamakau began publishing in *Ka Nupepa Kuokoa,* articles on traditions and legends. His series of articles dealing with Hawaiian history, particularly from the late eighteenth century on, and especially of Kamehameha, appeared weekly in the same publication in October 1866. When the newspaper ceased in 1869, this series continued in *Ke Au Okoa* for nine months. Kamakau then wrote a series on ancient Hawaiian religion, customs, and legendary history in *Ke Au Okoa* until February 1871. All of his writings were in Hawaiian (Leib and Day 1979:8, 9).
Very little work was done in translating Hawaiian mythology into English until late in the nineteenth century. It wasn't until 1888, over a hundred years after the discovery of the Hawaiian Islands, that the first book in English dealing exclusively with Hawaiian mythology was printed; *The Legends and Myths of Hawaii* by King Kalākaua. However, it was more likely authored by former United States Minister to the Hawaiian Islands, R.M. Daggett (Leib and Day 1979:5, 7).

Thrum is one of the most frequently cited authorities on Hawaiian lore. He was born in Australia in 1842 and arrived in Honolulu in 1853. In 1875 he began publication of the *Hawaiian Almanac and Annual,* later known as *The Hawaiian Annual* or *Thrum's Annual,* which appeared yearly under his editorship until his death in 1932. Thrum's contribution is as editor, compiler, and publisher of translations, not translator. By providing in his *Annual* a place for the publication of such material, and perhaps by persuading authors to provide him with translations, he was instrumental in much legendary matter appearing in printed form. Thrum wrote or rewrote a large portion of his own material (Leib and Day 1979: 17).

Thrum's first book *Hawaiian Folk Tales* was published in 1907 and consisted largely of tales that had previously been published in *Thrum's Annual.* Only 35 of the 260 pages were translated by Thrum, the rest were credited to Rev. A.O. Forbes, Rev. C.M. Hyde, William Ellis, J.S. Emerson, Mrs. E.N. Haley, N.B. Emerson, Mrs. E.M. Nakuina, Walter M. Gibson, Joseph M. Poepoe, and M.K. Nakuina. His second book *More Hawaiian Folk Tales,* published in 1923 was similar. A number were translations from Hawaiian language newspapers of half a century earlier, often with no translator cited. Translators credited were A. F. Knudsen, Henry M. Lyman, W. D. Westervelt, J. H. Boyd, and Lahilahi Webb. Some of the chapters were reprinted or abridged from the Bishop Museum translations of the *Fornander Collection,* of which Thrum was editor. His greatest work, *Fornander's Collection of Hawaiian Antiquities and Folklore,* was published by Bishop Museum in 1916 and 1920 in three volumes. The original editor was W. D. Alexander and most of the work completed under his supervision. However, he died in 1913 and Thrum was appointed to complete the production. Beckwith credits John Wise with the original translation of that work. In 1920 or 1921 Thrum completed another work "Ancient Hawaiian Mythology" which was never published (Leib and Day 1979: 18-19).

A great resurgence of interest in Hawaiian folklore began in the early twentieth century, in part caused by the annexation to the United States. People on the mainland wanted to know more about 'their new island possessions.' The funds of the Bureau of American Ethnology were made available for Hawaiian studies i.e., Emerson's *Unwritten Literature* and Beckwith's *Laeiekawai.* The most important twentieth-century translators of Hawaiian legends have been N. B. Emerson, Thomas G. Thrum, William D. Westervelt, William Hyde Rice, Laura C. S. Green, Martha Warren Beckwith, and Mary Wiggins Kawena Pukui. Emerson's extensive notes were a major contribution to Hawaiian scholarship. Most of them explain the meanings of Hawaiian words. In many, Emerson alludes to legends, giving a number of them briefly and relating a few in some detail. Some of these probably do not exist anywhere else in print (Leib and Day 1979:14).

C-2-b. *Ali'i nui* of Maui. In the legends or *mo'olelo* collected by Fornander, Kamakau, and others, we can get a glimpse into the lives of some of these people listed in the genealogies. To reproduce any legend completely would take too long, therefore only excerpts are generally used. The history of the Maui *ali`i* begins in very ancient times in Hāna on the eastern coast of Maui. One descendant of the *'Ulu* line, King Hua, had a particularly notorious place in the history of the Hāna Coast as explained in the following synopsis of Youngblood's (1992) story.

> **Legend of Hua.** This powerful 12th century Mo'i (sic) of East Maui is reputed to have brought about a three-year scourge of drought and famine that ravaged not only Maui but also half of the Big Island and, to lesser extents, the other islands. During that period there were two separate kingdoms on Maui, and it wasn't until nearly three centuries later, under Pi'ilani, that the Hāna Coast was united politically with the central and west-end portions of the island. During the 300 years between Hua and Pi'ilani in the mid 15th century, it seems that a family of the Nana'ula line was in control of the Hāna Coast. The rest of the island was ruled by descendants of the Maui 'Ulu line. It wasn't a stable time for *maka'ainana,* the common Hawaiian, due to persistent efforts of each ruler to become *mo'i* of all Maui (Youngblood, 1992:35, 38).

Hua lived in eastern Maui around AD 1170, and was known as the "robber baron that was censored by high priest Luahomoe" (Musick 1897:324). In *Tales and Traditions of the People of Old,* Kamakau (1991) discusses the infamous king Hua, but also clarifies the different Hua, their descendants and their relationships to Hāna and Maui. In spite of his infamy, most of his descendants turned out to be commendable chiefs. The following excerpt from Kamakau (1991) about Hua and his *ohana,* also illustrates that *ali'i nui* often went by different names. "According to ancient custom, it was very common for high chiefs to be known by several names" (Fornander, 1880:80).

> Hua was from Lahaina, Maui. This is not the Hua whose *heiau* was Apahu'a in Waine'e next to Puako; this is Hua the son of Kapua'imanaku (Pohukaina) whose *heiau* was Luakona, near to Kapō'ulu. Huanuiikalala'ila'i was born at Kewalo in Honolulu... (Kamakau, 1991:101). Hua-a-Pohukaina also known as Hua-a-Kapua'i-manaku was born at Lahaina, who built heiau of Honua'ula and Kuawalu at Ka'uiki.... He was a war-loving chief. He lived at Wananalua in Hāna.... Pau-a-Hua born, also Pau-nui-i-ke-anaina, at Wai'anae, Hua's son--he ruled Ohikilolo to Keawaula on O`ahu.... Hua-a-Pau also known as Hua-nui-i-ka-la-la'ila'i born at Kewalo. He was known as a good chief. His government was called *he aupuni la'i,* a peaceful government. He was chief of Honolulu and Waikiki (Kamakau, 1991:148, 149; see also Sterling, 1998:133).

Hua-nui descendants. According to legends, two of Hua's descendants, Hanala'anui and Hanala'aiki, became the progenitor's of the Hawai`i and Maui lines. These were twin children of Hikawainui the mother of Palena. They were born in Kahinihiniula in Mokae and Hamoa, and certain districts of Maui were named after these children. The following excerpt is from Kamakau (1991).

> **Hanala'anui and Hanala'aiki.** Paumakua, chief of Ko'olau and Mokapu was the son of Hua-nui. He married his sister Mano-kapili-lani and they had a son Haho who was born in Wai'alua, O`ahu. Haho's child was Palena-a-Haho...Palena (a-Haho) was born on the hill of Ka'uiki (sic), in Hāna,

> Maui at the site Hananaiku; he ruled and died on O'ahu...his grave is Kalua-o-Palena in Kalihi, O`ahu.... Palena-a-Haho who with Hi-ka-wai-nui had the twins Hanala'anui and Hanala'aiki who were born at Kahinihini'ula, at Mokae and Hamoa, (Hāna) and a certain *moku'aina* land was named after these boys...The twins were progenitors of Hāna people...and because of their good deeds...their descendants gave the land their names. This was after the division of the island into *ahupua'a, 'okana,* and *moku'aina* – at the time when the island was divided by Kalai-haohia during the reign of Kaka'alaneo... Hanala'anui was the ancestral chief for those of Hawai`i and Hanala'aiki for those of Maui.... (However) there is a dispute...Hanala'anui really belonged to Maui.... In the division and separation of the Maui ancestral genealogies, the line of succession of Maui chiefs was made clear. It can be found in the genealogy of Hanala'aiki to the time of Kahekili by turning to the ancient traditions of deeply versed persons. Here are made plain the places in which the chiefs were born, their deeds, and places in which their corpses were laid (Kamakau, 1991:101, 150- 152).

Beckwith's (1970) version is as follows:

> **Hanala'anuí and Hanala'aiki.** Maui chief Haho, son of Paumakua and grandson of Hua-nui-ka-la'ila'i (and grandfather of the twins), was the traditional founder of the *Aha'ali'i* or ranking body of chiefs whom were distinguished by the use of the sacred cord called *aha.* They cultivated a metaphorical form of speech to conceal their words from the uninitiated.... Between the periods of Hua and Pi'ilani, that is, between Moikeha's time and that of Umi on Hawai`i, the twins were born at Kahinihini in Mokae, Hamoa. 'Little and big sacred one of Hāna' called Hana-la'a-nui and Hana-la'a-iki, from who respectively the chiefs of Hawai`i and Maui are descended. From Kiha and his wife Koleamoku are descended the great Kaupō families of Ko'o and Kaiuli. From them, Kahekili's wife Kauwahine, mother of Kanlanikupule, the last ruling chief of Maui, and of a daughter, Kailikauoha, who became the wife of the Maui chief Ulumehe'ihe'i Hoapili and mother of Liliha, beloved wife of Boki of sandalwood fame (Beckwith, 1970:387, 389).

The following synopses consists of excerpts from Fornander's (1880) *An Account of the Polynesian Race: Its Origins and Migrations,* and give an overview of the various *ali'i nui* (ruling chiefs) of Hāna and Maui, which Fornander refers to as "Moi":

> **Independent Hāna Mo'i.** Among the Maui chiefs from the close of the migratory period, say Laamaikahiki to Pi'ilani, the contemporary of Umi and his father Liloa, not many names arrest the attention of the antiquarian student. The position of 'Moi' of Maui appears to have descended in the line of Haho, the son of Paumakua-a-Huanuikalalailai, though, judging from the tenor of the legends, East Maui, comprising the districts of Koolau, Hāna, Kīpahulu, and Kaupō, was at times under independent Mois (sic). The legends mention six by name, from Eleio to Hoolae,[2] the latter of whom was contemporary with Pi'ilani, and whose daughter (Kolea) married Pi'ilani's son, Kiha-a-Piilani. Their allegiance to the West Maui Mois was always precarious, even in later times (Fornander, 1880).
>
> (**Fornander's Note**: [2]) Maui Mo'i names were Eleio, Kalaehaeha, Lei, Kamohohalii, Kalaehina, and Hoolae, each one succeeding the other. They generally resided at Hāna, where the fortified hill of Kauiki was considered an impregnable fortress. I have a legend which mentions some transactions between Eleio and Kakaalaneo, the son of Kaulahea I, but, if the legend may be trusted, Eleio must have been very old at the time. Whether this Eleio of Hāna family descended from some of the southern (Tahiti) immigrant chiefs or from the ancient Nanaulu line, I have not been able fully to ascertain. The ever more or less uncertain state of allegiance of the Hāna chiefs to the Maui sovereign, and their frequently independent political status, would seem to have been born of some radical ancient antagonism. The old legends mention incidentally that Kanaloa and Kalahuimoku, two of the sons of Hualani, the wife of Kanipahu, and fifth in descent from Maweke, settled at Kauwiki (sic) in Hāna. While the Hawai`i chiefs retained the pedigree of the younger brother whose grand daughter Kamanawa married Kuaiwa, the Moi of Hawai`i, the descendants of the older brother, have dropped out of memory. Kanaloa may have been the great-grandfather of Eleio (Fornander 1880:78).

Kamaloohua and Ohana. While Kamaloohua ruled over the greater part of Maui, a chief who was doubtless a near relation, and who was called Wakalana, ruled over the windward side of the island and resided at Wailuku. During his time tradition records that a vessel called "Mamala" arrived at Wailuku. The captain's name is said to have been Kaluiki-a-Manu, and the names of the other people on board are given in the tradition as Neleike, Malaea, Haakoa, and Hika. These latter comprised both men and women, and it is said that Neleike became the wife of Wakalana and the mother of his son Alo-o-ia, and that they became the progenitors of a light-colored family, "*po`e ohana* Kekea;" they were white people, with bright, shining eyes, *"Kananka Keokeo, a ua alohilohi na maka*" (Fornander 1880:80).

> After the reign and times of Kamaloohua nothing worthy of note has been recorded of the Maui chiefs until we arrive at the time of Kakae and Kakaalaneo, the sons of Kaulahea I (Kaulaheanuiokamoku I), three generations after Kamaloohua.... Kakae's brother, Kakaalaneo, appears, from the tenor of the legends, to have ruled jointly with Kakae over the islands of Maui and Lāna`i . He was renowned for his thrift and energy. The brothers kept their court at Lahaina*, which at the time still preserved its ancient name of Lele, and tradition has gratefully remembered him as the one who planted the breadfruit trees in Lahaina, for which the place in after times became so famous (Fornander 1880:80). [*Other records indicate that Kakae preferred to reside in Wailuku.]

Kakaalaeno was a great uncle of Pi'ilani. The following synopses about Kakaalaneo and Kukanaloa are excerpts from Beckwith (1970). There appears to be a time-conflict with the arrival of the light-skinned foreigners. Fornander (1880) indicates they arrived during Kamaloohua's reign, while Beckwith indicates the foreigners arrived four generations later during the time Kakaalaneo.

Legend of Kakaalaneo. Many legends mention the name of Kakaalaneo (Kukaalaneo, Kaalaneo), who lived in the present Lahaina district on the hill Keka'a (Black Rock of Sheraton Maui). He also owned fishponds in the Hāna district on the opposite end of the island and planted a famous breadfruit grove in Lahaina. His wife was the Molokai chiefess whom Eleio found for him and who brought him the first feather cape ever seen on Maui, and by whom he had the mischievous son Kaululaau who killed off the spirits on Lāna`i. In his day Lahaina was called Lele. According to tradition, a group of strangers (*haole*) who later played an active part in court life and whose names were (according to Kamakau), kept in memory as late as Captain Cook's day, arrived on Maui in Kakaalaneo's time. Kukanaloa and Kaekae (also Kakae) were the leaders of this group. The "last allusion" in this legend is a pun about chief Lolae of O`ahu who abducted Kelea, the pretty chiefess of Maui, (sister of Pi`ilani's father), while she was out surfing and carried her away to O`ahu in the uplands of Lihue (now Schofield Barracks). She later deserted him for his cousin Kalamakua of Ewa (and Waikīkī), by whom she became mother of the high chiefess Lā`ie-lohelohe (The drooping pandanus vine), who became the wife of her Maui cousin Pi'ilani. All these names appear in the chant linked with the coming of Kū-kanaloa, together with the names of a wife and son of Kaka`alaneo (Beckwith 1970:384-385).

Legend of Kukanaloa. The strangers land first at Keei in South Kona and then come on to Waihe'e, Maui, and land at a place called Ke-ala-i-Kahiki (The road to Kahiki). They are exhausted and the natives clothe and feed them. In looks they are light with sparkling eyes. When asked after their homeland and parents they point to the uplands 'far, far above where our parents dwell' and show that they are familiar with bananas, breadfruit, mountain apple, and candlenut trees. The two leaders became Kakaalaneo's property. There is no *kapu* place closed to them. They married chiefesses and some of their descendants are living today. Kani-ka-wi and Kani-ka-wa they are called, 'perhaps because their speech was as unintelligible as that of the *lale* birds that live in the hill' (Beckwith, 1970:386). Pi'ilani and some of his family are mentioned in the following *mele* of this *mo'olelo*:

Puka mai o Kanikawi, Kanikawa	Came Sharp-sound, Loud sound,
O na haole iluna o Halakaipo,	The strangers above Halakaipo
Puka mai nei Kukanaloa,	Came Ku-kanaloa
Kupuna haole mai Kahiki	The stranger forefather from Kahiki
Puka mai nei Kakaalaneo	Came Kakaalaneo,

Me ke leo iki o Kakae,	With the soft-voiced Kakae,
O Kaualua is, o Kaihiwalua	Kaualua (the wife), Kaihiwalua (the son),
O Kelea, o Kalamakua,	Kelea (the wife), Kalamakua (the husband),
O Pi'ilani ia, o Laielohelohe	Pi'ilani (the husband), Laielohelohe (the wife).

Kakae Ohana. According to Fornander (1880), Kakae was the son of Kaulaheanuiokamoku I, and the brother of Kakaalaneo with whom he co-ruled Maui. He was also the father of Kahekilinuiahumanu I and Kaulaheanuiokamoku II, grandfather of Kawaokaohele and Keleanuinoho'ana'api'api and great-grandfather of Pi'ilani. The following excerpts from Fornander reveal some of their history.

> **Kahekili I and Kawaokaohele.** Kakae's son was Kahekili I, who is known to have had two children, a son name Kawao Kaohele(Pi'ilani's father), who succeeded him as Moi of Maui, and a daughter named Keleanohoanaapiapi (Pi1ilani's wife's mother), who was successively the wife of LoLale, son of Kalona-iki, and of Kalamakua, son of Kalona-nui, on the O`ahu Maweke line.
>
> From the time of Mauiloa, third from Haho and contemporary with Laamaikahiki, to the time of Kaulahea I (father of Kakae and Kakaalaneo) there must have been troublous times on Maui, and much social and dynastic convulsions, to judge from the confusion and interpolations occurring on the royal genealogy of this period. I have shown it to be nearly historically certain that the O`ahu and Maui Paumakuas were contemporary, and it will be seen in the sequel that it is absolutely certain that Kawaokaohele (Piilani's father) on the Paumakuahaho line was contemporary with Kalamakua, Piliwale and LoLale on the Maweke line of O`ahu chiefs, as well as on the O`ahu Paumakua line through Lauli-a-Laa; and yet the Maui royal genealogy, as recited at the court of Kahekili II at the close of the last century, counts thirteen generations between Mauiloa and Kaulahea I, or sixteen generations between Mauiloa and Kawaokaohele (Pi'ilani's father), whereas the Maweke and O`ahu Paumakua genealogies count only seven from Laamaikahiki to Keleanohoanaapiapi (mother of Pi'ilani's wife La`ielohelohe), the sister of Kawaokaohele (Pi'ilani's father) (Fornander 1880:78-79).
>
> **Kawaokaohele.** During the reign of Kawaokaohele (Pi'ilani's father), the son of Kahekili I, and grandson of Kakae, the island of Maui appears to have been prosperous and tranquil. No wars with neighboring islands or revolts of turbulent chieftains at home have left their impress on the traditional record. Kawaokaohele's wife was Kepalaoa, whose pedigree is not remembered, but who was probably some Maui chiefess (she was the daughter of O`ahu *ali`i nui* Piliwale). Kawaokaohele was succeeded as Moi of Maui by his son Piilani, who, through his good and wise government, and through his connection with the reigning chief families of O`ahu and Hawai`i, brought Maui up to a political consideration in the group which it never had enjoyed before, and which it retained until the conquest by Kamehameha I consolidated the whole group under one rule (Fornander 1880:83, 87).

There are several legends of Keleanuinoho'ana'api'api (Kelea), the sister of Kawaokaohele, aunt of Pi'ilani, and mother of La'ielohelohe, Pi'ilani's wife. Her story is one of intrigue, and romance, but also allegorizes the life and privileges of *ali'i nui* women. It further illustrates the interrelationships between the *ali'i nui* of the various islands. The following *mo'olelo* is extracted from Fornander's (1880) "Story of Kelea-Nohoanaapiapi."

> **The Story of Kelea.** The Story of Keleanui Nohoanaapiapi, sister of Kawaokaohele, begins in Hāna. Lihue, O`ahu Chief LoLale's men were searching for a wife for him... They went first to Molokai, then to Lāna`i, then sailed for Hāna intending to go to Hawai`i. While at Hāna they heard that Kawaokaohele, the Moi of Maui was stopping with his court and his chiefs at Hamakuapoko, regulating the affairs of the country, and enjoying the cool breezes of that district, and the pleasures of surf-bathing, and that with him was his sister Kelea, the most beautiful woman on Maui, and the most accomplished surf-swimmer.
>
> They thought of a plan to win her confidence by going surfing with her, and challenging her to a race. On her third time out, they captured her, and took her into a waiting canoe to O`ahu. They took her to Chief LoLale of Lihue, O`ahu, son of O`ahu Moi Kalona-iki, and brother of heir-apparent Piliwale. "And as she did not commit suicide, it may be inferred that she became

reconciled to her lot and accepted him as her husband. And as no invasion of O`ahu was ever attempted by Kawaokaohele, or vengeance exacted for the abduction of his sister, it is probable, though the legend says nothing about it, that the affair was diplomatically settled to the satisfaction of all parties."

Kelea and LoLae had three children: Kaholi-a-Lale, who later married Kohipalaoa, sister of Kukaniloko, Moi of O`ahu after her father, Piliwale's death (Kukaniloko was a contemporary of Pi'ilani, and Piliwale was Pi'ilani's maternal grandfather), Luliwahine, and Luli Kane. After several years and three children she informed Lolale that she was leaving him, as was her privilege due to her rank. He reluctantly gave his consent, but his grief was preserved in a chant. While traveling around O`ahu, Kelea met Kalamakua, chief of Halawa and cousin of LoLale. They marry and have a daughter Laielohelohe, who in her youth was betrothed to her cousin Pi'ilani, son of Kelea's brother Kawaokaohele (Fornander 1880:83-87, 90-91).

There are other versions of that story. The following synopsis corroborates Fornander's (1880) "Story of Kela." The genealogies indicate how *ali'i nui* from all the islands were related, and the *mo'olelo* also confirm this as indicated in the following story of La'ielohelohe in Kamakau (1991, 1992).

The Story of La'ielohelohe. Kalamakua was a good chief who cultivated large pond fields of Waikiki. He married (Kelea) Keleanuinoho'ana'api'api, a beautiful chiefess and sister of Kawaukaohele (children of Kahekili I), (Pi'ilani's father, also spelled Kawaokaohele) the *ali'i nui* of Maui. She loved to surf at Hamakuapoko, Kekaha, and Wailuku.... The chiefs of O`ahu, searching for a wife for Chief Lolae, ruling chief of Lihue, O`ahu, (now called Schofield Barracks) when reaching Hāna heard about the beautiful Kelea, they wanted to obtain her for their chief. They found her at Hamakuapoko, and she proved to be an unsurpassed surfer of East Maui. They tricked her and kidnapped her to Waialua, O`ahu, then she was taken to Chief Lolae at Lihue. They had three children: Kaholialale, Luliwahine, and Lulikane, ancestral chiefs of O`ahu. After ten years she asked her husband if she could go to Ewa to go sightseeing and he agreed. On her travels she heard about the surfing of Waikiki and asked her companions if she could go there and they agreed. She asked the *kama'aina* for a board and she proved to be a very skilled surfer. The people cheered and cheered her. Chief Kalamakua was working in his fields and heard the shouts. He went to check and watched her from the shore. When he saw her skill and beauty he asked if she were Kelea. She said yes. He wrapped his *kihei* around her naked body and took her to a *kapu* place. She married Kalamakua. They had La'ielohelohe, born at Helumoa and raised in Waikiki. She was betrothed to Pi'ilani, the son of the *ali'i nui* of Maui (Kawaokaohele). Her *akua* grandmothers Hapu'u and Kalaiohauola took care of her. Later she voyaged to Maui to marry Pi'ilani. They lived at Halehuki and had four children: Lono-a-Pi'ilani, Pi'ikea, Kala'aiheana, and Kihapi'ilani. La'ielohelohe returned to O`ahu for Kiha's birth. He was born at 'Apuakehau in Waikiki--there is a rock there to mark the place (Kamakau, 1991:45-49, Kamakau, 1992:22).

Pi'ilani. There is no "Story of Pi'ilani" by any of the early compilers of *mo'olelo*. However, Fornander (1880) notes that during Pi`ilani's reign, and perhaps during that of his father, the Hāna chiefs acknowledged the suzerainty of the Moi of Maui, and Pi`ilani made frequent tours all over his dominions, enforcing order and promoting the industry of the people (Fornander 1880:87). Beckwith alludes to Ka'uiki being the home of the Pi'ilani *ohana* in the following excerpt:

The island of Hawai`i lying over against Kauiki, home of the heaven-high chiefs of the Pi'ilani line, bred meanwhile the offspring of the second of those usurping chiefs (Kihapiilani; the first usurping chief Beckwith refers to is `Umi) whose final example is found in the well-known history of the first Kamehameha (Beckwith 1970:389).

According to Fornander (1880), Pi`ilani's children with La`ielohelohe were Lono-a-Pii, who succeeded him as Mo`i of Maui; and Kiha-a-Pii, who was brought up to the age of manhood among his mother's relatives on O`ahu. Their daughter Pi`ikea, became the wife of Umi, son of Liloa, Mo`i of Hawai`i, and through her great-grandson, I, became the ancestor of the present sovereign of the Hawaiian group, Kalākaua (Fornander 1880:87). They had another daughter, Kala`aiheana, of who no further mention occurs. With another wife, named Moku-a-Hualeiakea, a Hawai`i chiefess of the Ehu family, Pi`ilani had

a daughter, Kauhi`iliula-a-Pi`ilani, who married Laninui-a-Kaihupee, chief of Koolau, O`ahu, and lineal descendant of Maweke through his son Kalehenui. And with still another wife, named Kunuunui-a-kapokii, whose pedigree has not been preserved, he had a son, Nihokela, whose eighth descendant was Kauwa, grandmother of the late King Lunalilo on his father's side (Fornander 1880:87).

There are some modern references to Pi'ilani unifying Maui by warfare (see Speakman, 1978/1984; Kolb, 1991:67). However, in Youngblood's (1992) re-creation of Hāna's history, in *On the Hāna Coast*, we see a peaceful Pi'ilani, as well as his connection to Hāna and the Greater Maui, in the following excerpts:

It is known that Kaka`e established a court at Lahaina about 1360 AD and that he was succeeded by a son, Kahekili I, who was in turn, succeeded by his son Kāwao-kāō-hele then his son and successor, Pi'ilani. The Hāna Coast came under their control, thus unifying Maui under one family of *ali'i*. Pi'ilani's rule is remembered as a time of unity, peace, prosperity and construction of public works, including at Le'eleku, the largest *heiau* in existence. Although Pi'ilani kept his court "Out There" in Lahaina and Wailuku, he maintained a home in Hāna. Even then it was a place of physical and spiritual refuge.

Pi'ilani ordered the construction of fishponds and irrigation systems for the taro fields, and he undertook the immense task of building a network of stone-paved roads, four to six feet wide, around and across the island. The job was continued by his son Kiha-a-Pi'ilani, who extended the ribbon of coastal road first built in Hāna around the West Maui and also up Kaupō Gap through the center. Kiha was followed by his son Kamalalawalu (by Kumaka), who is said to have sent his son to spy on the Big Island.... The Maui line passed to Kauhiakama...to Kalanikaumakaowakea to Lonohonuakini to Kaulahea to Kekaulike [II] to Kamehamehanui to Kahekili, the last of the Maui kings (Youngblood 1992:38).

Lonoapiilani. Like his father, there was no "Story of Lono-a-Pi`ilani" in the *mo'olelo*. However, there are many references to him; he was said to hold his court in Wailuku and farmed in Waiehu [see Kamakau below]. The following are extracts from Fornander's (1880) collection of legends.

After Piilani's death, his oldest son, Lono-a-Pii, followed him as Moi of Maui. His character has been severely handled by succeeding generations and the legends they handed down. He is represented as unamicable, surly, avaricious---unpardonable faults in a Hawaiian chieftain. His niggardliness and abuse of his younger brother, Kiha-a-Piilani, drove the latter into exile and brought about his own downfall and death, as already narrated (Fornander 1880:205).

Lono-a-Pii's wives were Kealana-a-waauli, a great granddaughter of Kahakuakane, the sovereign of Kaua`i, and grandson of Manokalanipo. With her he had a daughter called Kaakaupea, who became the wife of her uncle Nihokela, and mother of Piilaniwahine (granddaughter of Lonoapiilani), the wife of Kamalalawalu (son of Kihapiilani). Lonoapii had another daughter named Moihala, from who descended Kapuleiolaa, one of the wives of Kanaloauoo, and ancestress of Sarai Hiwauli, wife of the late Hon. John Ii (Fornander 1880:205-206).

When Umi arrived with his fleet at Hāna, he was informed that Lono-a-Pii had died, and that a son of his named Kalanikupua reigned in his stead, and had charge of the fort of Kauwiki at Hāna; that Umi was disposed to spare the young man and allow him to remain on the throne of his father, but Piikea, Umi's wife, strongly opposed such clemency, and persuaded her husband to prosecute the war and place Kihapiilani as Moi of Maui (Fornander 1880:206).

Kihapiilani. The next major story in *Ruling Chiefs* (Kamakau, 1992), and also Thrum's *Hawaiian Annuals* was the 'Story of Kiha-a-Pi'ilani'---the youngest son of Pi'ilani's royal children. In Thrum's version (1916) of 'Traditions of Kihapiilani' he notes that there is a different version of the Umi/Kihapiilani story found in the *Polynesian* in 1840 "as told by natives" (Thrum, 1916:128-135).

The following story is based on Thrum's version. It gives a glimpse of Kihapi'ilani the man, as well as the conflict between his older brother and heir, Lono-a-Pi`ilani.

The Story of Kihapiilani. Kihapiilani was born and raised on O`ahu with his mother's family. Kihapiilani lived with his uncle and mother and wanted to know who his "real" father was and was told that his father was on Maui, so he wanted to go there and live with his father. "She made ready the canoe, provided the food and said: 'Go, you will find your father keeping the *awa kapu*, and no canoe will be allowed to land...if you reach Keawaiki at Lahaina...land on the beach, let all the men remain on board the canoe...but go yourself ashore to the large man sitting at the door of the house; he is your father, sit on his lap, and if he asks you whose boy you are, tell him you are his, I am Kihapiilani. If he places you at his left hand, that is your place; there is no land on that side; the right side is the place of lands. There will be two cups of *awa*, the one in his right hand represents your elder brother Lonoapii, the other ourself. He will drink first the cup in his right hand, then that in his left; then take pieces of potato in his right hand and left hand and eat them in the same succession; then a banana in each hand, eating them in the same order; after which he will eat fish and poi, then the *kapu* will be ended. If he offers you the cup and potato and banana which are in his right hand you will be the heir; if not, you have no inheritance.'

Kiha found everything as his mother said upon his landing...he sat in the big man's lap...his father kissed him and seated him on his left, but the boy leaped over to the right side. The father said 'You have taken your elder brother's place' and without consent of his father he continued to sit there. The father put out his right hand to take the cup of *awa*, but the son snatched it from him as he did with the potato and banana...he constantly conducted himself in this manner during the life of his father. At his death the lands were willed to the elder brother, who was angry with his brother Kiha for his efforts to obtain the birthrights.

After many conflicts and abuses from his brother, Kiha decided to rebel. They fought in the Wailuku valley near the present female seminary and Kiha was beaten---he and his guardian alone escaping. Kiha then returned to Lahaina to dwell. When he had grown a large following he rebelled again, and was again beaten and all his people killed, together with his guardian (Thrum, 1916:129, 130).

He escaped to Molokai and rebelled again. They fought on a hill called Pakui where he escaped again. A friend gave him a canoe and together with his wife he fled to Lāna`i where he stayed two days. His friend said lets go to Maui...They arrived in East Maui and went into the woods where they were seen by some fishermen who reported it to the king on his arrival at Maui. The king sent his runner after him...his friend advised him to go and hide in Kula while he returned to the King. Kiha and his wife lived in Makawao. He stole kapa implements to make kapa, he stole potato tops to plant, but was still befriended by a man from Kīpahulu who invited them to live with him (Thrum, 1916:131).

Kiha was later told to see a priest in Hamakuapoko who will see if the kingdom will be his. Then was told to go to see Hoko a priest in Keanae who would perform the same ceremony. He was then told to go to Hāna, to the priest Owao (part of the plan was to take Kolea (Hāna chief Ho`olae's daughter) as his wife—the priest advised his present wife to become their servant until he had gotten the kingdom, which she agreed). The lands he asked for were: Honokolani, Waipapa and Wananalua. Her father said "no, if you take those lands you take the two hills which are celebrated in war; you will then be rebels". He was then advised to leave his new wife, take his old wife and go to Hawaii to see his sister Piikea (Thrum, 1916:132).

He told his story to 'Umi who told him 'We shall lose our labor in fighting with your brother. He will hear of your arrival here and will be taken with fear of me and die trembling. This happened; he died and left his kingdom to his sons. Kiha lived with 'Umi till the end of the year (Thrum, 1916:133).

Then "they sailed to the war and landed at Hāna; all the chiefs and people and canoes of Hawaii, and the women and children. Landing a party at Hamoa, they fought with Holai (Hoolae) who drove them back to their canoes...(but) they took possession of Kauiki and put Holai to flight.... Piimaiwaa soon found him and chased him among the *lauhala* trees until dark, when he killed him...(In Kamakau's (1992) version, Ho'olae-makua was found at Kapipiwai in the back of Nahiku. He was killed and his hands were brought to Kihapi'ilani as confirmation of his death. "Ho'olae-makua was killed because Kiha-a-Pi'ilani bore a grudge against him, his father-in-law, for not helping on his side... revengeful indeed was the haughty O`ahuan!" (Kamakau 1992:31)).

The next morning they advanced by land and canoe until they reached Wailuku where they fought with the chiefs of Maui and put them to flight. The priests advised Kiha not to take the kingdom but to give it to the children of Umi (and Piikea, his sister). So Kumalae and Aihakoko were left in charge and Umi returned to Hawaii. Aihakoko eventually died after traveling to Lāna`i and Molokai on a (funerary quest) after his guardian was killed. He ended up in East Maui where he died. After Umi died, Kiha sent Kumalae to O`ahu, and took possession of Maui. He reigned a long time, oppressed the people, made a road of flat stones all around the island and finally died a natural death (Thrum, 1916:134-135).

Lonoapiilani-Kihapiilani Pilikia. We see a very different view of the brothers, Lonoapiilani and Kihapiilani, and their *pilikia* or conflicts in Kamakau's versions (1870, 1991, and 1992). Kamakau presents a brief overview of Kihapiilani in the following excerpts:

Kihapiilani Overview. Kihapi'ilani was taken by the *kahuna* and raised at the *heiau* of Mau'oki at Kamo'ili'ili (Mo'ili'ili). He was taught to be an orator and warrior. When he was twenty he was ordered home to become heir apparent, but when he got to Kalae on Molokai he found that his father Pi'ilani had died at Lahaina. The first-born Lono-a-Pi'ilani became the *ali'i nui* of Maui (Kamakau, 1991:49; Kamakau, 1992:22).

Pi'ilani died at Lahaina, Maui, and the kingdom of Maui became Lono-a-Pi'ilani's. He was the oldest son by Lā'ielohelohеikawai, next came Pi'ikea, Kalai'aiheana then Kiha-a-Pi'ilani. It was said that there were two heirs Lono and Kiha but Kiha wasn't present at his father's death because he was in O`ahu where he was born and reared. So it went to Lono. Pi'ilani commanded that Lono have the kingdom and Kiha dwell in peace under him. In the first years his reign was well and people content.

Lonoapiilani took care of Kiha and he cared for the people by giving them food. Then Lonoapii became angry with Kiha. They both farmed in the *ahupua'a* of Waihe'e. Lono's taro patch was smaller while Kiha's was bigger. Lono got angry and abused Kiha and they fought. Lono tried to kill Kiha so he fled in secret to Molokai to the fortress of Paku'i then later to Lāna`i ...from there he sailed to Kapoli in Ma'alaea, and from thence to the upland of Honua'ula. Someone saw him and it was reported to Lono. Kiha fled to Lahaina where he was hunted, but the gods saved him.

He and his wife went to the gulch of Kuanu'u and round back to the boundary of Honoa'ula and Kula to a place named Ke'eke'e. Later to Kula/Makawao--many people went there to play games and to go swimming in a pool called Waimalino as Kula and part of Makawao were waterless lands. During a famine Kiha cleared an immense patch of land for sweet potato (Kamakau, 1992:22-33)

Kiha went to Hamakuapoko and Hali'imaile to ask for slips...a rainbow revealed his identity. He later went to Pa'ia for help, but was directed to Kaluko in the upland of Ke'anae, then to Lanahu in Wakiu, then by Weua-Lanahu to Kawaipapa (Hāna) to consult [kahuna] Kahu'akole at Waipuna'alae. Kiha became a ward of Kahu'akole. He dwelt at Kawaipapa at a place called Kinahole. His wife's name was Kumaka whom he made his sister.

Hāna had a chief to govern it, Ho'olaemakua. It belonged to the ruling chiefs from ancient days, and the ruler was a descendant of the chiefs of Hāna. He belonged to a family that was noted for strong people, and Ho'olaemakua was numbered among them. He was small in size, but his hands had a very strong grip. Ka'hu'akole felt that if Ho'olaemakua sided with Kiha then war could be fought against Lono to take the kingdom from him. Ka`uiki was the strongest fortress there was.

Ho'olae had a daughter, Koleamoku, and Kahu'akole believed that when she became Kiha's wife her father would aid him.... Kiha's constant bathing reddened his cheeks to the color of a cooked crab and his eyes as bright as those of the *moho'ea* bird. Kolea surfed at Keanini in the bay of Kapueokahi (Hāna Bay). Kolea fell for Kiha, but her father was against it because she was betrothed to the ruling chief Lono-a-Pi'ilani. Kiha told her that he was the son of Ka'hu'akole. When Kiha didn't show up at surfing (one day) she went to the upland of Waika'ahiki to Waikaloa and to Kawaipapa where she and Kiha got married. When news that Kolea had married the son of Kahuamoku (same as Ka'hu'akole) her father became angry and he disowned her.

They had a son named Kauhiokalani and he became ancestor to some chiefs and commoners. Kiha asked Kolea to take their son to Ho'olae to make amends...and to ask for some farm lands... 'If your father should offer you all of Hāna, do not accept. These are the lands for us: Honoma'ele, Ka'eleku, Kawaipapa, and the two Wananalua.' Her father wanted to give her the district of Hāna, extending from Pu'ualu'u to 'Ula'ino. She said these are the lands my husband asks for 'Honoma'ele, Ka'eleku, Kawaipapa, the two Wananalua and Koali.'

He said "Your husband is no commoner. He is a chief, Kiha. Your child is a chief. I shall not take Kiha's part. I shall remain loyal to his older brother till these bones perish. Your husband does not want farmlands for the two of you, but is seeking means to rebel against the kingdom. "The lands of Honoma'ele and Ka'eleku supply the *'ohi'a* wood and *'ie'ie* vines of (the forest of) Kealakona to build ladders to the fortress. Kawaipapa supplies the stones of Kanawao that are used in battle, and then the fortress will be well supplied. The Wananalua lands hold the Ka'uiki fortress and the places below it. Koali is the fortress of Kue. I shall not take your husband's side."

Her father said he would give assistance only when Kiha was willing to abide under Lono's rule...then he took his grandson to raise. Kiha was angry when he heard this and wanted vengeance and to rule all of Maui. He decided to go to Hawai`i to consult his brother-in-law, 'Umi-a-Liloa. Kiha's first wife (Kumaka) was a chiefess of Hāna and Kīpahulu. Kiha took her to Hawai`i...they landed at Kohala, then to Maka'eo in Kailua where he told his entourage to wait for him while he visited his sister.

Kiha told 'Umi that his father had commanded that they share the kingdom of Maui, but his brother took it all for himself and wanted to kill him. 'Umi decided to help Kiha who had been wronged. Lono heard that war canoes were being built in great numbers. The *kauila* wood of Napu'u and Kahuku, the o'a and *koai'e* were being made into clubs to be used against Maui---they trembled in fear. After a year they were ready. When the first canoes reached Hāna, the last ones were still on Hawai`i.... Ho'olae was at Ka'uiki building a tower and ladders to reach the top.... The first canoes reached Kīpahulu and (were) coming towards Kapueokahi (Hāna Bay).... The Hawai`i canoes hardly reached the spring of Punahoa when Ho'olae killed the men who manned the spring. The canoes were forced to land at Waika'ahiki...the men who landed at Kihahale walked to Waikoloa in front of Kawaipapa where they fought with slings.... Ho'olae stayed close to a rock now called Ho'olae Rock...and was victorious over the warriors of Hawai`i who fled to open sea... (from) the expert stone-tossers of Waikiu and Honokalani, and the quick slinging lads of Ka'eleku....

The losing warriors of Hawai`i sailed for Wailuaiki at Ko'olau. When the canoes reached Wailuaiki they were dismantled and set upright...then they headed for battle. Upon reaching 'Ula'ino, the fighting commenced at Makaolehua, and in 'Akiala, at La'ahana, at Kawaikau (old name for the Honoma`ele Stream), at Nenewepue, at Kameha'ikana's kukui tree, and all the way along to Honokalani and Wakiu, into the pandanus grove of Kahalaoweke, down to Pihele, to the flats of Kalani and the spring of Punahoa. Ho'olaemakua proved to be an worthy foe...and very clever---he set up the giant image called Kawalaki'i and dressed it in war apparel (Kamakau, 1992:24-30).

Finally a warrior named Pi'imaiwa'a figured out the ruse of the *ki'i* and destroyed it. Ho'olae escaped. Kiha commanded that Ho`olae's daughter Kolea and her son not be hurt (Kolea was his second wife during his stay in Hāna). Ho'olae was finally found in the back of Nahiku at a place called Kapipiwai and killed ("Revengeful indeed was the haughty O`ahuan!") When Lono heard the news he trembled with fear of death and died in Wailuku. Kiha tried to find his body but it had been hidden. They sent for a prophet from Kaua`i to tell them where the corpse was buried. He said it was in Wailuku in a land called Pa'uniu, but Kiha's men could not find it. Kiha divided the lands...'Umi left his son 'Aihako'ko' to remain with Kiha and he went back to Hawai`i (Kamakau, 1992:31).

Beckwith (1970) first published her *Hawaiian Mythologies* in 1940. The following are excerpts from her version of the story of Kihapi'ilani.

Legend of Kihapi'ilani. The name of Kiha is preserved locally about the island of Maui in connection with his feats of leaping from a height into a pool of water, called *lelekawa*, and for the famous paved road about the island with the building of which he oppressed the people. Men are said to have stood in line and passed the stones from seashore to upland. Parts of the road are still in place and may be followed where the trail cuts in a straight line up and down the deep gorges that break the windward slope of the island.

Kihapi'ilani was brought up on O`ahu, but when his uncle scolds him for wasting food he goes off to Lahaina to find his true father. He is dissatisfied to take the place of a younger son. After their father's death Lono takes pains to humiliate him. The brothers come to blows. Kiha is defeated and saves him self only by leaping off a cliff down the hill Pakui. He hides himself in the Kula district at Kalani-wai in the Makawao region with his wife Kumaka of a Hāna family of chiefs, whom he passes off as his sister....

He consults various *kahunas* as to the course he should pursue to win the rule from his brother. He goes back to O`ahu, learns surfing and, returning to Hāna district, surfs with the daughter of Ho'olae (Chief of Hāna). The couple are repudiated by the father, but after a son is born, a reconciliation is effected and Kiha sends his wife to ask of Ho'olae such lands as will give him control of the fortress Kauiki.

Ho'olae recognizes at once that this is no common man to whom his daughter Kolea-moku has born a child, but the chief Kihapi'ilani. He nevertheless loyally refuses to desert his old chief Lono. Kiha retires to Hawai`i and succeeds in winning Umi's cooperation through the influence of his sister Pi'ikea. After the death of Lono, Umi sends an army to establish Kiha in the succession. Ho'olae defends Kauiki for Lono's son and sets up a wooden image so huge as to frighten off Umi's men.... Eventually Pi'imaiwa (one of Umi's warriors) discovers the trick and they defeat Lono's warriors. Kiha has Lono's son put to death and asks that the lands may be made over to Pi'ikea's sons. The two lads come to Maui, but are despised and done to death and Kiha is established as ruler over his father's lands. It is his famous son Kama-lala-walu (son of eight branches) who gives the name Maui-of-Kama to the island (Beckwith 1970:387-388).

In the following excerpt from Manu's (1884) version of *The Story of Kihapiilani*, he credits the phase "*Na Hono a Piilani*" to Kihapiilani.

> It was customary for Umi to participate frequently in the prayer duties both night and day with his *kahuna*. In this capacity he saw that Kihapiilani would achieve a superior position over Lonoapiilani, the chiefs and all the commoners of Maui, Molokai, Lāna`i , and Kaho'olawe. It was when these three other islands were joined with Maui's prominence that these famous words originated, from the parents of these chiefs until this new era, that is, "*Na Hono a Piilani*" (the bays beginning with Hono, ruled by Kihapiilani) (Sterling, 1998:6).

However, most other stories (Kamakau, 1991/1992; Fornander, 1916/1917; Thrum, 1916; and Pukui, 1997) describe Pi'ilani's realm to already include Molokai, Lāna`i , Kaho`olawe, and Maui, and all the Bays of Maui beginning with 'Hono.'

In Fornander's version of the "Story of Kihapiilani" he has this to say about the victory of Kihapiilani and his subsequent reign.

> **Story of Kihapiilani.** Kiha, who thus forcibly succeeded his brother as Moi of Maui, had been brought up by his mother's relatives at the court of Kukaniloko of O`ahu.... Having, as before related, through the assistance of his brother-in-law Umi obtained the sovereignty, he devoted himself to the improvement of his island. He kept peace and order in the country, encouraged agriculture, and improved and caused to be paved the difficult and often dangerous roads over the Palis of Kaupō, Hāna, and Koolau---a stupendous work for those times, the remains of which may still be seen in many places, and are pointed out as the "Kipapa" of Kihapiilani. His reign was eminently peaceful and prosperous, and his name has been reverently and affectionately handed down to posterity.

Kiha had two wives—Kumaka, who was of the Hāna chief families, and a sister of Kahuakole, a chief at Kawaipapa, in Hāna. With her he had a son named Kamalalawalu, who succeeded him as Moi of Maui. Koleamoku, who was the daughter of Hoolae, the Hāna chief at Kauwiki...with her he had a son called Kauhiokalani, from whom the Kaupō chief families of Koo and Kaiuli descended. Kamalalawalu followed his father as Moi of Maui. He enjoyed a long and prosperous reign until its close, when his sun set in blood and disaster (when Kahekili lost to Kamehameha I) (Fornander 1880:206-207).

Speakman (1984/2001) adds the following information in his version of the "Story of Kihapiilani" in *Mowee:*

Story of Kihapiilani. Kiha's name is forever preserved in Maui history as the builder of the Kiha-a-Pi'ilani Highway which circles the western part of the island and joins with the straight and smoothly paved highway which was begun by ancient chiefs and finished by the *Mo'i*, Pi'ilani, the father. This part of the highway is the eastern roadway running by way of Kaupo and through the crater. Remains of the Pi'ilani Highway are to be found today in some places but more often have disappeared beneath the roadbed of the modern highway around the island, still called by its ancient name. The name is also preserved in that of the great *heiau* at Hana, the Hale-o-Pi'ilani (or House of Pi'ilani), itself as remarkable a monument as the highway.

Umi assisted in building the island roadway, and the friendship of the two ruling families continued to give the people of Maui and Hawaii another long period of peace.... Maui, in this period, came to be called "The Haven of Pi'ilani," and the people of Maui were to look back with longing to this era in their history when the wars of the chiefs in the seventeenth and eighteenth centuries became a painful burden on the land and its people. Historians sometimes speak of the seventeenth and eighteenth centuries in Hawaiian history as the period of the "hundred years' war" or wars. Around 1700, one chief, a descendant of the Pi'ilani chiefs, established through war a powerful and united "kingdom" on Maui. His name was Kekaulike, "The Just" (Speakman, 1984:10-11).

The road that Kihapiilani constructed was estimated to have been 138 miles long (Handy, Handy and Pukui 1978:488). According to Beckwith (1940) *Alaloa* or long road was built around 1516 by Kihapiilani after his "conquest and unification of the whole island." It was paved with stones and is also referred to as the "Kipapa of Kihapiilani." This roadway, four to five feet wide, accomplished several things: it facilitated travel establishing better communication within the realm; it was useful in times of war; and it was used when collecting taxes (Beckwith, 1940:361).

**Legend of Kahekili at Kā`anapali** . Kahekili was known to have kept his court in Wailuku, but as customary with *ali`i nui* he visited other places of his realm. The following excerpt by Inez Ashdown in the *Maui News* (August 23, 1963) explains Kahekili going to Kā`anapali and the history of the "Kaanapali Ceremony."

In ancient times the people of Maui designated Puu Kekaa as one of three Soul-leaping-stations (Uhane-lele) in the island group. From here, the souls of the dead leaped into the sea, as did the dying sun, and traveled the Outgoing-tide (Ke-au-ka') to the Sea of Eternity (Kai-lalo, the Western sea). After the discovery of Hawai`i, when foreigners began to come here with new customs, the first whale-ship, *Mary* arrived in 1820.... Whaling ships' crews came to the hill called Kekaa and changed its name to "Black Rock," and built fires where the whale oil was "tried out" in huge iron kettles.

The stench of rotting whales, oily fires, unwashed kettles, and all sorts of refuse was something to be avoided. Perhaps that caused the story to start about "Black Rock is haunted. Don't go there anymore!"

It is told that King Kahekili (ca. 1700s), ruler of Maui, visited Kaanapali and to his dismay and anger, there was no feast waiting for him and his company. He ascended Pu`u Kekaa to pray in

company with his priests, and there he learned the causes of misery in the area. People had many illnesses which the local doctors could not understand or cure, and they also had learned to drink liquor distilled in various ways. Drunkenness, disease and idleness had afflicted too many in the village of Kekaa...and in all Lahaina-loa. By order of the king, strong men were sent to destroy stills, to burn filthy, squalid homes, and to renew the village. Others were ordered to renew the taro patches and fishpond, the sweet-potato-hills, and then begin life anew in the Spirit of Aloha.

When the area had regained some of it previous beauty, the king ordered all the people to assemble, be blessed by the priests, after repenting and asking forgiveness, and to cleanse themselves in the reviving waters of the sea.... As evening approached, the king went with the priests to the temple of purification atop Pu`u Kekaa. The people assembled, not knowing what might take place. Suddenly the king lays aside his golden-feather raiment and stood clad only in his white loincloth. Looking so handsome and strong, the sacred necklace about his throat, the late sunshine making a kind of luminous halo about his tall figure, the king impressed his people with his dignity and beauty. His words impressed them with consternation and fear as he reminded them of the meaning of the Soul-leaping-station (`Uhane-lele)....

Then he laid aside the sacred necklace, the Lei Palaoa, and walked to the Soul-leaping-station. As the sun sank in all its glory into the sea, King Kahekili dived from the cliff-summit into the dark, surging water below. A shocked silence followed his act, while the people waited. When at long last the king appeared and swam strongly to shore, an echoing wail of relief and triumph was heard. The king paid no attention, walking quickly back to the temple and there being blessed, cared for, and reclothed. Then he smiled knowingly at the priests, for all the people were going into the sea to bathe. Those too ill to walk were carried into the cleansing waters. Fear had departed.

King Kahekili had been a champion of all sports, particularly the game called *lele-kawa*, or diving from some great height into the water. After he "leaped among the spirits" thus banishing fears and superstitions from the minds of his people, many brave ones tried the Leap of Death. As a reminder of the great achievement of King Kahekili, the priests often went themselves, or sent someone, to dive from the Uhane-lele point at sunset. This was to remind the people of the king's teachings and to inspire them to achieve the true way that is living Aloha. The custom grew until it was part of the Sunset Ceremony to have a diver enter the sea during the lighting of the evening torches, the *Ho`ohana o Komohana I ka La*, the ceremony when the sun enters the western sea, or sunset (Ashdown 1963:3, 8).

Legend of Chief Kaanapali . The following story is very long so only an excerpt was presented below.

Once, very long ago, in the land we now call Hawai`i there dwelt a kindly, humble Hawaiian ruler, an ali`i. This prophet's name was Ka`ana-pali, which means Cliff Climber. His kingdom was the ever-green forests, the rolling plains and the blue-shadowed valleys of Laha`ina on the island of Maui. Kaanapali delighted in roaming across the land and took daily walks. He talked with the birds, the animals, the trees, the flowers. Even to the cool streams of water flowing through the valley of Hono-ko-wai and, on to the other five hono where mountain streams meet the sea, he chanted softly, his adoration. Na Hono A Pi`ilani, the six indentations of Maui's broad land-body, he spoke of reverently: Hono-ko-wai, Hono-keana, Hono-ko-hua [sic], Hono-lua, Hono-ko-hua and Hono-nana (Paki n.d.).

C-2-c. Place Name Legends. The following *mo`olelo* or legends are about various place names within the Kā`anapali District or in the vicinity of the project area.

Kā`anapali. There are many meanings to this name, the simplest being the Cliff Cave. According to Alice Hoapili, when all that area was granted to her ancestor, William Shaw, it was called by him as 'Cornwall" from the County in England where he once lived. The Hawaiian pronunciation of Cornwall became Kaanapali. According to Alice Kaae, whose grandfather was William Shaw, who with her father Patrick Shaw and her mother and others of the *alii* family, is buried in the cemetery at Puu Kekaa, there is a deeper meaning.

Once upon a time, Kekaa was the capital of Lahaina-side area while the southern Hua family of rulers lived there. One of those Hua Family kings was Kekaalaneo, father of Prince Kaululaau who was banished to Lanai, the Isle of Demons. He destroyed the evils, returned to West Maui, and became a noted ruler after Kekaalaneo's death. Kekaalaneo supposedly wore the first feather cloak here, and it is now a memento of that family in Bishop Museum. There was also a Hua whose bones rattle in the sun, since he was very cruel and his misdeed caused punishment in the form of a dread drought and famine which left desolation in this area. In this instance, Ke-kaa, La, neo means the revolving of the sun which left desolation (Ashdown 1960s).

Ana-pe`e-kau`a. In those days of warfare and during the battles between the Hua family of kings, the *ana-pe`e-kau`a* or war-hiding cave was used by old people and children for safety. The war-hiding cave has its opening in Hono-ko-wai valley and is a lava tube tunnel that extends toward Hono-ko-hau valley. When a chief was conquered or slain, his family and retainers usually were slain by the victors. The Hiding Cave saved many lives which were sustained by the plentiful water and abundance of edible plants in that once-luxuriant forest area. Both ends of the cave could be closed by large, flat stones and these "doorways" were curtained by vines such as *ko`ali, i`e-i`e,* and other natural greenery. Part of this tunnel was later used to carry irrigation water to fields (Ashdown 1960s).

Hono-ko-wai. Spelled this way, the name means the bay or indentation of water. Spelled in the old way *Hono-ko`a`e* it means where the mountains join and their cliffs provide homes for the white messenger *Koa`e,* the Bosun or Tropic Bird.... At the mouth of Honokowai valley is the ancient royal fishpond or *loko i`a* built by the deities, maintained by the Alii and forgotten by their descendants today (Ashdown 1960).

**C-3. `Ōlelo No'eau.** *`Ōlelo no'eau* or proverbial/traditional sayings usually had several layers of meanings. They reflected the wisdom, observations, poetry and humor of old Hawai'i. Some of them referenced people, events or places. The following *`Ōlelo no'eau* were compiled by Pukui between 1910 and 1960 with both translations and an explanation of their meaning (Williamson, et al. in Pukui, 1983:vii), which are often more *kaona* (hidden or double meaning) than obvious.

'Ōlelo no'eau: *Na hono a Pi'ilani*
Translation: The bays of Pi'ilani
Meaning: The realm of Pi'ilani, a powerful ruling chief of Maui, included the islands of Molokai and Lanai, as well as all the bays of Maui whose names begin with *hono* (#2218, p 234).

'Ōlelo no'eau: *Honokōhau `ōpae lele.*
Translation: Honokōhau's leaping shrimp.
Meaning: An epithet for the *kauwā* of Honokōhau, Maui (#1056, p113).

'Ōlelo no'eau: *Kano ke kihi po`ohiwi o Honokōhau.*
Translation: Hard are the shoulder muscles of Honokōhau.
Meaning: The people of Honokōhau were said to be hard workers (#1503, p 162).

'Ōlelo no'eau: *Mānu`unu`u wale kini o Honokōhau.*
Translation: Multitudinous are the inhabitants of Honokōhau.
Meaning: Said of the people of Honokōhau, Maui, who were known for having big families (#2140, p233).

'Ōlelo no'eau: *Honolua kōhi lae.*
Translation: Honolua of the weighted brow.
Meaning: Said of the fishermen of Honolua, Maui, who never raised their heads lest they be expected to share their catch of fish (#1057. p113).

'Ōlelo no'eau: *Kā`anapali wāwae `ula`ula.*
Translation: Red-footed Kā`anapali.
Meaning: A term of derision for the people of Kā`anapali. The soil there is red, and so the people are said to be recognizable by the red soles of their feet (#1280, p140).

Ōlelo no'eau: *Kāhana auhā.*
Translation: Kāhana of the shed.
Meaning: Said of natives of Kāhana, who were said to be stingy. Their Fish was hidden in the canoe shed rather than shared (#1297, p142).

'Ōlelo no'eau: *Ka pali hinahina o Kā`anapali.*
Translation: The gray hills of Kā`anapali.
Meaning: (no meaning given) (#1526, p165).

'Ōlelo no'eau: *Ka ua leina hua o Kā`anapali.*
Translation: The rain of Kā`anapali that leaps and produces fruit.
Meaning: (no meaning given) (#1581, p170).

'Ōlelo no'eau: *Ka ua Lililehua o Kā`anapali.*
Translation: The Tiny-drops-on-the-lehua rain of Kā`anapali.
Meaning: (no meaning given) (#1583, p170).

C-4. Place Names. Hawaiians of old generally named everything; from winds and mountains, to rocks, canoes, taro patches, fishing stations, and "the tiniest spots where miraculous or interesting events are believed to have taken place" (Elbert in Pukui et al., 1974:x). They all represented a story, some known only locally, while others became legendary. The list below (Table 2) represents place names with an association to project lands in Māhinahina Ahupua`a and vicinity of Kā`anapali Moku.

Table 2. Place names (selected) in the Moku of Kā`anapali and their significance*....

Hono-a-Piilani	Highway around southwest Maui. *Lit.,* bays (acquired) by (Chief) Pi'ilani. Six West Maui bays whose names begin with *Hono* (bay) and the islands seen from them (Lāna`i , Kaho'olawe, Molokai), were ruled by Pi'ilani and are famous in song; the six bays are Honokahua, Honokeana, Honokōhau, Honolua, Honokōwai, and Hononana (Pukui et al., 1974:48). Highway around Southwest Maui. *Lit., Bays of Pi`ilani wahine, wife of Ka`ulula`au* (MHS n.d.:6, Ashdown)
Honokahua	Land division, point, stream, village, and bay, Honolua qd, West Maui *Lit., sites bay* (Pukui et al., 1974:49). Honokahua or Honokohua. If spelled Honokahua the name means the fruit or result bay. It also refers to the *kahua* (site) *holua* (slide) and *`ulumaika* (bowling) near the present Pineapple Hill. If spelled Honokohua it means *the moment of conception.* Honokohua also refers to the era when the Hua family of rulers dwelt at that area of Honolua ranch (MHS nd:6, Ashdown).
Honokeana	Land division and bay, Honolua qd. *Lit., the cave bay* (Pukui et al., 1974:49). Honokeana may also mean *the private parts of the female body* (MHS nd:7, Ashdown).
Honokōhau	Land division, village, stream, falls, ditch, tunnel, bay and hill (305 feet high), Honolua qd. *Lit., bay drawing dew* (Pukui et al., 1974:49; Sterling 1998:47)
Honokōwai	Land section, ditch, point, stream, beach park, Lahaina qd. *Lit., bay drawing water* (Pukui et al., 1974:49). *Lit., bay drawing dew* or *the coolness after making love.* The name also may be, figuratively, *human semen* (MHS nd:7, Ashdown).

Honolua	Land section, village, landing, bay, winter surfing area, stream, mountain (2627 feet), and quadrangle, Lahaina District. *Lit., two harbors* (Pukui et al., 1974:49)
Hononana	Bay near Honolua Bay, West Maui. *Lit., animated bay* (Pukui et al., 1974:49). Some say the name refers to love-making, others say it is *watching or looking bay* (MHS nd:7, Ashdown).
Kahana	Land division, camp, point, stream, Honolua qd. *Lit. cutting* (Pukui et al., 1974:63).
Kahana Iki	Gulch, Honolua qd.
Kā`anapali	Landing, village, district, Lahaina qd. Also called Pōhaku- Kā`anapali and Kā`anapali-pōhaku (Emerson 1915:83 in Pukui et al., 1974:60). *Lit. cliff cave. Lit., rolling cliffs,* or *working together in harmony* (MHS nd:9, Ashdown). The name of the area around Kekaa (MHS 1958:3).
Kapalua	(*two borders*) in Sterling 1998:47; Flemings Beach, Honolua qd. (Pukui et al., 1974:87).
Ke-ka`a	Place of legends, heiau, burials, kahuna, as well as the ancient *Leian-aka-`uhane*, the leaping place of the soul to Pō and ancient capital of Hawai`i (see Fornander 1916/1917:5:542, 544, 574; Sterling 1998:47-50; Johnson 1959:15; Manupau 1922). Black rock and area, site of Sheraton-Maui Hotel. A man, Moemoe, insulted the demigod Māui; after lassoing the sun, Māui chased and killed Moemoe, who turned into this rock. *Lit., the rumble*, such sounds are said to be heard during storms (Pukui et al., 1974:106-Fornander V:538). Pu`u Keka`a or *turning point hill* (MHS nd:15, Ashdown). The site of the original capital of the Islands before 1802 in the time of King Kakaalaneo. Pu`u Kekaa is the name of the hill. There is a sacred heiau and burials on top of the hill. The leaping off place of the souls is to be found on the top of the hill one the cliff ledge over the ocean (MHS 1958:3). *To roll* (Walker [ms] 1931:56).
Māhinahina	Land division, plantation, and point, Honolua qd. *Lit. silvery haze* as in moonlight (Pukui et al., 1974:138).
Pulelehua	Project lands, created name. *Lit. butterfly, moth, the Kamehameha butterfly* (Pukui & Elbert 1986:353).
Pu`u Kukui Mountain,	West Maui. *Kukui hill,* also called *the hill of light* or *enlightenment.* It is the highest peak in the West Maui mountains (MHS nd:26, Ashdown). Peak (5,788 feet high). The highest point on West Maui, Lahaina qd. (Pukui et. al., 1974:200 – Macdonald and Abbott p342).

* Ili place names are too numerous therefore listed here.

C-5. Rains of Kā`anapali.

Ua-ulalena and *Ua-lihai* were just two of the types of rain in Kā`anapali (HEN I:1253).

C-6. Heiau/Sites of Kā`anapali District. [Most references found in Sterling (1998); Walker (1931)]

Site No.	Heiau/Site	Location	Comment
	Ho`akua	Pu`u Keka`a	Heiau, destroyed (Ashdown 1971:46; Sterling 1998:48)
	Leina-`uhane	Pu`u Keka`a	Souls Jumping off to Po (Fornander 1916:5:572, 574)
	Large Stone	Kā`anapali	Pohaku-o-Wahine-o-Manua (Thrum 1908:45)
	Battleground	Honokōwai	When Pele-io-holani heard that Alapa`i was at Lahaina he gathered all his forces at Honokahua and at Honolua. At Honokowai an engagement took place between the armies, and the forces of Alapa`i were slaughtered and fled to Keawawa (Kamakau 1961:74).
12	Kahana	Māhinahina	Heiau, Kahana Point. Totally destroyed (Walker 1931:115).
		Kahana	Salt Gathering Depressions (Nuuhiwa/HAW 84.2.1).
	Boulder	Kahana	Pohaku-o-Ka`anapali (Lyons 1966:8).
13	Mailepai	Mailepai	Heiau near Mailepai Point (Walker 1931:116)
14	Hihiho	Mailepai	Heiau near Kalaeokaea (Walker 1931:117)
15	Unknown	Alaeloa	Heiau, small rectangular enclosure (Walker 1931:118)
	Battleground	Napili	(Kamakau 1961:74)
16	Kahauiki	Honokahua	Heiau, makua of Kahauiki Camp (Walker 1931:119)
17	Puhalakau	Honolua	Ku`ula heiau, makai of Honolua Park (Walker 1931:120)
18	Honolua	Honolua	Heiau in gulch; platform and walls (Walker 1931:121)
	Holua Slide	Honolua	(Walker 1931:329)
19	Iliilikea	Honokohau	Heiau on ridge west of Punaha Gulch (Walker 1931:122)
20	Ma-iu	Honokohau	Heiau, east of Honokohau Valley (Walker 1931:123)
	Waiuli Pit	Honokohau	Pit where dead commoner bodies thrown (Kamakau 1931:107)

D. Historic References.

By and large "Historic References" pertain to notable historic events, overviews of important place names and land tenure within the project area and districts. One of the most significant practices in the history of the Hawaiian people was their concept of stewardship of the land. However, over time, these practices were replaced by more western methods of land tenure and use, as the lands of Maui went from the domain of the monarchy to various individuals and corporate entities.

D-1. History of Land Divisions. It was during the time of Kaka'alaneo and Kaka`e of Maui that the division of lands is said to have taken place under a *kahuna* named Kalaihaohi'a. He portioned out the island into districts, sub-districts, and smaller divisions, each ruled over by an agent appointed by the landlord of the next larger division, and the whole under control of the ruling chief over the whole island or whatever part of it was his to govern (Beckwith 1970:383). Each island was divided into *moku* or

districts that were controlled by an *ali'i 'ai moku.* Within each of the *moku* on each island, the land was further divided into *ahupua'a* and controlled by land managers or *konohiki.* The boundaries of the *ahupua'a* were delineated by natural features such as shoreline, ridges, streams and peaks, usually from the mountain to the sea, and ranged in size from less than ten acres to 180,000 acres (Moffat and Kirkpatrick 1995:24-29, see also Chinen 1958:3). But sometimes "only the line of growth of a certain tree or grass marked a boundary; and sometimes only a stone determined the corner of a division" (Chinen 1958:1). The ideal *ahupua`a,* from mountain to the sea, enabled a chief and his followers to obtain fish and seaweed at the seashore, taro, sweet potatoes and bananas from the lowlands, and forest products from the mountains. However, this more often than not, was not the case (Chinen 1958:3).

Each *ahupua'a* was often divided and sub-divided several times over (i.e., *`ili, kuleana, mo'o, pauka, koele, kiha pai*), answerable to *ali'i* where the lesser division was located. However the *ili kupono* or the *ili ku* was "completely independent of the *ahupua'a* in which it was situated...tributes were paid directly to the king himself" (Chinen 1958:4). Some *ahupua`a* did not have any *`ili,* while others had as many as forty, "each with its own name and carefully defined boundaries" (Chinen 1958: 3). *Mo`o* or *mo`o`āina* were the next size of land division; these were set for cultivation purposes only. *Mo`o* were subdivided into *pauka* which were also for cultivation only. Patches of land cultivated by tenants for their chiefs were called *koele* or *po`alima* because they were worked only on Fridays. A *kihapai* was cultivated only for the tenant and his family. Rights to lands were mutable or revocable; a ruling chief or any "distributor" of lands could change these rights if displeased, or as favors--usually after a victorious battle, and after the death of the *ali'inui* (Chinen 1958:5).

During the period between 1839 to 1855, several legislative acts transformed the centuries-old Hawaiian traditions of *ali'inui* land stewardship to the western practice of private land ownership. In the first stage King Kamehameha III (Kauikeaouli) divided up his lands among the highest ranking *ali'i* (chiefs), *konohiki* (land managers), and favored *haole* (foreigners) (Chinen 1958:7-14; Moffat and Fitzpatrick, 1995:11, 17). This historic land transformation process was an evolution of concepts brought about by fear, growing concerns of takeovers, and western influence regarding land possession. Kamehameha III, in his mid-thirties, was persuaded by his *kuhina nui* and other advisors to take a course that would assure personal rights to land.

One-third of all lands in the kingdom would be retained by the king; another one-third would go to *ali`i* as designated by the king. In 1846 he appointed a Board of Commissioners To Quiet Land Titles, commonly known as the Land Commission, to "confirm or reject all claims to land arising previously to the 10th day of December, AD 1845." Notices were frequently posted in *The Polynesian* (Moffat and Kirkpatrick, 1995). However, the legislature did not acknowledge this act until June 7, 1848 (Chinen 1958:16; Moffat and Kirkpatrick, 1995:48-49), known today as The Great Mahele. "The mahele did not actually convey title to the various *ali'i* and *konohiki*; it essentially gave them the right to claim the lands assigned to them--these lands became known as the *konohiki* lands. The *konohiki* chiefs were required to present formal claims to the Land Commission and pay a commutation fee, which could be accomplished by surrendering a portion of their land to the government." The government could later sell these lands to the public. Upon payment of the commutation fee, the Minister of Interior issued a Royal Patent to the chief or *konohiki.* The last one-third was originally designated to the *maka'ainana,* but not acted on--instead it was set aside to the government,-"subject always to the rights of the tenants" (Moffat and Kirkpatrick, 1995:41-43; see also Chinen 1958:15-21).

Ili kupono were the only *ili* (parcel) recognized in this process, all the *ili* and lesser divisions were absorbed into the *ahupua'a* claim (Chinen 1958:20). The *ahupua`a* of Māhinahina where the project lands are located were once under the jurisdiction of Hoapili Kane [husband of Keōpūolani (widow of Kamehameha I), brother of Ka`ahumanu, and Governor of Maui. He later assigned some of these lands to Charles Cockett, a blacksmith who worked for him. However, these lands were also claimed by Paki, (see Appendix F). Abner Paki was the father of Bernice Pauahi Bishop; he was born on the island of Molokai,

the son of Kalanihelemaiiluna and Kuhooheiheipahu, great-grandson of Kekaulike and descendant of the Kamehameha and Kiwalao families of Maui (Day 1984:102).

In 1892 the legislature authorized the Minister of Interior to issue Royal Patents to all *konohiki* or to their heirs or assignees where the *konohiki* had failed to receive awards for their lands from the Land Commission. The Act further stipulated "that these Royal Patents were to be issued on surveys approved by the Surveyor General of the kingdom" (Chinen 1958:24; Moffat and Fitzpatrick 1995:41-43). Kamehameha III formalized the division of lands among himself (one-third) and 245 of the highest-ranking *ali'i* and *konohiki* (one-third) between January 27 to March 7, 1948. He acknowledged the rights of these individuals to various land divisions in what came to be known as the *Buke Mahele* or 'sharing book.' These lands, however, were all "subject to the rights of native tenants" or *kuleana* lands, with reversionary rights to *ahupua`a* and *ili kupono* claimants if the tenant died without heirs (Chinen 1958: 29-30). The *Great Mahele* marked the end of the feudal system in the kingdom (Chinen 1958:15).

D-2. Land Commission Awards (LCA). An LCA internet search (Appendix F) on the website www.waihona.com (*Waihona `Aina, Inc.*) produced the following information regarding LCA claims made between 1847 and 1852 in the project area:

LCA Claims in Māhinahina Ahupua`a.

LCA #	Claimant	Apana	Ili	Land Use
075	Cocket, Charles [also Kale Makapaa]	1	Māhinahina 4	Lauhala, Kula, Pasture, House Lots
04248	*Kekalohe	3	Kapili	Pasture [3 pieces; 1 bounded by Cocket, 1 bounded by Gov Rd]
	[Kekalohe also had taro lands at Honokowai]			

Māhinahina LCA (in Griffin & Lovelace 1977: 60-63).

LCA 75 LCA 6539	Charles Cocket Hoonoho	Māhinahina 4 "	N boundary the bottom of Māhinahina Gulch houselot; in Cocket's land

LCA 6539 Hoonoho. *In the ahupua`a of Māhinahina, which is possessed by Paki, I am a subject under him, and I have a claim for the place I made with my own hands; however, this is an ancient right, from the time of the makua, and we, the keikis, have a long-standing right at this place. That claim is for kula planted in sweet potatoes, and a kahawai (valley area) planted with bananas, olonā and sugar cane. I also have a house claim. It is enclosed by a fence. However, it is in another place, it is not in our land claim* (1848: NR 6:398)

LCA 4239 LCA 4248	Kaukau Kekalohe	" "	houselot/kula land; in Cocket's land houselot; in Cocket's land
Grant 1166	Baldwin, Pogue, Bishop "	Māhinahina 1,2,3 Kahana 1,2,3	

Crown Lands of Kā`anapali.

The following *ahupua`a* in the Kā`anapali District were claimed by Kauikeouli or Kamehameha III and designated Crown Lands or reverted to Crown Lands following commutation by heirs and successors (Baker 1989):

Crown Land*	Heir	`Ili	Page
*later Konohiki Lands			
Honokowai	Kamamalu		13, 87
Waiokila	Lota Kapuaia Kamehameha	Kahakuloa	14, 87
*Honokohau	Moses Kekuaiwa		17, 102
2 Kahana 1 & 2			17
3 Māhinahina			17
Kahakuloa	William Lunalilo		20
1 Kahana 3	William Lunalilo		20
*Napili 1, 2 & 3	L. Konia		62, 87,
Polua			87

The following lands were designated Konohiki lands in the Kā`anapali District and were awarded to the following(Baker 1989):

Konohiki Lands	Awardee	`Ili	Page
2 Honokeana 1 & 2	L. Konia		102
2 Alaeloa	L. Konia		102
Mailepai	L. Konia		102
Honolua	William Lunalilo		103
Honokowai	Mikahela Kekauonohi	Hookahi ilaila	106
Honokahua	Kale		145

Some of the lands Kamehameha III designated for himself, he divided further; they are sometimes referred to as Government Lands, but are more correctly called "Kingdom Lands" or *No Ke Aupuni* (Baker 1989:150-151). The following are Kingdom Lands in the Kā`anapali District.

Kingdom Lands		Page
1 Kahana 1	*I Kamaalaea Puali Kom* (west)	167
Kahana 2	*I Kamaalaea Puali Kom* (west)	167
3 Māhinahina 1, 2 & 3	*I Kamaalaea Puali Kom* (west)	167

D-3. Kā`anapali Moku and Ahupua`a. The lands of Kā`anapali have changed greatly over time; from a modest village that supported ancient *ali`i nui* and *kahuna*, to over a century of sugar cane fields and plantation infrastructures, to a vast competitive tourist resort destination that conservatively supports three million tourists per year. The cinder cone of Keka`a now called Black Rock, was once a significant ancient place of worship and burial. It was also used as a burial place during historic times as will be discussed in other sections of this report. Today it is part of the structural design and landscape of the Sheraton Maui Hotel in the Kā`anapali Resort complex

**Keka`a.** Handy and Handy (1978) quoted Fornander's (1919) description of Keka`a, which was based on legends. They write that Keka`a "was once an area of intensive cultivation. This implies continuous cultivation on the coastal region along the northwest coast" of Maui.

> Kekaa was the capital of Maui when Kakaalaneo was reigning over West Maui. ...Many houses were constructed and people cultivated a great deal of potatoes, bananas, sugar cane, and things of a like nature. I have been told that the country from Kekaa to Hahakea and Wahikuli—that country now covered by cactus, in a northwesterly direction from Lahaina—was all cultivated. This chief (Kakaalaneo) also planted breadfruit and *kukui* trees down at Lahaina. Some of these trees southwest of the Lahaina fort, were called the bread fruit trees of Kauheana (Fornander 1918-1919, Vol 5, pp 540-541 in Handy and Handy 1978:494; Handy 1940:106).

Handy and Handy (1978) go on to note their own observations of the Kā`anapali area in *Native Planters in Old Hawaii: Their Life, Lore, and Environment.*

> North of Lahaina are five valleys watered by streams draining the western slopes of the West Maui watershed: Honokawai (sic), Kahana, Honokahua, Honolua, and Honokohau. The first four all had extensive *lo`i* lands in their valley bottoms, where terraces rose tier on tier in symmetrical stone-faced *lo`i*. On this part of the coast there is no sloping *kula* land seaward of the valleys as there is back of Lahaina and southeastward... (Handy and Handy 1978:494).

In the late 1800s the lands now referred to as Kā`anapali were covered with sugar cane fields maintained by the Pioneer Mill Company. This included the project lands in the *ahupua`a* of Māhinahina, which at one time was planted in sugar cane instead of pineapple. In the late 1980s those lands were exchanged and planted in pineapple [Nohara 2004].

D-4. Pioneer Mill Company. The history of the Pioneer Mill Company comes from a variety of sources such as a company brochure *Pioneer Mill Company, Limited* by Manager Keith Tester (1966) which gives a brief history of the company; newspaper articles from *Maui News* with headlines that purport to give 'The Inside Story' of Pioneer Mill"; as well as articles from smaller periodicals such as the *Paniola Press;* and several texts which include an overview of the history of the company (see also Goodwin & Leineweber 1997:15-30). While the *Annual Reports* of the company do not provide much in the way of a personal history, they give snippets of information regarding a range of topics such as sugar yields, number of fields planted, types of sugar cane planted, reservoirs, ditches and tunnels built, and occasionally even tidbits of information about the laborers. Pioneer Mill was not the first sugar plantation or sugar mill to be founded on West Maui, but it did outlive the others. The following history comes primarily from the company brochure by Tester (1966), a newspaper article by Godinez (1990), and text by Wilcox (1997) and Dorrance and Morgan (2000).

The company was formed in 1860 when James Campbell was joined by Henry Turton and James Dunbar. Campbell had arrived in Lahaina in 1852 and worked as a carpenter for a number of years. Turton was a mason by trade, but at the time he joined Campbell and Dunbar, he was the owner of a billiard hall and a bowling alley. The partners operated as Campbell & Turton purchased their sugar cane from native growers and other independent planters that included Henry and Dwight Baldwin, L.C. Torbet, Captain McKee and J.M. Horner (Tester 1966). Henry Baldwin had entered the sugar business in 1863 at age 21, when he joined his brother in raising cane to be ground at the partner's mill (Dorrance and Morgan 2000:63).

German-born Capt. Heinrich Hackfeld and brother-in-law J.C. Pfluger established H. Hackfeld & Co. in 1853 and entered the sugar industry after helping Dr. Robert Wood salvage his East Maui and Koloa plantations. In 1861 Hackfeld went back to Germany leaving Pfluger in charge. During that year the company became sugar agents for Lihue Plantation, Pioneer Mill (Campbell & Turton) and Grove Farm (Dorrance and Morgan 2000:140).

In 1863 Campbell & Turton's competitor, the Lahaina Sugar Co. went bankrupt and sold their holdings to the partnership. By 1865 Dunbar left the partnership and the company became known as Pioneer Mill Company (Tester 1966). The company started with a steam-powered mill and 126 acres of their own under cultivation. By 1866 annual production was 500 tons of sugar. By 1872 the mill's yield was 1,000 tons and the plantation continued to grow (Dorrance and Morgan 2000:63).

In 1870 Kamehameha V and his partners founded the West Maui Sugar Association, however, this company also folded and was sold to Pioneer Mill. In 1876 partners Campbell and Turton won an award for their sugar exhibition at the Philadelphia World's Fair, however, Campbell sold his interest in the company to Turton the following year (Tester 1966).

By 1880 agents H. Hackfeld & Co "backed one-third of all plantations in the Islands." The following year Paul Isenberg, H. F. Hackfeld, and H.F. Glade arrived in the Islands from Bremen, Germany to become active partners in the firm (Dorrance and Morgan 2000:140). Turton, in the meantime, obtained permission to build a railroad across the plantation property in 1882 and a year later, trains were hauling harvested cane between Kā`anapali and Lahaina. A few years later (1885) Turton went bankrupt and the company's agents, H. Hackfeld & Co. submitted a bid for James Campbell and Paul Isenberg (Tester 1966), and H. Hackfeld & Company bought controlling interest in Pioneer Mill Company (Dorrance and Morgan 2000:63). Turton died two years later in July 1887 (Tester 1966).

In 1889 Campbell once again sold his interest; this time to C. F. Horner who succeeded him as manager. On June 29, 1895 Isenberg and Horner incorporated Pioneer Mill Company under the laws of the Kingdom of Hawaii (Tester 1966; Ashdown 1977; Godinez 1990:4; Wilcox 1997:126). Pioneer Mill has succeeded over the years against obstacles that killed off many a competitor. Their success could be attributed to an assertive method of land and water use as reported in their annual reports.

D-5. Honokōhau and Honolua Ditches. In order to acquire more water for their sugar crops, PMC began a systematic program of well drilling, building reservoirs, flumes, ditches and pumps in 1895. In the PMC Annual Report of 1901, Vice President H. Alexander Isenberg reported that the Directors had "concluded an agreement with Hon. H. P. Baldwin, by which the Company will acquire an additional amount of...mountain water from the Honokohau Gulch...." He also reported that twenty miles of railroad had been constructed" (PMC 1902:4-5). [NOTE: It appears that "Honokohau" and "Honokahau" are used interchangeably to mean the same ditch which was actually Honokōhau.]

In the report of 1903, Manager Barkhausen states that "the Honokahau (sic) Ditch is almost ready for the water. Scarcity of labor, rain and other unforeseen complications have delayed its completion beyond all expectations" (PMC 1904:10). In 1905 Barkhausen reports the following:

> The Honokohau Ditch has been completed in May (1904) and turned over to Mr. H. P. Baldwin on the first day of June-payments for the water commencing from that date.... The capacity of the ditch is close to 30 million gallons, and the minimum flow has been 10 million gallons. The ditch is extended through the entire length of the plantation at an elevation of about 700'. Nine reservoirs are situated below this elevation with a storage capacity of 70 million gallons. The acquisition of this new water supply has resulted in a considerable saving in pumping, besides enabling us to take in about 1000 acres new land-otherwise too high for pump water. The Kaanapali Pumping Station which formerly supplied 12 million gallons to an elevation varying from 60' to 400' has been entirely abandoned, and the Wahikali (sic) Station is only operated during planting time. Bringing the water out of the Honokohau Valley and through the broken and difficult country to the lands of the Pioneer Mill Co. required considerable engineering skill and reflects great credit on the able and accurate work done by Mr. J. S. Molony (sic), the Civil Engineer in charge (PMC 1905:11-12).

Weinzheimer reports the following:

> The Kahoma flume, length 6,300 ft., which would have had to be entirely reconstructed during the coming year, has been replaced by a tunnel (Kahoma) 5,300 ft. long, which will be finished next month, and be sure to catch all the storm water. A ditch, flume and syphon [sic] have been constructed through the Kahoma and Kanaha Gulches, which enable us to take the Honokahau [sic], Honokawai [sic] and Wahikuli waters over to the Lahaina section of the plantation, thus relieving the Lahaina pumps (PMC 1911:4).

Weinzheimer reported on company activity for the year 1911:

> The syphons, flumes and ditches bringing the Honokahau and Honokawai surplus water to the Lahaina side, have been in operation since April (PMC 1912:5).

A greater need for water prompted an arrangement in 1912 with Baldwin and Honolua Ranch to purchase water from Honokōhau watershed (Tester 1966). The companies agreed "that Honolua Ranch would build and own the Honokōhau Ditch, while Pioneer Mill Company would finance it and use the water" (Wilcox 1997:126). The first Honokōhau Ditch had been built in 1902-1904 but heavy damages called for a new ditch to be built in 1912. Honolua Ranch manager David T. Fleming, reported in 1912 that the old ditch leaked worse every day. The new ditch (referred to as both Honolua [by MLP] and Honokōhau Ditch [By PMC]) was fully cement-lined, and the unreliable wooden flumes were eliminated by utilizing tunnels and siphons. When it was completed there were 34,241 feet of tunnels, 726.3 feet of covered crossings, 1,183 feet of inverted siphons and only 427.3 feet of open ditches (Wilcox 1997:127). [By the 1980s PMC no longer received all of the Honokōhau Ditch water; at least 6 mgd were allocated elsewhere, such as Honokōhau Valley farmers, MLP pineapple fields, Kapalua Resort and Maui County (Wilcox 1997:137)]. In spite of the expansiveness of the Honokohau Ditch, the source of which were the Honokohau and Honolua Streams, and ended at Kahoma Stream near Mala, PMC was compelled to build at least seven more ditch systems in West Maui of which the Honokōwai Ditch (1917) was the most documented according to Wilcox (1997).

D-6. Dr. Dwight Baldwin and H.P. Baldwin. Henry Perrine Baldwin (1842-1911) was born in Lahaina, the sixth of the eight children of Dr. Dwight Baldwin and Charlotte Fowler Baldwin who were part of the fourth company of American missionaries. Dr. Baldwin was not only an ordained minister, he was also a physician who served fellow missionaries, *ali`i* and the *maka`āinana*; first in Kohala and Waimea and all the way to Hilo. Then for health reasons he was transferred to Lahaina (Piercy 1992:134-140). After seventeen years of service, Dr. Baldwin was granted (ca. 1853) 2,675 acres of land in the *ahupua`a* of Māhinahina and Kahana for farming and grazing (KR 2003:H-2).

Henry grew up in Lahaina, was educated at Punahou and although he first wanted to get a medical education, he started managing a rice plantation, then went into sugar, first working for his brother David Dwight, followed by a long-lasting partnership with his soon-to-be brother-in-law, Samuel T. Alexander. Henry and Emily Whitney Alexander Baldwin had eight children [Henry's older sister Abigail married Samuel and Emily's brother William De Witt Alexander, who was a noted Hawaiian historian (Lyons v1:4)]. Alexander & Baldwin first worked together at the Waihee Plantation, then in 1876 tackled the construction of the Hāmākua-Haiku irrigation ditch. Although Henry lost an arm in a mill accident, that did not deter him (Day 1984:7-8). He became famous when he climbed down a rope into Maliko Gulch to show his workers it could be done; they followed him thereafter (Day 1984:8; Wilcox 1996:60; Dorrance and Morgan 2000:59). Their success in this venture allowed them to form a business partnership, Alexander and Baldwin or A & B, which is still a viable corporation today. Alexander moved his family to California in 1883 and Baldwin ran the firm for almost thirty years (Day 1984:8).

Other ventures of the firm included establishing the *Hawaiian Sugar Company* on Kauai (1889); acquiring control of the *Hawaiian Commercial & Sugar Co.* in Pu`unene (formerly owned by Claus Speckles); and operating a fleet of vessels between Hawaii and the mainland--these were eventually replaced by steamers of the *American-Hawaiian Line*, then the freighters of the *Matson Navigation Co.*, which is still a subsidiary of A&B. From 1887 to 1903 H.P. Baldwin also served in the legislature; he devoted much of his income to community works (Day 1984:8).

D-7. Honolua Ranch to Maui Land & Pineapple (MLP). In the late 1800s, Henry P. Baldwin acquired lands at Honokahua, which included Honolua Ranch. Ranch operations included cattle [the herd included "about 2000 scrub cattle" at one time (Clare & Morrow 1930:63)] and coffee ventures, as well as fishing, farming crops of taro, mango, and aloe. At some point, Honolua Ranch lands included seven *ahupua`a* of Honokahua, Honolua, Honokōhau, Mailepai, Kahana, Māhinahina and Honokōwai, acquired through royal grants, purchases, marriages, and mergers until the holdings reached 24,500 acres in 1902 (KR 2003:H-2).

As president of Honolua Ranch, Baldwin entered an agreement with Pioneer Mill Company in 1901 to build Honokōhau Ditch. Construction started in 1902 and was completed in 1904. Before he died in 1911, H. P. Baldwin appointed David T. Fleming of Scotland, as manager of Honolua Ranch and Baldwin's son Henry "Harry" A. Baldwin became president of the Ranch. In 1912 Fleming planted 20 acres of pineapple on Honolua Ranch, and construction began on the new Honolua Ditch, which was to replace the leaky Honokōhau Ditch (KR 2003:RT).

Between 1912 and 1915 the ranch settlement and coffee operations were relocated to the uplands of Honokahua and a new office, store, plantation housing, churches and coffee mill were built. The Honokahua Cannery and the railroad system also began construction at this time. The cannery was completed in 1914 and the first 6,000 cases of pineapple products were shipped from Kā`anapali to the mainland. This same year the Honokahua Valley hydropower plant was constructed. In 1920 the company changed its name from Honolua Ranch to Baldwin Packers and a new cannery was built at Māla in Lahaina. Canning started in May and the old Honokahua Cannery was closed. That same year watermelon was planted on 100 acres of Honolua Ranch (KR 2003:RT, 2).

In 1923 the company incorporated and Harry Baldwin was president and Fleming remained manager of Baldwin Packers, Ltd. In 1926 the West Maui Golf Club and clubhouse at Lipoa Point was formally opened with facilities used by managers, supervisors of Baldwin Packers, Ltd. and visiting dignitaries. In 1928 a new slaughterhouse was built on Honolua Ranch and a rain gauge was established on Pu`u Kukui; that year a rainfall of 400 inches was recorded. In 1929 a new store was built, the same one that is located on Office Road Today (KR 2003:RT).

Photo 9. Honolua Store, once part of another era.

The following excerpts were written about Baldwin Packers by Clare & Morrow (1930) in *Maui: A Few Facts about the Valley Isle,* with reference to the project area of Māhinahina:

> The traveler going north through historic old Lahaina is met on the one side by the marine beauty of the famed Lahaina Roadstead with Lanai in the offing. To the right are the waving sugar canefields of the Pioneer Mill Company. Then suddenly the picture changes. One has reached Māhinahina. Lanai and Molokai now break the main view with their peaks of color, light and shade; to the right there is no longer the familiar canefield, in its stead is the battalion-like array of pineapple plants, rising from the sea to the West Maui Mountain slopes, with roads running like so many ribbons through the symmetrical fields. This is the property of Baldwin Packers, Ltd., an organization that packed 5,975 cases of pineapple in 1914 and 426,249 cases in 1929.
>
> Fronting for 15 miles on the waters of the Pacific, this pineapple district extends from Māhinahina on the south to Kahakuloa on the north, with both sides of the property centering at Kukui, the highest point of the West Maui Mountains. This area forms a sector of a gigantic circle and is the property locally referred to as Honolua (Clare & Morrow 1930:61).

Between 1930 and 1940 the company established a piggery [pure bred Duroc Jersey and Berkshire* hogs (Clare & Morrow 1930:63)] and dairy at Honokahua; a social clubhouse for Japanese Camp and Amusement Hall was built; and Fleming began planting fruit orchards and forests. Transportation of pineapples by rail to Lahaina was discontinued in 1939 and the company began using trucks to haul pineapple. By 1946 the company phased out manual harvesting of pineapple and introduced boom harvesters. That same year Harry Baldwin died and his brother Frank succeeded him as president. The

following year cattle-ranching was discontinued and the slaughterhouse was closed. In the 1950s David Fleming retired as manager, became Managing Director and his son Bruce was appointed manager. Watermelon production discontinued, as did coffee. In the early 1960s Frank Baldwin died and J. Walter Cameron, son-in-law of Harry Baldwin, was named president of Baldwin Packers, Ltd. and his son Colin C. Cameron was appointed General Manager. This same period the company merged with Maui Pineapple Company, Ltd., the surviving corporation; who now operated both Hali'imaile and Honolua pineapple plantations (KR 2003: RT). [*see http://www.ansi.okstate.edu/breeds/swine/duroc/ for more information on the breeds.]

In 1965 565 acres of West Maui land was reclassified from agriculture to urban use. In 1969 the Cameron family, descendants of H. P. Baldwin, in an agreement with the parent company Alexander & Baldwin, acquired Maui Pineapple Company, Ltd., and changed the company name to Maui Land & Pineapple Company, Inc. (ML&P), now the parent company of Maui Pineapple Company, Ltd., and ML&P went public. The 1970s saw a lot more company activity as 317 more acres of West Maui lands were reclassified from agriculture to urban use, and Honolua Plantation Land Company, Inc., a wholly owned subsidiary of ML&P, was incorporated for the purpose of land management and development. This was followed by the construction of Napilihau, a 174-unit employee housing, as families were relocated from plantation homes in Honolua and plantation homes demolished to make way for resort development. The resort development, which included an 18-hole golf course, the 141-unit Bay Villas, the Bay Club restaurant, the Bay hotel and the Golf Villas. The resort project name was changed to *Kapalua* because "Honolua" was often confused with "Honolulu." In 1976 J. Walter Cameron died and Colin C. Cameron was elected Chairman of the Board of ML&P and its subsidiaries (KR 2003:RT).

In the early 1980s The Ironwoods, The Ridge and The Village Course were completed. In 1985 Kapalua Bay Hotel sold to Kapalua Bay Hotel Company. In the late 1980s Pineapple Hill at Kapalua was completed, as did Kapalua Place. The 1990s also saw a lot of activity as Plantation Estates I started lot sales, Plantation Course and Clubhouse were completed, and the Kapalua Villas vacation rentals started. During this period Colin Cameron died and his sister Mary C. Sanford was elected Chairman of the Board and Gary L. Gifford was named President & CEO of ML&P. That same year (1992) the Ritz-Carlton* opened. In 1995 Donald A. Young succeeded Gary Gifford. In 1998 a Special Management Area (SMA) approval by Maui Planning Commission, giving the go-ahead to construction of 36 luxury beachfront condominiums called Coconut Grove on Kapalua Bay; this was followed by the groundbreaking for the Kapalua Golf Academy. The end of the 1990s saw the inauguration of the Mercedes Championships, which started the PGA Tour season. The Village Club House & Golf Academy was completed in 2000; and Plantation Estates II and Coconut Grove on Kapalua Bay were completed in 2001 (KR 2003:RT).

*The Kapalua management considers "the most important historical site at Kapalua to be the Honokahua preservation site, which was unearthed when digging began for The Ritz-Carlton, Kapalua." The hotel plans were re-designed and the hotel was moved inland to allow the "900 ancient Hawaiian burials dating between AD 610 and 1800" to remain in what is part of the Honokahua preservation site that also includes sections of the 16th century *Alaloa* or King's Trail (KR 2003:H-3).

D-8. Lahaina, Kaanapali, Pacific Railroad. A few visionaries in the 1870s saw that there was a need for common carrier railroads. Samuel Wilder was one of them. In 1878 Wilder was appointed to the King's cabinet as Minister of Interior. "A month later King Kalākaua signed into law *An Act To Promote The Construction of Railways* which provided for eminent domain to create rights-of-way." Wilder managed to have the Act amended to include subsidy payments by the Kingdom for railroad construction. Two years later, over the signature of the Minister of Interior, the Kingdom awarded a charter of incorporation to the Hawaiian Railroad Company, which was majority-owned and controlled by Wilder. A month after the charter was issued, Wilder resigned to pursue his business plans (Dorrance and Morgan 2000:164-165). The first train used in West Maui for sugar cane production began operating around 1890 and continued until around 1950. The train hauled tons of raw sugar cane to the mill to be processed for the sixty years it operated. The sugar cane train was retired when motorized trucks and mechanical claws

proved more efficient and cost effective (SCT 2004). In the 1920 PMC annual report noted "the extension of our lower railroad to Kahana" (PMC 1920:16). The last operating railway in Hawaii was the Lahaina, Kā`anapali and Pacific Railroad (Dorrance and Morgan 2000:64).

D-9. Maui Trails. In 1933 Martha Foss Fleming, wife of Maui visionary David Fleming published *Old Trails of Maui* in which she discusses the importance of ancient Hawaiians the trails that are in historic times being obliterated by the ever expansion of communities in Maui. The following excerpts illustrate the importance of trails as well as where the very significant ancient *ala loa* trail passed through the Kā`anapali District.

> There is a certainty that in the past, before the influx of "haoles" to the Hawaiian Islands, Maui had trails and paths here, there and yon to meet the need and convenience of her people. The canoe maker with his "kahuna" and attendants was ever making expeditions into the forest to select the biggest and best koa trees for his "wa`a." The bird catcher traveled far, wide and high to secure the bright feathers of the "i`iwi" and "o`o" for his majesty's mantle. The adz-cutter had beaten paths to his quarries. And more recently, when China was calling so assiduously for sandalwood, the mountains were simply infested with men gathering the fragrant "`iliahi." Every ravine had a trail leading to the grass hut with its taro patch; every ridge had a "kuamoo" (lizard back) climbing the steep pali into the mountain forest.
>
> These trails, "ala-nuis" as they were called, were not permanent, definite. They were ever shifting, to fit the necessities of the inhabitants.... The old Hawaiian trail, however, the "alaloa," which encircled Maui, and which still exists in places, was something more enduring, more substantial, a monument of the past.
>
> Since the introduction to the islands of the bullock cart, the wagon and the automobile, the paved trail has not been as universally used, and has been going out of existence – rapidly in some places, gradually in others. For some reason, the early historian almost ignored mentioning this memorial that encircles Maui, giving mute evidence of the ability and industry of former generations. Fortunately, however, folklore has not been so negligent; and still more fortunately, the road itself silently speaks of proceeding inhabitants.
>
> Mr. J. M. Alexander's map of Maui (1885) has this paved trail definitely located. The land descriptions in Government records often refer to it.... The total length of this encircling trail is, roughly, some 138 miles in all –100 on East Maui and 38 on West Maui.

Fleming (1933:4) follows the trail "on paper" and describes the *Alaloa O Maui* as it begins in Kaupō, eventually winding its way through the Wailuku District and on throughout West Maui and back to Kaupō. The following excerpts pick up her paper trail as it goes through the Kā`anapali District :

> From Kahakuloa to Honokohau, the path has been turned into a horse trail. At several places the more recent trail diverges, leaving the paved one as it first existed, save for being more overgrown with grass. East of Honokohau, along the flat for a mile or so, the trail is now non-existent. Evidently it was not needed on these level flats. But it is in the best condition as it winds down the steep pali near the ocean at Honokohau and after crossing the mouth of the stream shoots up the western pali. Again it is seen at Punalau, and still again crossing Pohakupule Gulch. At one time it was very distinct on the West Maui Golf Course between the fifth and sixth holes. However, the enthusiastic golfer has so often removed the troublesome "pohaku" to aid the erring ball, that the old trail has lost its identity.
>
> Leaving the golf course, the trail is almost obliterated to Lahaina and beyond. The cultivation of cane as well a of pineapple has greatly interfered with its path. And, too, there is little doubt but that it availed itself of the long stretches of white sandy beaches so prevalent on this side of the island (Fleming 1933:4).

D-10. The Gorilla Foundation Preserve. Future plans for the lands *mauka* of the project area are seventy-acre preserve set aside for The Gorilla Foundation, a non-profit group promoting the protection, preservation and propagation of the endangered gorilla species. *Koko*, who has learned to communicate with humans using sign language, is their most popular primate. Koko and two other male gorillas are soon to enjoy the Maui wilderness approximating their natural African habitat (KR 2003:E-3).

D-11. Pulelehua Community. Maui Land & Pineapple Company, owner of 23,000 acres of land in West Maui, has pledged to "continue to engage in responsible stewardship of the environment." With this in mind they propose to develop only 3,000 acres, leaving 20,000 acres in agriculture and open space. Their proposed Pulelehua Community in the *ahupua`a* of Māhinahina, has been designed with this "holistic" view in mind, following the traditional *ahupua`a* concept ("self-contained ecological, social and economic unit"), with vision plans for development in the project area to provide the following: (1) a mix of uses and housing types; (2) affordable housing options, integrated into complete neighborhoods; (3) neighborhood-serving commerce and live/work units; (4) design with Hawaiian architecture, the landscape, the climate, important views, outdoor life, and 'malama `āina;' (5) incorporate networks of green space, streets, trails into the neighborhood, allowing multiple types of circulation; and (6) design the streets to be walkable and bikeable (Dover, Kohl & Partners 2004:1). This is the CIS/A project area, located between the Kapalua West Maui Airport and the Hono-a-Pi`ilani Highway in the *ahupua`a* of Māhinahina. The following (Figure 6. is an illustrative plan of *Pulelehua Community:*

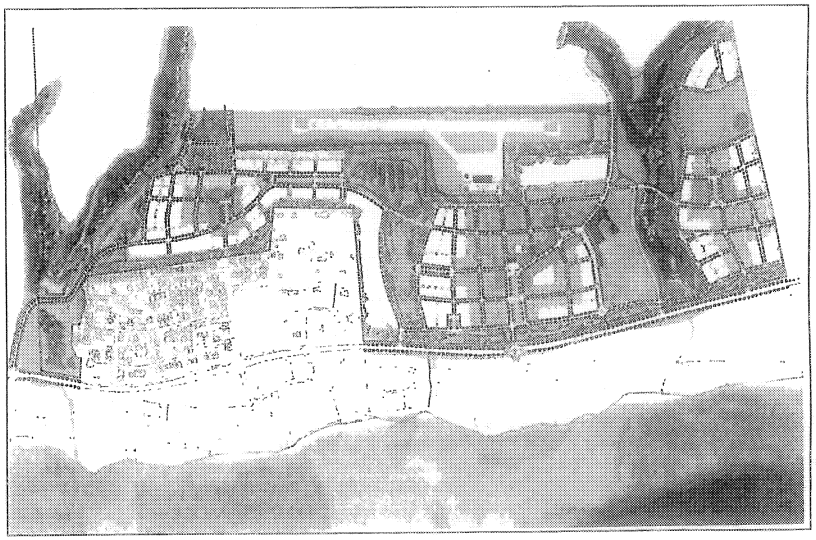


Figure 6. Illustrative Plan of Pulelehua Community (Dover, Kohl & Partners 2004:1.1)

Photo 10. Proposed Pulelehua Community project lands.

E. Previous Archaeological and Historical Research: Māhinahina-Kahana

A range of archaeological studies have been conducted in the Kā`anapali District; from Thrum's compilation of lists of heiau (based on oral histories and information from sources like S.M. Kamakau and J. F. G. Stokes), to reconnaissance, inventory and data recovery studies. Each contributes to the history of cultural properties and practices, and land, water and marine resources and use in the Pulelehua Community project area. The following are summaries of studies, or notations that a study was undertaken, in the vicinity of the project area.

Thrum (*...for* 1909, 1917, 1918, 1921). When Thomas G. Thrum began his search for *heiau* sites in 1905 (for 1906), he said he was already 50 years too late (In Emory & Hommon 1972:6). In Thrum's *Hawaiian Almanac and Annual for 1906* (1905), his list of *heiau* were for Hawai`i Island. The following year his list was for Kaua`i and O`ahu. It wasn't until *Hawaiian Almanac and Annual for 1909* (1908) that his "Heiaus and Heiau Sites Throughout the Hawaiian Islands" listed Maui's heiau (Thrum 1908:38-39). However, there were no *heiau* listed for Kā`anapali at that time [6 listed in Lahaina]. The following is from "Tales of the Temples: Part III, Heiaus of Maui" in *Hawaiian Annual for 1909* (Thrum 1908:45-48): It was the last of a series of articles that told brief stories of heiau:

> Among the more prominent of the doubtless many heiaus once existing on the island of Maui little information is now obtainable beyond that handed down by tradition, nor is there much in evidence to mark their sites, so complete has been their demolition. History couples the first temple building on Maui with Hua, the infamous king of that island who reigned prior to the 10th century [pre Paao]. He is designated at times as Hua-a-Pohukaina, and also as Hua-a-Kapuaimanaku, - referring to the two names by which his father was known. His first work in this line was in Lahaina, his birth-place, where, of the six heiaus we have learned of as having existed in that locality in all the years of its history, he is credited with erecting two, and another Hua, probably Hua-nui-kalalailai, two generations later, built the third (Thrum 1908:44).

"Maui's Heiaus and Heiau Sites Revised" (1916). This article in Thrum's *Hawaiian Almanac and Annual for 1917* was a revision of the previous (*...for* 1909) article. The focus of this article was in East Maui and Wailuku, however, Thrum noted the following in regards to sites in West Maui:

> Should a younger enthusiast on the subject make a like investigation of the western end of the island, from Kaanapali around to Waihee, a section not yet represented, and the Koolau district only partially so, the total list of *heiaus* for Maui would likely be found to exceed one hundred (Thrum 1916:61). [At the time of Thrum's 1916 publication 93 *heiau* had be located on all of Maui; by the time Walker (1931) finished his survey 266 *heiau* were located on Maui; the majority in East Maui.]

Stokes (1916). "Maui Site Notes." In December 1916, Stokes spent two weeks on Maui with Wailuku as his base, checking out sites in "as far as Kahakuloa on the northwest, Wailua on the east, Keoneoio on the south and Lahaina on the southwest. With a little more time to spare, the whole of west Maui could have been covered." [only one heiau was recorded in the "Kaanapali" area – an unnamed heiau at Honokahua near a bell stone]. Stokes mentions that in 1913 he met a man who found a small anthropomorphic stone idol along with a stone cup in a cave in West Maui (Stokes 1916:1, 3).

Stokes (1918) "Report on the Heiau of Maui." [Report not available at time of this report.]

Walker (1928-29). "Archaeological Surveys of Maui." Winslow Metcalf Walker conducted his surveys of Maui in 1928-1929; copies of his notes are on file at the Maui Historical Society archives at Bailey House Museum. Most of them unfortunately, don't have exact dates on them. However, Walker's notes were catalogued by the staff and issued reference numbers; these will be cited. Some of the notes are hand-written and some typed; it was sometimes not easy to make out the spelling in the hand-written notes. The following excerpts are from various notes Walker wrote about Maui:

> **Introduction:** The island of Maui affords one of the best places on which to study evidences of ancient native life because it is large and centrally located and its culture was very likely representative of the Hawaiian group as a whole. Also there are large stretches virtually uninhabited now or peopled only by the last remnants of full blooded Hawaiians. The survey was begun in October 1928 and carried on continuously...until August 1929. Previous to 1928...there had been two trips to the island by Thos. G. Thrum and J. F. G. Stokes in 1909 and 1916 in which hasty notes were made at some of the prominent heiau sites. Kenneth P. Emory in company with R.G. Aitkin made a trip to Maui in 1918 for the purpose of making an archaeological reconnaissance of the crater of Haleakala, the result of which were published by the B.P. Bishop Museum in 1921 as Vol 7 No. 11 of the Occur. Papers. But no other detailed study had been made on this island before 1928....
>
> Through the auspices of the B.P. Bishop Museum the writer was able to begin the work.... The entire circuit of the island was traveled and trips were made as well to the highest points on the West and Eastern parts of Maui.... Regions beyond the reach of auto roads were negotiated on horseback or afoot and in this manner all the open country was covered in detail.... (AR-7-2-15).
>
> **Village Sites and their Features.** Ancient Hawaiian villages on Maui were generally placed at the mouths of the larger gulches or at least within sight of the sea. No evidences of villages were seen in the higher forested parts of the island although scattered house sites were observed. The village is a collection of large and small house sites, canoe sheds, shelters, storage caves, pens, house shrines, koas, burial platforms, and generally one or more large structures for worship and sacrifice, the heiau. Many of the villages near the shore had stone-lined wells which supplied brackish water for drinking purposes....
>
> Taro terraces were observed on West Maui in the vicinity of Waihe`e, Kahakuloa, Honokōhau, Kā`anapali, Lahaina, Olowalu, and Ukumehame. Very likely the gulches on the Wailuku side also contain taro terraces formerly but the sugar-can plantations have now obliterated all traces of them. Taro is still grown at Waihee, Kahauloa, and Honokōhau, and at Keanae on East Maui. Dry land taro required no special terraces for its cultivation, so there are no evidences to show where it was grown formerly....
>
> Houses of the ancient Hawaiians on Maui were of two types. In the sheltered valleys where there was abundant vegetation the houses were built of light pole frames thatched with pili grass. The

house was built on a stone pavement to raise it slightly above the level of the damp ground. The floor was generally covered with matting. On the shore in many sites, pebbles and coral were substituted for the paved floor. Only five of these grass-thatched houses are still to be seen on Maui, and none of them are inhabited. In the open country exposed to the driving rain and wind the houses were built with thick stone walls up to five feet in height and only the roofs were of grass....

Certain of the larger dwellings appear to have had their own shrines within their establishments. Such a shrine in many sites consists merely of a stone platform or shelf raised a few feet above the floor and covered with coral and pebbles and shells. It is possible that offerings were made here before small idols of wood or stone.

The villages are not laid out according to any definite plan or grouping of sites. The heiau generally occupies the highest section of ground so that it has an imposing appearance especially if large.... Large dwelling-sites probably belonging to the chiefs occupied the higher and more favorable locations in the village.... Coops and pens for fowls and domestic animals were found closely adjoining some of the house sites.... Canoe sheds were walled structures averaging 15 x 30 feet with frequently both ends left open. They were built as close to the water as possible.

Certain level pieces of ground were covered with fine pebbles or fragments of coral and used as places for drying tapa when making it into cloth. Lauhala for weaving was dried the same way...the house of the tapa maker stood nearby in the old days.

The *heiau* and *ko`a* places of worship and sacrifice, were important features of most villages.... Small platforms of different heights and size were for burial purposes. Many of them are to be found within the precincts of villages themselves, close to the house sites.... On the east coast of both East and West Maui the vegetation is so dense as to make impossible the locating of all such sites.... The mountainous parts of both East and West Maui were but sparsely inhabited if at all.... Allowing even for large villages at Lahaina and Wailuku it would seem as though 10 or 12,000 inhabitants is a liberal estimate for the ancient population of Maui. This of course is only about a fifth of Capt. Cook's estimate (AR-7-2-15).

Battle Sites. Maui was the scene of many bloody battles fought principally with the warriors from Hawai`i, as has been recounted. The site of the "Battle of the Sand Hills" is still pointed out near Wailuku. Occasionally even now the wind lays bare fragments of broken bones belonging to some warrior who fell in that great two day's fight. Near Lahaina several battles were fought, of which the fiercest was the civil war between Kamehamehanui and his brother, Kauhiaimokuakama....

In the sand dunes near Honokahua Camp is the scene of a fight between the chief of Olowalu and one of the Honokahua chiefs (cf. Jarvis). A few bone fragments may yet be seen sticking out of the sand (AR-7-2-17).

Burial Sites. `Īao Valley is reputed by legend as a place of royal sepulture for many of the ancient kings of Maui and neighboring islands. But the locations of all such burials are kept carefully secret so that even the late King Kalākaua was unable to find any of them in spite of the extensive investigations which were instigated by him (AR-7-2-18). [Burials are noted at various places all over the island; burials and/or bone scatter have been recorded at Kā`anapali, Pu`u Keka`a, and Honokahua.]

Fishermen's Shrines. The *kuula heiau* or *ko`a* as they are called are the smallest of the structures of worship and are dedicated solely to the service of Kuula, the god of fishing. They are plentiful around the shore of the island and appear in various shapes: rectangular platforms and terraces, small enclosures, circular or horseshoe shapes, or irregular heaps of stones. Most *ko`a* are less than 20 feet square, structures larger than this are only doubtfully classed as *ko`a*. Coral is always associated with a true *ko`a*, the name itself being a contraction of the word *ako`ako`a*, which means coral. Remains of fish and shellfish are often found as these articles of food constituted the nature of the sacrifices (AR-7-2-21).

Walker's 'Approximate Maui Chronology'* (AR-7-2-19) (Ms 1931:21)

Generation (Ulu Hema Genealogy)			I	II
39	Paumakua	10th Century	0975	1200 Tahitian Voyager
40	Haho	11th Century	1000	1225 Maui Mo`i ancestor
41	Palena		1025	1250
	Hanalaanui		1050	1275
42	Hanalaaiki		1050	
43	Mauiloa & Hua		1075	1300
44	Alau	12th Century	1100	
45	Kanemokuhealii		1125	
46	Lonomai		1150	
47	Wakalana		1175	Arrival of Japanese ship
48	Alo	13th Century	1200	1325
49	Kaheka		1225	
50	Mopuleo		1250	
51	Paukei		1275	
52	Luakoa	14th Century	1300	
53	Kuhimaua		1325	1350
54	Kamaloohua		1350	1375 captured in war
55	Loe		1375	1400
56	Kahaokuohua	15th Century	1400	
57	Kaulahea I		1425	1425
58	Kakae		1450	ruled jointly
	Kakaalaneo		1450	ruled jointly
59	Kahekili I		1475	
60	Kawaokaohele	16th Century	1500	
61	Piilani		1525	
	(Lonoapiilani)		1550	
62	Kihapiilani		1550	
63	Kamalalawalu		1575	
64	Kauhi-a-Kama I	17th Century	1600	
65	Kaulanikaumakaowakea		1625	
66	Lonohonuakini		1650	
67	Kaulahea II		1675	
68	Kekaulike II	18th Century	1700	
	Kamehamehanui		1736	
69	Kahekili II		1765	
70	Kalanikūpule		1795	

* Based on Fornander Vol I; the order is the same as in McKinzie (1983:14)

Traditional Legendary History of Maui. (AR-7-2-19)

- Early Tahitian Voyages: Moikeha came to Hawai`i, settled at Kaua`i (Honuaula, Maui named from companion); Kila his son made trip back to Tahiti from Kaho'olawe. Returned with Laa-mai-kahiki. No voyages after him.
- Priest Paao came to Hawai`i, later returned to Tahiti to bring back a new king Pili (21-27 generations)
- Last great period of voyages 500-600 years ago
- Paumakua ancestor of Maui chiefs from Hua; conducted earliest war between Hawai`i and Maui at Kauiki
- Maui 100 years war with Hawai`i in 18th century
- Trail of Kihapiilani around island
- Wars of Kekaulike
- Civil wars of Kamehamehanui about 1738; battle near Lahaina
- Invasions by Kalaniopu'u beginning 1759
- Accession of Kahekili about 1765

Historical Background. (AR-7-2-15)

- Islands first visited by Spaniards 1542-1555; *La Mesa, La Despracioda, Los Morijes* (spelling may not be correct as his writing is not clear) shown on Cook's map from Azores.
- Cook on return trip from NW Coast in 1778 coasted along Maui and landed in Hawai`i-traded iron and nails for provisions.
- La Perouse first to land at Keoneoio SW Maui May 20, 1786; Portlock & Dixon at same time touched Maui.
- Metcalf involved in Olowalu Massacre-1790.
- Vancouver visited Lahaina 1793 attempted to make peace between Kamehameha & Kahekili
- Kamehameha conquers Maui in 1790 in Battle of `Īao ; O`ahu 1795; dies in 1819
- Arrival of Missionaries in 1820

Walker (1931). On file in the Bishop Museum archives and the Hāna Cultural Center Museum archives is Walker's typewritten, [edited] report. The following is from two paragraphs of his three-page summary of "Religious Structures" (Walker 1931:97), which may help to explain the dearth of sites in west Maui.

> The *heiau* or temple was the place of worship among the Hawaiians. A total of 230 of these sites have been found on Maui, 48 on the western part and 182 on the eastern part of the island. The structures on many of these sites have, however, been totally destroyed in the progress of the pineapple and sugarcane industries. So that, of the total listed, only 134 remain in a good enough state of preservation to permit being measured and studied. Examination of these structures discloses the fact that no two of them are built according to the same exact plan, but the general appearance of many is similar. The heiaus are all quite simple in construction, native rock or stones from the vicinity being used without any attempt at cutting or facing.... No mortar of any kind is employed. The stones being fitted as tightly together as possible, both for strength and in order to produce a fairly even wall-facing (Walker 1931:97).

Walker systematically measured each *heiau* with tape line and compass and oriented to the sea. He reported that "the presence of graves on some heiaus should be noted. In most cases they were found to contain intrusive burials of comparatively recent times... [possibly] the remains of the last keeper or *kahu* of the heiau" (Walker 1931:99). [See Section C-7 above]

Ashdown (1971). Inez MacPhee Ashdown was co-founder of the Maui Historical Society, once Maui County Historic Sites Commissioner and County Historian, and a published author of several books about the legends and history of Maui. She helped to save several historical and archaeological sites throughout Maui and was recognized in 1982 for her works. In the 1960s Ashdown was a member of a working group "Hui Hāna Malama" who made at least twenty-four field trips to various places around Maui, recording the sites so the data could be used by the Bishop Museum staff (i.e., Emory and Hommon 1972). Most of her research appears to be East Maui; of West Maui she states that "in Honokowai, Honolua, and Honokeana modern living and structures have obliterated the taro and other indigenous plants and trees" Ashdown 1971:12)

> Ka-eo-kulani, uncle of Pe`a-pe`a who was a son of King Kamehameha nui on Maui, had two man-eating dogs and at one time dwelt at Hono-ka-lani in Ka`anapali. Here the bones or Pe`ape`a were buried in the sea after deification at the Heiau Ho`akua atop Pu`u Keka`a in Ka`anapali (Ashdown 1971:46).

The following are a few other places of interest in West Maui that were noted by Ashdown:

Placename	Location	Comment
`E`Eke or `Eke	West Maui Mtns	Once was a settlement of priests and attendants who taught, among other subjects, astronomy and astrology.
#28 Ho`akua Heiau	Pu`u Keka`a	(Ashdown 1971:76)
#64 Ke Awa`awa Battle	Kā`anapali	Near Hahakea Stream (Ashdown 1971:76)
#127 Leina	Pu`u Keka`a	Souls jumping off place to Pō (Ashdown 1971:76)
#267 Royal Village	Kā`anapali	(Ashdown 1971:76)
Honokohau Valley	(Headlands)	Forests *of koa, kukui, mamane, iliahi, kamani, `a`ali`i, hau, i-wa, hau-pu, maile, ie`ie, hala-pepe, `ohia lehua*; taro *lo`i*
Honolua		*heiau* between Kahakuloa and Honolua
Honokeana		once taro *lo`i*

Emory and Hommon (1972). In 1970 Dr. Kenneth P. Emory met with Maui Mayor Cravalho, Inez Ashdown and others to form a cooperative effort of sharing records. An agreement was reached whereby Bishop Museum staff would locate and report on endangered sites in Maui County. Their report "Endangered Hawaiian Archaeological Sites Within Maui County" included an overview of all archaeological research in Maui County up to 1970, lists of vulnerable areas and recommendations. Some of the areas where they assessed endangered sites are: Honokowai Gulch, valleys along the highway corridor, Honokeana and Mokupea gulches, Makaluapuna peninsula, Iliilikea Heiau, and Maui Heiau in Honokohau, Sites D15-2, 3 (Emory & Hommon 1972:40-41, 59).

Hommon and Connolly (1973). "Statewide Inventory of Historic Places for the Island of Maui." During this survey two archaeological sites were recorded in Honokōwai Gulch: sites #1207 (45 petroglyphs) and #1208 (house outline); other sites were recorded in Honokahua, Oneloa, and Kapalua (In Griffin and Lovelace 1977:5). The original report is not in Bishop Museum archives. The staff said the inventory survey was done by Bishop Museum staff for a government agency. They tried to locate a copy to no avail.

Kaschko (1974). This walk-through survey of Honolua Watershed took place prior to the construction of the proposed flood-control dams with connected channels. Agriculture and development have destroyed virtually all sites in this area (Honokowai to Napili) except in the following gulches:

Gulch	Feature/Location	Recommendation
Napili 2-3	5 Salt Pans on coast near channel outfall	Preserved
Napili 4-5	Site 1. Platform 10 x 15m Site 2. Platform5 x 10m (artifacts found), stone walls, alignments, terraces, 30 ahu, possible burials	Greatest number of archaeological features found *Resurveyed, recorded, tested or salvage excavation
Honokeana	Site 3. Walled structure-may be historic	Area already compromised by bulldozing (*same)
Kaopala	Wall; rock quarry	Heavily impacted by historic roads, remains (*same)
Kahana	Historic house site in N gulch; walls; stone alignments/foundations; stone retaining wall along S gulch	All probably historic or historically altered (*same as above)

Pohakukaanapali	None	
Māhinahina	Site 4. Cultural deposit-charcoal/shell midden 20cm thick, 50cm below surface Site 5. Extensive cultural deposit also N bank of gully 30-50cm thick and extends for 15m along bank	Floor of gulch covered by desilting basin (*same as above)
Honokōwai	Site 6. Complex stone alignments, platforms	State Historic Sites Inventory #50-50-03-1208

Davis (1977). "Archaeological Surface Survey, Honokowai Gulch, Ka`anapali, Maui Island." Davis reports the following:

> Historical references indicate this (Honokowai) was one of four valleys in leeward West Maui which was intensively used for the cultivation of irrigated taro. Archaeological survey...found that the lower portion of the gulch had been extensively modified with terraced pond-fields, habitation platform-terraces and related structures. It is suggested that these features date back to the prehistoric settlement of the gulch (Davis 1977: iv).
>
> A baseline survey map shows numerous stone wall alignments in the project area which were suspected to be irrigation terraces for the cultivation of taro. The *Indices of Land Commission Awards* (1929) lists 114 grants totaling 86 *`apana* in the *ahupua`a* of Honokōwai.... A walking reconnaissance was made along the access road to place the study area in its overall context...it must be pointed out that virtually the entire floor and much of the lower talus slope between the *mauka* pump house and the well head has been culturally modified. A brief summary of observed features includes stone-faced terraces for both irrigated and dry land agriculture, habitation platforms, field shelters, multiple retaining walls, free standing stonewalls, remnant diversion dams, irrigation channels (*auwai*), and a possible agricultural shrine (*ko`a ho`oūlu`ai*) [Sites 228, 229, 230, 231] (Davis 1977:1, 3, 6).
>
> Handy and Handy note that Honokowai was one of four valleys in Ka`anapali which "...had extensive *lo`i* lands in their valley bottoms, where terraces rose tier on tier in symmetrical stone-faced *lo`i*" (Handy and Handy 1972:494). During the early Historic Period, Thrum (1876:46-48) notes that the cultivation of coffee had expanded to favorable lands on Maui by 1847-50. Although there is no specific reference as to where these lands where located, it is likely that they included the major leeward valleys of West Maui.... Over the next decade, blight seriously disrupted coffee production in the islands. Coffee holdings in the *kula* lands above the valleys... gradually began switching over to the cultivation of sugar cane. Yet, as late as 1896, the Government of the Hawaiian Republic was still advocating the expansion of coffee culture in West Maui--and elsewhere (Dept. of Foreign Affairs 1896). This ultimately failed, however, and the local coffee industry continued to decline. Within four years, production had fallen so low that it was not even recorded in the *Hawaiian Almanac and Annual for 1900* (Thrum 1900:128) (Davis 1977:8-9).
>
> Botanical Evidence. Coffee (*Coffea arabica*) is a historically introduced tree crop and although second to *kukui* (*Aleurites moluccana*), its sheer numbers in the gulch is impressive. Although not numerous, several mango trees (*Magifera indica*) of immense size (20+ meters) and age are also scattered through the gulch.... The present composition of the forest, particularly the number of coffee trees, indicates that Honokowai Gulch was one of the areas turned over to coffee culture in the last century. The apparent absence of feral remnants of the traditional cultigens suggests that, at least in the study area, this shift in agricultural production may have been complete to the exclusion of other crops.... This was effectively terminated with the completion of the Pioneer Mill tunnels (c.1900-1926) if not earlier by the coffee blight (Davis 1977:12-14).

Griffin and Lovelace (1977) Eds. "Survey and Salvage-Honoapi`ilani Highway. The Archaeology of Ka`anapali from Honokowai to `Alaeloa Ahupua`a." Salvage excavations were conducted in an extensive cultural deposit (Site 225, previously sites 217 & 218) in Māhinahina Gulch. Evidence from these excavations indicated "that the site represented a prehistoric occupation of unknown type and duration" (Griffin & Lovelace 1977:2). Evidence of prehistoric habitation were found in other nearby valleys of Kahana and Honokōwai.

Fieldwork for the proposed highway realignment project from Honokōwai to `Alaeloa was conducted in three phases: archaeological surface survey, initial salvage excavations, and final salvage excavations. The highway corridor is located in the district of Kā`anapali and extends through five *ahupua`a*: Māhinahina, Kahana, Mailepai and ending in `Alaeloa; each contains at least one stream gulch running from the West Maui mountains to the coast--Kahana and Honokōwai were permanent streams (Kaschko in Griffin & Lovelace 1977: 1-4).

Both of these *ahupua`a* had extensive irrigated taro-terrace systems in their valley floors (abandoned in the 1930s) and could have supported sizable prehistoric populations. Most of the lands were in sugar cane with a few exceptions; the gulches were predominantly alien vegetation. Today all the gulches are controlled by the sugar plantation and their stream tapped for sugarcane fields (Kaschko in Griffin & Lovelace 1977: 1-4).

Previous archaeological research includes Walker (1931), Sites 12-15; Bishop Museum Statewide Inventory of Historic Places for the island of Maui (1973), Sites 50-50-03-1207 "Honokōwai Petroglyphs" and 50-50-03-1208 "Honokōwai House Outline" (Complex); Bishop Museum (Kirch 1973) survey of Honokahua, Oneloa, and Kapalua--recorded six prehistoric (Site 50-Ma-D13-1 identified as a small, late prehistoric fishing settlement) and two historic sites were recorded; and Bishop Museum (Moore 1974) survey of Honolua Valley recorded eleven prehistoric sites and two historic sites (Kaschko in Griffin & Lovelace 1977: 1-4). Only Kahana Iki and Māhinahina will be addressed here.

Two sites were recorded in Māhinahina Gulch and two sites recorded in Kahana Iki Gulch (Silva in Griffin & Lovelace 1977: 14):

Māhinahina Gulch Site 50-50-03-217*:	Cultural deposit (Kaschko #4)--shell midden represents one period of human occupation. Good research potential. Valuable. [BM #50-Ma-D9-1*]
Māhinahina Gulch Site 50-50-03-218*:	Cultural deposit (Kaschko #5)--shell, charcoal, coral midden N bank of N fork, visible for 12 m along the eroded bank; rock-lined fire pit in profile of cultural layer represents one period of human occupation. Good research potential. Valuable. [BM #50-Ma-D9-2*]

*Both sites were determined to be one extensive site and redesignated Site #50-50-01-225. The site is unusual in that it is farther inland that most coastal settlements; however, it has been greatly impacted by road construction, plantation activities and the desilting basin. Initial salvage excavation produced flora midden and land and marine faunal midden. Artifacts included fragments of stone adzes, coral abraders, cut bone, a pig tooth pendant, and basalt glass flakes. The cultural deposit was more continuous and extensive than previously thought; the deposit was visible on both *mauka* and *makai* of the cane haul road, and continued to the seaward boundary line of the highway corridor. The final salvage excavation produced more of the same in the way of midden and artifacts (Silva in Griffin & Lovelace 1977: 31, 49).

Reconstruction of Māhinahina Environment. Pre-occupation stratification of the site indicates an alternating wet and dry sequence of deposition with intermittent, seasonal stream flow in the gulch. The streambed was likely shallow and rocky with assorted grass and brush (Silva in Griffin & Lovelace 1977: 60).

These lands (Māhinahina 1, 2, 3, and Kahana 1, 2, 3) were described as follows:

> *These lands are only kula, and is not suitable for cultivation, it is dry in summer, and a little better in winter. I know it is only kula, and not fit for cultivation, it is good mauka, but makai it is not very good* (Kauwealoha letter 1850) (Silva in Griffin & Lovelace 1977:62).
>
> From the 1850s to about 1915, the most prevalent use of land in Māhinahina *ahupua`a* was apparently as cattle pasture. In the winter of 1916, a large flood occurred in Māhinahina Gulch during which a bridge was swept away and a concrete road bulwark was shifted. About this time the sugar plantation began extensive operations including the building of as railroad in this area, initiating some of the changes and disturbance obvious in the Site #225 area at present (Silva in Griffin & Lovelace 1977:62)
>
> The *ahupua`a* of Honokōwai and Kahana contain permanently flowing streams... [from] the West Maui mountains. At contact, the valleys of these two land units contained extensive irrigated taro terrace systems. These *ahupua`a* could have been very productive, with the capacity for supporting sizable populations (Silva in Griffin & Lovelace 1977:63).
>
> By the beginning of the 1850s, the drier land areas had begun to be used for pasturing cattle. Kahana and Māhinahina (Alexander letters 1852, a & b) are noted as being used for this purpose. The problem of cattle trespassing on adjacent cultivated ground, especially in Honokowai, is also mentioned. Cattle ranching was prevalent in this area until about 1915, when the sugar and pineapple plantations began to develop. In the 1920s, there was very rapid expansion of plantation agriculture, resulting in drastic and permanent alteration of the original environment. The present replacement of some agricultural use areas with resort and condominium developments continuing this process (Silva in Griffin & Lovelace 1977:63).
>
> Layer II, the cultural layer, was non-compact; three or four different types of archaeological features were recorded-possible post holes, probable fire pits, refuse pits, and non-distinct pits. One conclusion was that the site represented repetitive, short-term use or occupation (Silva in Griffin & Lovelace 1977:67).

After all the lab work was completed and the lab analyses returned, the estimated initial occupation for Site 225 in Māhinahina Gulch was c. AD 1150 with an initial time span of AD 1265-1480; the maximum time span for occupation of this site was approximately AD 1150 to AD 1778 (Griffin & Lovelace 1977:195).

Prehistorically, Māhinahina *ahupua`a* must have been marginal or of secondary importance in terms of productivity. The pattern of occupation on the land unit should reflect this marginality. Noteworthy here is that the three Land Commission Awards located in coastal Māhinahina 4 are only houselots, with the exceptions of one which includes some *kula* land as well. All three awards, however, include a number of additional pieces of good cultivated land in Honokowai *ahupua`a*.... Such a unilateral relationship between Honokowai and Māhinahina would appear to make sense (Griffin & Lovelace 1977:199).

Modern development may have destroyed or made inaccessible virtually all primary or permanent habitation sites, thus necessitating that work be carried out on the temporary site. In conclusion, Site 225 at Māhinahina represents our only extant prehistoric Hawaiian archaeological remains available in this locale (Griffin & Lovelace 1977: 203).

Kahana Iki Gulch Site 50-50-01-216	Low wall separating Kahana and Mailepai, *mauka-makai*, prehistoric. Marginal.
Kahana Iki Gulch Site 50-50-01-227	Retaining wall along bank of Kahana Nui Stream, prehistoric, altered. Marginal.

Hommon & Ahlo (1982). A reconnaissance survey was conducted on the proposed community airfield in the *ahupua`a* of Māhinahina and Kahana. The entire survey area (35 acres) was cultivated in sugar cane at the time of the field inspection. The area lies on gentle slopes of a portion of the West Maui Mountains formed during the Wailuku Volcanic Series. The elevation of the survey area ranges from 220 to 280 feet asl. The survey area soils are the Lahaina Silty Clay Series (LaC) derived from underlying igneous rock. Rainfall in the area averages between 20 to 30 inches per year.

A major reason for the paucity of sites in the region is the extent of agricultural, urban and resort development. Undoubtedly, many sites have gone under the shovel, the plow and the bulldozer during the last 200 years. According to PMC/AMFAC management the survey area has been under cultivation for at least the past 50 years. No effect...no further archaeological work is warranted or necessary.

Komori (1983). The project area (c. 20 acres) is located in the *ahupua`a* of Kahana and includes all of the flat gulch bottoms, and portions of the steep gulch slopes, formed by Kahana Stream from an elevation of ca. 14 to 38m above sea level. The stream flows intermittently, but periodic flooding is evidenced by the debris scattered along side the steeply cut stream bed and gulch slopes and the alluvium deposit in a 5-meter modern well. The vegetation is predominantly alien with some *kukui* present in small numbers. The gentle slopes surrounding the gulch are planted entirely in pineapple and sugar cane, with sugar cane extending into the gulch bottom of Kahana Iki Stream to the south.

Although the Kahana *ahupua`a* was deeded to the Hawaiian Government during the mid-1800s, *kuleana* claims were awarded; 39 parcels to ten individuals. LCA 3925I, Apana 6 was awarded to Pala and is located in the survey area. Pala described the land as pasture; the land having passed from his parents during the reign of Kamehameha I. Kahana was used as pasture for cattle from the mid-1800s until about 1919 when plantation agriculture was introduced to the area. Previous surveys recorded two sites in the gulch, but it was determined that they were either historic or historically altered, assessed marginal and no further work recommended.

Seven sites were located during this survey and assigned BM site numbers 50-MA-D10-3 through -9:

*Site D10-3 (both prehistoric)	3a. Over-hang Shelter-16m	Shallow, unmodified (marine midden present and waterworn stones) on steep north slope of gulch
	3b. Terrace segment-10m	Stacked stones, on steep north slope of gulch
Site D10-4	4a. Terraces (3) 4b. Rectangular platform	Stacked stones, indigenous and historic material deposits
Site D10-5	5a. Wall segment 5b. Parallel alignments (2) 5c. Rectangular enclosure	 Foundation stones for a wall modern
Site D10-6	Wall segments and terraces	Stacked stones 13m terrace; barbed wire (cattle)
Site D10-7	Stone walls (2), terraces	one wall 55m long; possible ranching
Site D10-8	Stacked stone walls (2)	55m and 110m long; possible ranching
*Site D10-9	9a. Overhang Rockshelter 9b. Terrace 10m long	small unmodified; hammerstone and *`ulu maika*

*These two sites appear to be related to prehistoric activity, possibly connected to sweet potato cultivation mentioned in early historic accounts of the area; and may represent temporary occupation or

short-term utilization of resources. The other sites in the project area appear to be associated with cattle ranching. #D10-4 contained a cultural deposit and may represent a transition period between prehistoric and historic. The construction of the siltation dam will have adverse effects of the sites. Additional archaeological work is recommended: salvage excavation of Site D10-3a and test excavation of Sites D10-3b, -4b, -5b, and -6. Sites D10-7 and -8 will not be affected by the dam; and Site D10-9 is well outside of the dam impact area.

Walker and Rosendahl (1985). Archaeological study at the Kahana Desilting Basin Site called for substantial testing of Sites D10-3, 4, 5, and 6. This was amended to include inspection and recording of Sites 4b, 5b, and 6; and collecting portable artifacts and midden from Site4a. Three LCA and Royal Patents awarded indicate that the lands of the area were for sweet potato cultivation and habitation structure were for short-term use while the fields were being tended. Test results indicated that the previously thought ranching walls and terrace were actually part of the sweet potato cultivation from the late prehistoric and early historic periods. No preservation recommended; no further work.

Kennedy (1986). Study of stone building at Kahana, once thought to be Queen Kapiolani's Church.

Donham (1989). "Interim Report-Kapalua Mitigation Program, Data Recovery Excavations at the Honokahua Burial Site, Land of Honokahua, Lahaina District, Island of Maui." Donham reported on surface and subsurface evaluations, mitigation data recovery field work in Honokahua from March 1987 through December 1988. The report documents a complex, multi-component burial site with initial use as early as AD 600 (In Jensen & Mehalchick 1992:7).

Fredericksen, Fredericksen, and Fredericksen (1990). Inventory survey of 10 acres in Kahana bordering 10 properties with dwellings on them. Portions of project area has fallow pineapple fields as well as a 40 ft wide easement of the former PMC railroad and extends along residential property for 1000 feet. Planned development includes 36 houselots, utilities and access roadways. The project area if part of Kahana/Mailepai/Alaeloa with RP 1663, LCA 5524, pt. 3 & 4 to L. Konia; portions of 4 & 6 Mailepai Hui and formers lands of Maui Land and Pineapple. Notes Walkers list of heiau and supposition that stones from heiau could have been used for the railroad. Did not find anything, however recommends that monitoring take place during construction.

Sinoto & Pantaleo (1991). "Archaeological Inventory Survey of TMK 4-4-01:2, 11 and 12, Honokowai, Lahaina, Maui." This study was conducted on a parcel of land 1000 feet inland from the shoreline, and north of the old Ka`anapali Airport. The area was sugar cane fields until about 1965. Archival research [LCA #3689, #3987, #4241, #5002:2] indicates that portions of these lands were once cultivated in sweet potato and dryland taro (Sinoto & Pantaleo 1991:1, 4).

> Recent synthesis by Kirch (1979) and Cordy and Athens (1988), suggest that the earliest settlements on Maui Island were between AD 300-600 in windward areas. By AD 1000, populations expanded into the dryer leeward areas. Later prehistoric expansion into harsher or more ecologically marginal regions occurred in order to expand the range of resource exploitation (Kirch 1985). Although only a small number of archaeological studies have been conducted in West Maui, evidence suggests that early inhabitants utilized coastal areas for marine resources. Kirch (1973) conducted excavations at Site 50-Ma-D13-1, a small fishing camp at Hawea Point. Results of these excavations indicated that this camp was used during the sixteenth and seventeenth centuries. Griffin and Lovelace (1977) conducted testing at Site 225, a buried cultural deposit in Māhinahina Gulch. Results of testing indicated that this temporary habitation site was occupied during the thirteenth century (Sinoto & Pantaleo 1991:6).
>
> The results of their survey indicated no archaeological remains. They noted extensive disturbance due to sugar cultivation and highway construction (Sinoto & Pantaleo 1991:7).

Griffin (1994). Inadvertent discovery of burials on the property of a house construction. The skulls were re-interred and the plumber adjusted his pipe. The site #3747 was backfilled and landscaped with grass and now a developed residential area located on the peninsula of Papua Pl.

Moore & Kennedy (1994). Inventory survey for Kahana Ridge Subdivision. At the time of the survey (1992), the survey area was planted in sugar cane. In the Mahele ten land tenants claimed 50 apana in Kahana. The majority were for *kula* lands or potato pasture or just pasture; taro mentioned twice, once as "four taro patches" and "upland place for cultivating taro." Five house lots were claimed; one coastal house lot in Kahana Nui was bordered by a fishpond. A railroad was built in 1887 and by 1919 extended to Kahana. In a 1928 field map, sugar cane extends to Mailepai, while pineapple is north in Napili. A 1923 USGS map show Kahana Camp just inland from Kalaeokaea Point and Māhinahina Camp almost two miles inland from Kahana Point. The railroad extends all the way to `Alaeloa. The plow zones consists of Layer I. No sites or cultural deposits found.

Fredericksen & Fredericksen (1995). An inventory survey of the proposed Kahana-Kai, a 4-acre parcel, entailed backhoe trenching and manual testing. One historic site (Site 50-50-01-4069), a stone bridge footing was discovered (no longer significant); and a grave site (Site 50-50-0104072) is to be preserved. The following oral history of the area was recorded:

> The Kahana area was the home of many families of Hawaiian ancestry, as seen by the LCAs issued. At least a portion of the study parcel was owned by Charles Manase and his wife Loika (Lois) Panui, both of whom are buried on the property. Mrs. Loika Manase was born in 1854 and died in 1918. The property was passed on to her daughter, Lucille Manase Rodriques, who sold the land to David Fleming in the 1930s. According to Vincent Hinanao Rodriques, grandson, the sale was actually made to Maui Pineapple Company (Honolua Plantation Co., Ltd.), and David Fleming only acted as a "straw man" in the transaction. He intimated that Hawaiian Lands could only be sold to individuals, not to corporations. Although the property was conveyed, the gravesite (Site 50-50-01-4072) remained an exception, and is retained by the Rodriques family.

Honolua Plantation/Maui Pineapple Co. leased the land to Pioneer Mill Co. for sugar cane cultivation, which continued until 1970s when commercial and residential development began to impact the area. "The 1931 annual report for Pioneer Mill Company notes that 'cane is delivered to the factory via the 30" gauge railroad, 36.3 miles in length; 30.95 miles owned by the Pioneer Mill Company and 5.35 miles owned by Baldwin Packers' (Conde and Best, 1973:254)."

> The railroad began in May of 1882, when the Minister of the Interior of the Kingdom of Hawaii granted permission to Henry Turton, one of the originators of the Lahaina Sugar Plantation [aka PMC] to proceed with the railroad construction. A condition was stipulated: "in accepting the right hereby, you will observe, that in case of damages you must be responsible, and that when the public weal require the use of the road or highway occupied by you or your successors you will deliver the same up peaceably free of charge" (Conde and Best 1973:252). By the summer of 1883 the railroad had progressed four and one half miles north from the mill, just past Black Rock [Pu`u Keka`a] (Ka`anapali). It was not until 1919 that the railroad was extended to Kahana and beyond. In 1921, $45,169 was spent on a 23-ton Porter locomotive called *Kahana*, the heaviest engine on the line (Conde and Best 1973:254).

Locomotive #6, *Kahana,* was retired in 1921. By 1953 all signs of the railroad had been obliterated as locomotives and other equipment was sold off: usable ties to ranchers for fence posts; #10 to Lihue Plantation; tracks, rail and switches to San Francisco; and remaining bits of scrap metal to other buyers. The railway bed was leveled, cindered and rolled into truck hauling roads and plantation transportation was completely via trucks.

Settlement Pattern Analysis. The positioning of *heiau* in the area suggests precontact usage of this area. The typical subsistence economy would have included exploiting marine resources and inland resources, which would have included dry land agriculture and resources available in the valleys and mountains.

> *On the south side of western Maui the flat coastal plain all the way from Kihei and Ma`alaea to Honokahua, in old Hawaiian times, must have supported many fishing settlements and isolated fishermen's houses, where sweet potatoes were grown in the sand soil or red lepo (dirt) near the shore. For fishing, this coast is the most favorable on Maui, and although a considerable amount of taro was grown, I think it is reasonable to suppose that the large fishing population which presumably inhabited the leeward coast ate more sweet potatoes than taro with their fish* (Handy 1940:159).

Fredericksen & Fredericksen (1999). Inventory survey for the proposed Lower Honoapi`ilani Road improvements in `Alaeloa section located three previously unrecorded archaeological sites: SHPD No. 50-50-03-4797 (a precontact habitation area); 50-50-03-4798 (a road retaining wall and shoulder barrier wall) ; and 50-50-03-4799 (retaining wall)--these latter two are considered post-contact and are associated with the old road and are no longer considered significant. Site #4797 yielded a date of AD 1420-1660 and is considered a rare example of a surviving precontact habitation area on this part of the West Maui coastline. It appears that parts of this site (a wave-cut that extends to Kaia Point) also extends under the road, therefore monitoring is recommended for any earth moving activity.

A map by Alexander (1885) indicates that land north of Honokōwai was designated as "grazing land." Ranching continued until 1915 in Kahana when pineapple cultivation extended there (in McGerty & Spear 1977:8-9).

Monahan (2003). Inventory survey of 3.054-acres of land in Honokōwai and Māhinahina 4 *ahupua`a* (*makai* of the Highway) prior to the proposed construction of a condominium. No significant site or features were located, therefore no further work is recommended with no adverse effects.

Dega, Michael (2003). Inventory survey for a proposed residential development in Napili, Alaeloa Ahupua`a. Nearby is Kaopala Gulch, the nearest drainage, and Napili Stream to the south of the property. While not in the project parcel, nine *kuleana* claims were made for 32 *apana* in the *ahupua`a* of `Alaeloa. Testimonies indicate habitation (houselots) and agricultural activities (sweet potato and dry land taro cultivation). After the Mahele much of the land in the Ka`anapali district was converted to livestock pasturage, followed by sugar cane and pineapple cultivation. The testing results were sterile therefore no monitoring or further work were recommended.

Tulchin (2003a). Archaeological assessment of parcel and waterline in Māhinahina 4 proposed for a house lot development (between the road and highway).

> Background research of previous archaeology in the area suggests a high probability of encountering human skeletal remains. A historic cemetery (Site #50-50-03-4218) and possible burial mounds (Site # 50-50-03-4219) were documented within a parcel (TMK: 4-3-06:3) adjacent to the project area (McGerty and Spear 1996). Additionally, LCA documentation revealed the presence of multiple house lots surrounding the project area, further supporting the possibility of encountering archaeological remains...it is recommended that that a qualified archaeological monitor be present during all ground disturbing activities.

Tulchin (2003b). Monitoring Plan for the parcel and waterline in Māhinahina 4 proposed for a house lot development (between the road and highway).

Pantaleo & Titchenal (2004). Inventory survey for Pulelehua Community. Twenty backhoe trenches; no cultural remains or deposits. One isolated precontact and two historic artifacts found (surface). Monitoring recommended.

PART IV: ETHNOGRAPHIC SURVEY

The Ethnographic Survey (oral history interviews) is an essential part of the Cultural Impact Study (CIS) and Assessment because they help in the process of determining if an undertaking or development project will have an adverse impact on cultural properties/practices or access to cultural properties/practices. The following are initial consultant selection criteria:

- Had/has Ties to Project Area
- Known Hawaiian Cultural Resource Person
- Referred by PBR Hawaii and/or Kapalua Land Development Staff
- Referred By Other Cultural Resource People

The consultants for this CIS were selected because they met the following criteria: (1) consultant grew up, lives or lived in Māhinahina-Kahana; (2) consultant is familiar with the history and *mo`olelo* of Māhinahina-Kahana or Kā`anapali in general; (3) consultant referred by Hawaiian Cultural Practitioner(s); and/or (4) consultant referred by Staff of PBF-Hawaii and/or Kapalua Land Development. Copies of signed "Consent" and "Release" forms are provided in Appendices G and H.

Research Themes or Categories

In order to comply with the scope of work of this cultural impact study and assessment, the ethnographic survey was designed so that information from consultants interviewed would facilitate in determining if any cultural sites or practices would be impacted by the implementation of the proposed *Pulelehua Makai* project. To this end the following research categories or themes were incorporated into the ethnographic instrument: Consultant Background, Land Resources and Use, Water Resources and Use, Marine Resources and Use, Cultural Resources and Use, and Anecdotal Stories. Except for the 'Consultant Background' category, all the other research categories have sub-categories or sub-themes that were developed based on the ethnographic raw data or responses of the consultants. These responses or clusters of information then become supporting evidence for any determinations made regarding cultural impacts.

A. Consultant Background

Each consultant was asked to talk about their background; where they were born and raised, where they went to school and worked, and a little about their parents and grandparents. This category helps to establish the consultant's connection to the project area, their area and extent of expertise, and how they acquired their proficiency. In other words, how the consultant met the research consultant criteria.

The consultants either grew up, live, and/or work in the project vicinity. Two consultants grew up in West Maui and one consultant spent his summers in West Maui while growing up, then later moved to West Maui. One consultant is a member of a family that has lived and fished the waters of Māhinahina-Kahana for several generations. Two of the consultants live and/or have family ties to lands in Māhinahina-Kahana. [An additional person was informally interviewed as he was cleaning fish caught in the channel between Māhinahina and Lana`i.]

There is always a danger of not allowing the consultant's "voice" to be heard; of making interpretations that are not theirs; and of asking leading questions. To remedy this, the "talk story" method is used and allows for a dialogue to take place, thereby allowing the consultant to talk about a general topic in their own specific way with their own specific words. All of the excerpts used are either in the exact words of each consultant or paraphrased to insert words that are "understood" or to link sentences that were brought up as connected afterthoughts or additions spoken elsewhere in the interview. The following excerpts in "Consultant Background" provide a summary of each consultant, as well as information about their parents and grandparents. Last names are used to identify quotes for two consultants; the third consultant preferred to use a pseudonym. The last name is also used for the consultant at the beach.

A-1. Wesley Nohara. My name is Wesley M. Nohara. Born in Lahaina, October 16, 1954. Raised in the Honolua Camp which is now the heart of Kapalua Resort. Went to school at Honokahua School, elementary school, which is right where the Ritz Carlton is today. And attended Lahainaluna High School, graduated 1972. And attended the University of Hawaii at Hilo in 1973, and graduated from UH Mānoa in 1979. Lived and worked in West Maui in this Napili area, generally, my whole life. In the last year I moved to Hali'imaile, where now I reside at Pukalani, and work at the Hali'imaile Plantation.

My parents were born and raised in Lahaina as well, both of them. Both lived also in the Honolua Camp. Interestingly, they were both next door neighbors in the old Honolua Camp. Got married, resided at the Honolua Camp. Both worked for, back then, the Baldwin Packers, which is the company before merging with Maui Pineapple Company. My grandparents on my father's side both worked for the plantation since the early 1920's. Plantation, meaning the pineapple company. Also, my grandfather was born in Lahaina town in the early 1900's and worked for the sugar company that was in Kaua`ula Valley. And, I believe, in the early 1920's moved to Honolua Camp and since then worked for Maui Pine…well Baldwin Packers. And retired, I think, in the early 1960's.

On my mother's side, my grandfather and my grandmother immigrated to Hawaii from Japan. They worked for the pineapple company, Baldwin Packers. Gosh, I don't remember…my grandfather died in the 1940's…something like that. And my grandmother died in the late '60s. They both worked and lived in the old Honolua Camp as well. So my family heritage is pretty much in West Maui, but specifically here at the Honolua area.

We call it Honolua Camp because the plantation is called Honolua Plantation but really the village was probably properly named Honokahua Camp. Honokahua Village. It is right where Honolua store is today, which is pretty much the heart of Kapalua Resort. Honolua store is the plantation store that supplied much of the day-to-day needs that the residents needed. Back then people didn't have a whole lot of money, so you didn't buy too much from the store. You grew a lot of your own things, like vegetables and raise chickens and ducks… and whatever else…you did fishing. You pretty much lived a very inexpensive lifestyle. It was a very slow …but for the most part a good lifestyle. Most of us played… a lot of recreation … made our own things … obviously there was football and basketball, an important part of our recreational life. But things that most people don't realize … stuff like climbing mango trees, make your own slingshot, make your own kite and make your own toys basically. Most of us couldn't afford to buy new toys; you had to make your own things.

Dirt roads, old plantation houses, pretty much everybody knew each other and often there would be gatherings--community gatherings--and everybody would show up for those. As I would imagine, it was fairly typical of most plantations, be it sugar or pineapple, it's a pretty tight community.

My grandfather was born, I believe, about 1901 or 1902 in Lahaina, and was raised in Kaua`ula Valley. My grandmother, I'm not sure if she was born in Hawai`i but if she wasn't as a real young child she was already in Hawai`i. I'm not sure where her side of the family roots go back to. My Grandfather Nohara, his father and mother immigrated to Hawai`i to work for the sugar company, as most people's grandparents …. they actually came from Japan. I'm not sure what prefecture. I think they were from Niigata, but I may be wrong. They worked for Pioneer Mill Sugar Company. My grandfather was born in the early 1900's and I believe upon birth, his mother died. They had just moved from Japan. Work was difficult, lifestyle was difficult. And for a single parent, my great-grandfather could not support an infant and work. So he actually moved back to Japan and left my grandfather to be cared for by hanai parents, the Nohara's. My great-grandfather's name was really Takahashi. So my grandfather was adopted by the Nohara's who lived in Lahaina town. So Nohara is really an adoptive name.

They lived on Lahainaluna Road…the junction of Lahainaluna Road and Waine`e. And I guess they were family friends of my great-grandfather and they agreed to adopt and take care of my grandfather. There are some other members of that family. They would be step-siblings of my grandfather. I lost track of that section of the family.

1969 I started working as a fourteen year old in the pine fields doing manual work, meaning picking pineapples. I did that until I graduated from high school in 1972. In 1973 I started as a truck driver on a part-time basis working my way through college. In 1979 I came back to work as a management trainee doing first-line supervisory work and learning all the different job functions in management. In 1982 I became a harvesting supervisor, in 1986, I may be off by a year or so, I did field establishment which is basically planting and tractor work. In 1987 I did a short stint with field maintenance, which is the growing of the crop…spring. In 1988 I became plantation superintendent, which is basically the manager of the West Maui Honolua Farm here And I did that from 1988 until 2001 when I became plantation manager for all of the farms of Maui, which is pretty much where I'm at now [Nohara].

* * *

A-2. Pohaku: I was born on Oahu, 1953. Raised in Oahu in Mānoa Valley until 1965. Went to Maryknoll Grade School. Moved to Maui in the summer of 1965; my parents retired from working in the State office. We moved to Maui, to my grandmother's property. I continued education at Kam III School, and on to Lahainaluna, graduated in 1972. I have lived on this property for the past thirty-eight years. My Mom was born in Pa`ia, and my Dad was born in Wailuku on Maui. My Dad's family moved to Oahu, I don't know exactly what year, they lived on Hassinger Street. My Dad had family in Lahaina so he used to come up every summer. In the old days, how the families knew other families, he was brought up with a young girl that he was attracted to and somehow they met and that's how they got together. This be my grandmother's property, we used to come up every summer and spend the summers on Maui. The story I got was she [grandmother] bought it [the land] at an auction when the previous owners didn't pay their land tax at that time. She bought it an auction for … cheap. They built the house down here. They owned five acres which was across the street and this road didn't go through here. The road was mauka. So a lot of the ocean side properties were bigger. And then I don't know how they decided, but the government said they were coming in and were going to put a new road in and it dissected the property. That's why the property's split up. Or else this would be five acres beach front. The road was level…well not level but it came up on a hill...but because it's built on a turn it's hard to see on the other side…so they came in and made the road further down. So this wall … the road was right on the other side of this wall instead of being down … so when they did that they planted the cactus to keep people out. In those days there was hardly anybody out here. My grandmother was the principal of Honokohau School and she's in the book on, 'Here's Maui'. And then she was a school teacher at Kamehameha III grade school. She passed away in 1956. My older brothers and sisters remember her more than me. I have two brothers that live here on the same property, and two sisters that live on Oahu.

* * *

A-3. Kenneth Sadang. I was born here in Maui, in Lahaina. We used to have our own hospital, called Pioneer Mill Hospital. And that's where most of the people were born that lived down here in Lahaina. Was raised in Kahana, western Maui, one of eight children. I'm the second youngest from the eight. The land that we have, that we were raised on and we still have, was swapped way back in my grandfather's day. We had some land up in Kapalua and then we go fishing there we cross over this piece of property that we have now. And D. T. Fleming, I think, at that time had ownership on that property and he wanted to grow fruits. So he asked my grandfather if he wanted to swap land. And that's how we got it. We were a very close family because all of our aunties and uncles live right in that area. From where we are, I don't know how far that is … all the way up to the creek, Honokowai, that's our family lot. My Mom's brothers and sisters all had that piece of property from our grandfather, they divided it equally. And the place that we are at, that's my Mom's property. So that's how we got that. In the beginning they were living up by Puukolii. There was a camp up there. The land was divided amongst the children and they moved down there over fifty years ago. Maybe sixty, I'm just guessing.

My dad was an immigrant from the Philippines, and when he came to Maui they provided homes [at Pukolii] for the workers. And he was assigned to that area, and then he was match mate to my Mom…they had eight children. You know how they do that just like the Japanese did. My mom (Nani) is Hawaiian …my grandmother was Kamakanahinu. And she was from the Big Island of Hawaii. I asked him a long time ago how did they come to Maui. They said that at that time they had this big bowl then they put all the names inside, I don't know how they did that, and then when they pull the name that's the island that you go to. And they went from the Big Island to Moloka`i and from Moloka`i to Maui. I don't know how true that is. My grandmother's side is Kamaka, Nahinu, and Nalei`eha. And my grandfather's was Nalei`eha; the four lei of the Island…. After we were born [father died] she remarried to Palakiko. Harry Palakiko. And the Palakiko, I think was in Lahaina. I can't think of the name, but up in the mountains…Kaua`ula, yeah! And they still have that piece of property now my cousin them lives there. She was married to Peter Nalei`eha, then he passed away, then she married Harry Palakiko. Everybody was here [grew up] in Kahana. It was a big property. Way back then, there was the Honokawai School. The grade school was in Honokawai. The eighth grade school was closed down, so we were moved to Kam III school in Lahaina. And then the ninth year we were all up in Lahainaluna, and graduated from there. I went to Oahu, worked over there, did a couple of jobs and then moved back home. Now I'm working for a water company; private water system for Ka`anapali. It used to be Ka`anapali Water and then it got bought out by Aqua Source, a mainland outfit and now it's owned by California Water. My dad (Villiriano) worked for the plantation [Pioneer Mill Company]. So when he first started he had a horse to go work and his job was …first he was a luna and then he became a ditchman. His job was to open up all the [ditch] gates early in the morning to let the water go down to the flumes to irrigate the fields. And you have all the laborers over there adjusting the water for the cane. So that's what he does. Wakes up early in the morning, he goes way up in the mountains and he opens up all the [ditch] gates, let the water go down, flow down into the flumes for the people taking care of the fields. And then in the afternoon he goes and shut all the valves. And that was his job. When he got a jeep, then he started taking us up there [Māhinahina *mauka*]. And that's how we got really familiar with that area. He retired in 1966 at the age of 67 or 68. He went over his age. He came here when he was about twenty something years old. I think he got married when he was about twenty-five…got married to my mom. When our parents passed away, they just handed down the property... there are five owners over there now…me, my sister Be-bop, and my brothers Joe, Filimon and Lorraine [Sadang].

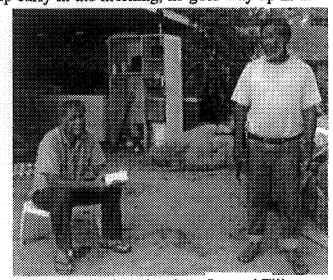


Photo 12. Sadang brothers Joe and Filimon.

* * *

Photo 13. South end of eroding Sadang property.

**A-4. James "Bobo" Nalei`eha.** "Bobo" is related to Mr. Sadang. He was with his crew at Pohaku Park or "S-Turns" next to the Kahana Iki drainage [*makai* of Lower Hono`api`ilani Road] cleaning fish they caught in the channel between Māhinahina-Kahana and Lana`i.

Photo 14. Fishing crew cleaning their akule catch.

B. Land Resources and Use

Land resources and use change over time. Often evidence of these changes are documented in archival records. Occasionally cultural remains are evident on the landscape and/or beneath the surface. However oral histories can give personal glimpses of how the land was utilized over time and where the resources are or may be. Oral histories also provide indications of cultural practices. The project area and vicinity was once leased to the Pioneer Mill Company for a number of years, before reverting back to Maui Land & Pineapple Company. The most dominant historic use of the land in the project area was sugar cane cultivation and railroad tracks, then pineapple and an airstrip.

Māhinahina-Kahana Neighborhood.

There wasn't a whole lot of development (*makai*); there were a few homes in Māhinahina area along the lower Honopiilani Road … there were a few homes along there … but for the most part there wasn't a whole lot of houses there. There definitely wasn't resort development. The area called Kahana Keys and all that, I believe there was only one house in there, the Ley family; they had one house there. I think that's about it until you get down by Kahana where there were other homes and families, like the Nalei`eha's and the Lara's. Those have been there…further down by Kahana side, those families have been there quite sometime. Robinson. Billie Robinson was my classmate…. Their families have been there a long time. They're makai of the Lower Honoapiilani Road. The Smith family has been there a long time too… The Aluli's...those homes have been there a long time [Nohara].

It was, compared to now, there was no traffic lights, no traffic on the roads, and was real slow. Our neighbors…each property on this area…they were big properties…a couple acres each property…they had one house and it was spread out. No traffic. Nalei`eha house. Palakiko's. Amoku Pali was over there… And out here we just had…one family was here and one across the street and then had the Smith's family over here…which they had like one or two houses on that big property. We had Thompson that was further down … they had like one big property. Aluli came late sixties [Pohaku].

The one right next [to our's] is the Nakoa clan. Because Nakoa, then Nalei`eha, goes all the way up to the creek, or the *kahawai*. And then above that, or past that, are the Tomlinson's and the Smith, and the Robinson [Sadang].

Māhinahina Camp Life.

Photo 15. Remains of Māhinahina Camp.

The [Māhinahina] camp was quite a big camp from what I understand. In those days, each place had a camp for the workers so they didn't have to travel to go to work. And that's how we get the Haole Camp in Lahaina...that was the supervisor's ....lived in Haole Camp at the end of Front Street. We had the Pump Camp, because they had the water pump in that area. Different camps based on the area they were. But they did have villages too. They had Spanish Village, Filipino Village....and the reason why they kept everybody segregated...to control the masses ... so they can say, 'You know what the Japanese said about you guys?'... and then, 'Yeah, you know what the Hawaiians...' So they did that so nobody would come together and be strong. So they separated everybody. There were no interracial marriages. It was forbidden...stick to your own kind. But you know how that goes. Slowly [change]...that's why when you go to a party you get Hawaiian food, Japanese food, Filipino food ... it's all together now. But as far as I remember this was all cane fields. All the way to Māhinahina to that bridge. There was two houses right there before the bridge. From there on to the other bridge over here, that was all cane fields...on the *mauka* side. *Makai* side we still had a lot of houses but was big lots with single houses; a lot of families. Next to the Sadang's, we had the Naleiʻeha's. That was one family that was down here next to Sadang...where those two condos are. Aluli's came in the late sixties; they moved from Oahu to come up here.... And then after that was all pineapple fields all the way to Napilihau Road. Had just the old houses next to the road and pineapple fields in between--up to Kapalua--well Honokahua and Honolua Pineapple. They had one big camp in Honolua, Honokōhau...all the area is all forgotten yeah [Pohaku].

I don't know when that came out [Māhinahina Camp], but that was originally for supervisors. And you can still find like lemon trees and things like that in here [gully next/north of camp].That road on the left when you go to the pineapple field on the main road, then you can see the trees that are still hanging over there [Sadang].

Pulelehua Project Area.

Well, today it's Field 8, Field 2 and Field 22 of Maui Pineapple Company [Nohara].

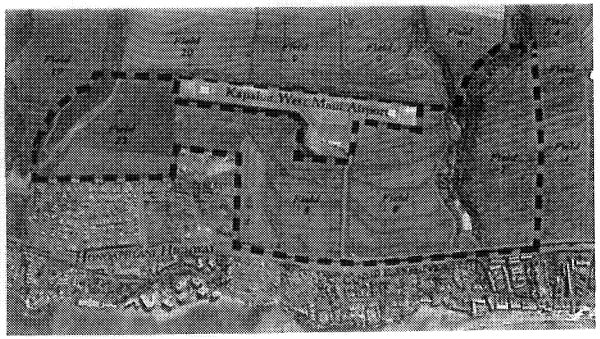


Figure 7. Former pineapple fields now the proposed Pulelehua Community (MLP 2004).

Māhinahina Offset Lease.

All of those lands were part of the Māhinahina offset lease. We had, I believe, a three way agreement between A&B, Amfac, and Maui Pineapple Co. to exchange lands between Haiku, and Hamakuapoko, and here at West Maui. And, I believe, A&B took back the Hamakuapoko lands to go back to sugar cane as they needed more lands, because technology changed to drip irrigation and they could now farm more acreage with the same amount of water. So they then took back the Hamakuapoko fields from Maui Pine, which is by...right above Hoʻokipa. So today much of those lands are sugar cane, and in doing so Maui Pine needed to compensate for those lands, so they took back in increments...the lands from here which is the Napili area marching on to the south end of Māhinahina. So we took back in increments from Amfac and from Pioneer Mill. And I believe A&B ...ah Amfac then took back lands from Haiku area. It was like a three-way...everybody took back lands from each other. At some point all the lands were taken back and the Māhinahina offset lease was abolished. It was no longer needed [Nohara].

The area right below field twenty-two ... some fifty acres or so...a good chunk of that, I believe, was our lands that we settled through Quiet Title that went to a group of Hawaiians who laid claims to other parts of the lands. We gave the lands to this group of Hawaiians who then sold it to a developer, who then developed what is now Kahana Ridge. But that also was, at one point, sugarcane. The only place that is called Kahana Hui, and those are the two acre lots, those were somebody's land...who was that? ...I believe some investor who developed those two-acre parcels that never sold for quite some time, just sat there. Today most of it is starting to be developed on those two-acre parcels. That was not part of that settlement with us. And then there's a sliver of land on the other side of Māhinahina Gulch that is field two ... it's a strange way of the lands, boundaries ... I guess that's the way it is ... it abuts the larger track of land that used to be DLNR but they settled with DHHL, Department of Hawaiian Home Lands. They have a huge track of land that is now field One, Two, Three, Four, and Five. So our landlord for that piece is Department of Hawaiian Home Lands [Nohara]

Train Tracks to Highway.

There was Māhinahina Road that intersected with the Lower Honoapiʻilani Road. Because there was no Honoapiʻilani Highway back then, it was all sugar cane. In fact, where the Honoapiʻilani Highway is today, there was actually part of the Cane Haul Road that we used to haul pineapples on. There was a road there that we called the Track Road. And the Track Road was really a road that was built over the old train tracks. There used to be a train that ran all the way from Kapalua all the way to Māla Wharf that hauled pineapples from our fields at Kapalua all the way to Māla. And we had a cannery right at Māla, and the wharves were used to load ships to haul big cartons off. We needed the Māla Wharf because that can be...Pali Highway was not a road that you would reliably haul things out of West Maui. So there was a train track that became a road today, it's a highway [Nohara]

Māhinahina Road to Māhinahina Camp.

Photo 16. Akahele Road.

The road that goes to the airport, is called Akahele. It was really Māhinahina Cane Haul Road that went straight up to the houses, or call Māhinahina Camp. When the airport was constructed, it blocked the road. So to get up to the houses you had to go around the south end of Field 8. And then it loops back and ties into Māhinahina Rd and goes straight up. Māhinahina Road used to go through from the sugar cane field straight up [Nohara].

Photo 17. Airport entrance.

Photo 18. Remnants of the bamboo forest.

There's a bamboo forest up there [by Māhinahina Camp in Kahana Iki Gulch]. I don't know who planted it [Pohaku].

Māhinahina Gulch.

Māhinahina. There is some, although it's fairly arid, there is some signs of cattle pasture. I believe even today, somebody up there...Alvin Panlasigui has a lease with us and he raises cattle in that gulch. Most of that is rocky [Nohara].

Kapalua West Maui Airport.

I'm not sure what time...but I believe it was Maui Land & Pine that built the airport right there and at some point leased it to Hawaiian Air. I believe sold it at some point and somehow it went back to the State of Hawai'i. That airport wasn't always ... I remember when that was all cane field [Nohara].

Photo 19. Kapalua West Maui Airport, former Māhinahina sugar cane lands.

Māhinahina Rock Storage/Crusher.

There is a field site where some of the rocks from the sediment retention basin were stored on the side of the airport. There's a rock quarry ...actually a rock crusher...a rock crushing unit there that's leased to Greg Ibara [Nohara].

Photo 20. Rock Quarry Crusher.

Photo 21. Rock Storage area.

Sugarcane & Post Sugarcane Eras .

That side [Māhinahina-Kahana] was always sugarcane prior to 1986.... How far back, I would have to check the records. I know that when I worked in the fields in, there was already sugarcane. When driving to high school on the bus, that area was all sugarcane. My guess would be at least to the early '60s, maybe earlier, that the area was in sugarcane [Nohara].

After they closed out [sugar cane] most of them [workers] went to hotel working because that's all you had. Either you work on the plantation or you work in the hotel. That was the only work available. Most of the stores were all privately owned, family type. Very few hired outside workers. Either your Mom, your children, or your relative, who owned the store, was going to work in it. My Dad was working for the sugar plantation and my Mom was a housewife. She took care of all of the chores for the home [Sadang].

Pineapple Lands.

Most recently, I believe, according to the records the first planting of pineapple was about 1986, so prior to that it was sugarcane.... I used to drive pineapple trucks as well as some of the field equipment, and those [Akahele-Māhinahina-Main Haul Road] were roads that we used to use to get to pineapple. Pineapple was limited to Māhinahina Camp *mauka*, below that was all sugar cane.... Between the Honoapi'ilani Highway and Lower Honoapi'ilani Road near Akahele, that intersection, we had a truck dispatch that we used to have to stage our pine haulers there. It was like a depot. Today it's all houses [Nohara].

Māhinahina Aloe Farm.

You know the Māhinahina area, according to my Mom; they used to have an aloe vera farm in that area. So evidently we farmed aloe vera at the Māhinahina area [Nohara].

Maui Land & Pineapple Diversifies.

Well...probably just recently we were almost strictly pineapple. Our endeavors to diversify have been more in line with resort and development, as well as shopping centers. We tried a few other crops, not very successful. We're now looking into reviving a diversified ag, diversified business segment that will enhance our resort commercial site as well as pineapples. But we're just starting that process of diversified ag.... I believe there's some discussion about some horses and horse riding, where exactly I don't know. Bobby Brooks, he's our diversified guy; that's his job to come up with some means of diversifying ... not only agriculture, but other land uses that ties in agriculture but other land uses that ties in agriculture and resort and developments [Nohara].

Photo 22. Pineapples in Field 2.

Photo 23. Fields *mauka* of Project area.

Kahana Gulch.

I did a bit of walking through the Kahana Gulch. Kahana has two gulches that merge at the sediment retention basin, flood control basin called Kahana Dam…. There are some large mango trees in the gulch indicating that there was probably some form of residence there. It is now a floodplain because of the basin. There's quite a bit…it's actually a flat bottomed gulch on the Kahana Nui side. They have signs of pasture, someone was raising animals in there. On the Kahana Iki, there's mostly *haole koa* and a few other trees. I've not gone through Kahana Iki very much, so I'm not sure what's in there [Nohara].

Photo 24. Lower Kahana Gulch from Kahana Ridge.

You have to remember too, this is all cane field. So they already have road going alongside the *kahawai* and all along the place. Because you have the big trucks and you could go and harvest the field. There's always road in there. But when we walked through the *kahawai* it was kind of old already. We went for mangos, plums …just play…. We never pay attention [to other things] because we only went up there for apple mango, sugar mango … they don't have it anymore. Sugar mangos are extremely sweet. They look like common mango and when they are ripe they're yellow [Sadang].

Kahana Area Camp

Well, you know when you are young kids…we played in Kahana Gulch, Honokawai Gulch…typical kids. In fact, right above you know where they have that catch basin right by Kahana, that Kahana Stream, there used to be a camp over there before. Did you know that? They called it Mailepai One, Mailepai Two. You know where the highway is now…that used to be the old plantation road. Where the old plantation road was there's a separation, they call it Mailepai One and Mailepai Two. Right in this area, this is Kahana Stream, right around this area there used to be a camp over here. It was a little camp. It wasn't a big camp. And you know where we live, where our home is…it's way up…the service station…and that complex there used to be a farm up there. A nice farm [Sadang].

West Maui Lifestyle.

[Poi] Yeah, it was ono. We always had poi in the house. In those days you could let it spoil for three days and it was perfect! Nowadays, poi gets rotten before it spoils. We used to get our poi from the store, but the taro that they used was from Maui Taro Shop, I think was the name. Maui poi. But the taro was from Honokohau Valley that Vicki Andrews and Sunny Andrews did the lo`i … did the taro in the valley. And they only had the two of them and one helper. They had a lot of acreage of taro. It's about eight miles-north of here. Honokohau Valley. I can show you a map of that. So they were the main growers of taro on this side of the island. I don't think Kahakaloa had any taro at that time…it was a long time ago. It just got re-established again with Dukelow and some of those guys who are doing taro farming. A lot of the young guys are trying to do taro now … the *auwai* is still there [Pohaku].

Photo 25. Honokōhau Stream still flowing into the Bay.

Local Domestic Flora.

My Dad couldn't plant any vegetables in the yard. Orders from Mom! That was all flowers. She had nothing but flowers in there; plumeria, orchids, you know pretty plants like daisies. Of course, a lot of mango trees, mountain apple, lychee, grapes, and avocado [Sadang].

Local Wild & Domestic Fauna.

There are a few pigs. For the most part the areas that we want to protect are pig-free. We have a program to build fences and we have snared or trapped the pigs to get rid of them where we don't want them. We allow pig hunting down in the lower areas to put pressure on the pigs where it … not that we want them, but they're not as constant. We have been very successful in the pig management on our portions of the land [Nohara].

My cousin, Raymond, used to go hunting for pigs and goats. Right up the road in Kahana Gulch. They still may [have pigs and goats], I'm not sure. Too much noise now. We raised pigs…. Back in those days either you work or you no eat--that was the theme--so you gotta work. And they teach you everything, from cleaning the fish, to feeding the pigs and chickens, and gathering all the food for them. That's how I know this area real well, because they used to have *honohono* grass and pig grass. And that was our job--to go follow our Dad and collect all the food for our pigs--all in the ditches. In the ditches they had a lot of *honohono*…you know what that is, right? The *honohono* grass and the one we call pig grass; it's a low growing, thick like your finger size. And we boil it n the 55 gallon drum. We used to have a lot [of pigs] in Kahana. You know where they have the big net house down at the beach? That used to be our pigpen. And right in the back of that where they have the condo that was all *kiawe* trees. That's where we used to get all our wood to heat up the food for the pigs. There was a pigpen, a chicken pen, and we raised ducks, and in the back of the house on the north end, we raise vegetables….cause that was part of our diet. And my Dad who was the type to share what he had, so I think at the most eight to twenty pigs. Then when they give birth, we raise them up so much then we would eat, and we shared it. Oh, those days they had parties every month! And everybody raised pigs over there. My aunties, my uncles, everybody! Every time we go shopping my Dad, he goes for rice, matches, canned goods, things like that…but as far as meat, we had our own poultry, we had our own fish…its right there. So we depended on the environment where we lived. And the seaweed, is right that [Sadang].

My son-in-law goes hunting [*mauka*] for pigs and stuff. I believe he goes on legal land, not private property [Pohaku].

West Maui – The Old Days.

The old days, like even Lahaina Town, you could park your car, leave all you groceries, don't lock it, nobody's going to touch it. Your house, you can leave it open, no one is going to break in. All stores close at five in the afternoon, nothing was open on Sunday's. No shopping centers. Just had the stores on Front Street, which were all local stores. It wasn't a tourist town yet. In those days you only had the Sheraton Hotel and Royal Lahaina. Ka`anapali Beach.... And that was it. There weren't that many rooms and they weren't that busy because costs to fly here was expensive. So that controlled how many tourists we had. Out here we had no condos yet because all the families were still living on their land. There was no traffic, nobody out here, you could drive on the road and see two cars maybe, or three cars.... Lahaina was small where everybody knew everybody. Everybody knew the families, so that if you got in trouble everybody knew about it. One of the other families would tell somebody, 'Eh, I saw your kid doing something...' So everyone would help [Pohaku].

We surf, went to town, hung out here [Kahana] on the property-- couldn't drive yet. Pretty short day; swimming, playing in the ocean, whatever. In those days we didn't have a phone in our house, we didn't have a radio, we didn't have a TV because the reception was--only had like three channels in those days, 6, 4, 9 and 13, which was kind of foreign, and then if you're out here you had to get your signal from Oahu which was kind of slow. 'Cause the summers up here we didn't have any TV, no radio, and the phone was in the yardman's house that used to take care of the property when we weren't here--so if we had a call he would have to come call somebody. You'd have to walk to his house...so it was kind of nice...it was boring [Pohaku].

C. Water Resources and Use

The Hawaiian word for fresh water is *wai;* the Hawaiian word for wealth is *wai wai.* This is because of the value the ancient Hawaiians placed on fresh water. For the sugar industry water was a crucial resource and a lot of effort was employed and strategies used in order to get it to the fields.

Irrigation water.

[Above Māhinahina Camp] was still pineapple. Those fields, Field 14, 13, 12, 15 and 16, those were pineapple as opposed to sugar cane. I believe the reason for that was there's the Honolua Ditch that intersects at about the 700 foot elevation. And sugar cane needs a lot of water, and so they grew sugar cane gravity feed from the ditch which is right by the Māhinahina houses, Māhinahina Camp down, so they took the water out of the ditch and irrigated the field lands down below. If they were to grow sugar cane mauka they would have to pump...back then everything was furrow irrigation so they didn't have the technology to pump; they didn't use drip irrigation so sugar cane was limited to below the ditch. They used flumes...water flowed through gravity and open-ditch systems. Māhinahina. Above the basin there are some flumes, irrigation flumes; Pioneer Mill used those flumes to move irrigation ditch water across from one field to another [Nohara].

Photo 26. Remnant sugar cane flume.

Domestic Water.

It's all well water. It's cleaner yeah. When they had the sugar cane, pineapple fields, they spray and all that chemical goes in the surface water. Now they have well water. They have holding tanks, after you bring it out of the ground they have holding tanks and then it goes ... they disinfect it and then go to the tap, and the resorts. Any place outside of Ka`anapali Resort is county water. Like over here this is Kapalua, this is private water, it's not owned by the County. They have their own water system. It's maintained by Kapalua Water Company. [Kahana-Māhinahina] it's all County. The only private water system we have on the West Side is Ka`anapali and Kapalua. Anything run outside of that is run by the County. They put the treatment [Māhinahina Water Treatment Plant] because they collected surface water. [That's] domestic water [Sadang].

Gulch Basins.

Māhinahina Basin. Of the gulches...there is that big gulch, Māhinahina, between that sliver of parcel...that parceled land that is next to DHHL...and Field 8 there's a retention basin, a very large basin. I'm not sure what year we built that ... I think it was about ten or fifteen years ago. That's a project for soil conservation. I'm working with the West Maui Soil & Water Conservation District; the County of Maui; NRCS, which is the US Federal Government Soil Conservation Service; and I believe the State of Hawaii, the DLNR. They jointly acquired the lands through Maui Land & Pine. Maui Land & Pine donated the land to the County of Maui. They used federal funds to build that basin to capture storm water, to settle out mud and sediments before entering the ocean. The main reason is for flood control, to protect people's homes and property. I remember going to High School in the late '60s, early '70s, there was a house that was nearly washed away down straight below Māhinahina. Big water and big floods, and property damage was very threatening to those homes. Since then we've built the basin and a concrete channel to reinforce, so today it's not an issue. The basin is doing its job for public safety, as well as capture soil sediments [Nohara].

Photo 27. Māhinahina Basin.

Kahana Basin. I did a bit of walking through the Kahana Gulch. Kahana has two gulches that merge at a sediment retention basin...flood control basin called Kahana Dam. But the main gulch, which is to the north side of...there's a split and it's called Kahana Nui and on the south side it's called Kahana Iki, and they merge at the Kahana Basin. The basin also was built to the West Maui Soil & Water Conservation District [Nohara].

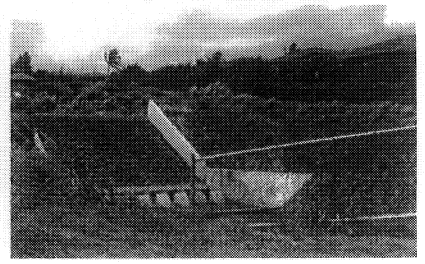


Photo 28. "S-Turns" Basin .

**Pohaku Ka`anapali Gulch Basin.** Pohaku Ka`anapali Gulch, which is between that Kahana Nui subdivision area, there's a sliver of Field 22 that goes down, and Field 8 there's a basin that we built using federal funds, what was then the algae bloom monies. Those were monies that were appropriated by Senator Inouye. I believe channeled through EPA for addressing...there was a bad algae bloom in West Maui. I believe it was 1989 or 1990, and there was enough public outcry requesting that something be done. Senator Inouye heard the cries and allocated several million dollars for a study, as well as come up with programs to help address this algae problem. We formulated an algae advisory committee, which I sat on, and we did a lot of research work and heard recommendations. One of it was to implement a sediment retention basin in Pohaku Ka`anapali. Maui Pineapple Company was hired through the District West Maui Soil & Water Conservation District to actually construct this basin, and we did build this basin and it's still there today [Nohara].

Gulch Streams.

Māhinahina. As far as I know, definitely Māhinahina is not a perennial stream. Kahana had been...way up into the top end of Kahana ...generally it does not flow ... there might be a spring or two way, way up. I'm talking about 1500, 2000 feet elevation. The Kahana Iki is definitely a much shorter gulch. The Kahana Nui, I believe, is not a perennial stream. There are signs of an old diversion that looks like it goes back to the early 1900's, that's no longer active in Kahana. My understanding is that diversion was given up because the water was unreliable ... tied in to... in other words when the water came it meant it was raining and when you need the water it went dry [Nohara].

Kahana. The one here by Kahana, the reason it did flow and that was part of our fun on the weekend.... When we were growing up, yeah, [it flowed] when we were little. I don't know when it stopped. You don't pay attention when you grow up because you're not doing that anymore. You find different activities. [Now] only when rain [Sadang].

Honokohau-Honolua Ditch.

The early...late 1800's there was already some discussion between Pioneer Mill and, back then, we were called the Honolua Ranch, for agricultural water for sugarcane. Back then we weren't even in pineapple. There was a little bit of agriculture and cattle and some other diversified tree crops, particularly coffee. We didn't need a lot of irrigation water for our agriculture, but sugar needed. So they knew there was quite a bit of water up north in some of the valleys that they wanted to bring south, as in the case of most of the irrigation ditches in Hawai`i today. Move water from the wet side of the island to the dry side of the island. We began discussions with Honolua Ranch about investing and constructing a ditch system to move water primarily up Honokohau Valley up north and moving it south to where they would use it for sugarcane. The first ditch system was constructed, I believe about 1901 or 1902, and it was called the Honokohau Ditch. It was, I believe, about 11 or 12 miles long of open ditches and flumes and hills and tunnels. It was a gravity system and because they ran most of it along side slopes of gulches and ridges, it meandered up and down all over the sides to move the water south. It was a very expensive and unreliable system because it was prone to breakage from fallen boulders and trees or whatever that would hit the flumes and they would have to send people up there to go fix it. So back at about 1912 they went back and reconstructed a parallel ditch system which was pretty much totally underground. It was about seven or eight miles of underground tunnels to replace the Honokohau Ditch. It ran from Honokohau Valley underground all the way to Māhinahina. At that time they renamed the ditch, Honolua Ditch so not be confused with the old Honokohau Ditch. Interestingly enough, where the ditch comes back out at Māhinahina, from there on it still retains the name Honokohau Ditch. The Honokohau Ditch begins at parts of Māhinahina and goes all the way to Kanaha Valley in Lahaina above the Cannery Shopping Center. So that section of the ditch is called....still called today Honokohau Ditch. But the section above Pulelehua, which is underground, about the 700 foot elevation, is known today as the Honolua Ditch. That's the camp [Māhinahina] right here. Houses is right there. It's underground. There are areas in the gulches

Photo 29. Portion of reservoir seen north of Kahana Iki.

where you can really see it ... you can see the water flowing. It's right next to the house [Māhinahina Camp] actually. Either side you can actually see where it comes out from underground and becomes an open ditch, and that's where the Honokohau Ditch begins. The Board of Water Supply has built a huge reservoir and water treatment plant that draws water as it comes out of ... the transitional location from Honolua Ditch to Honokohau Ditch they have built a water treatment plant [Nohara].

Photo 30. West Maui Mountains in background.

Pu`u Ku`kui Watershed.

West Maui Mountains, and the peak is called Pu`u Kukui. The highest point, rather, is called Pu`u Kukui. I believe the name is Mt. Kahalawai, or something like that. I've been to Pu`u Kukui many times. The least expensive would be to walk. It's not an easy hike and it is not accessible as we closed it off because we don't encourage people to go there. We have programs to protect that whole upper watershed because it's of huge importance to our environment, and economically because that's where our drinking water comes from. Over the years there were pigs and uncontrolled hikers have gone up ...they've actually damaged the watershed and introduced non-native weeds that actually compete and threaten to destroy our ... basically it's wherever you have our drinking water. Reliability of it, the natural function of that watershed the way Mother Nature intended it to work...non-native animals and weeds have threatened it. So we protect it by closing it off. You can walk or another way is to helicopter ... people have flown in. Basically, Puka Camp Road or Māhinahina cut across. This field right above the Board of Water, that's Field 12, used to go to an area called Ha`ela`au, which has a cabin. That's the highest you can drive up and then from there is all walk [Nohara].

D. Marine Resources and Use.

The sea can be a great resource to people with access to its bounty. Most of the consultants benefited from the resources of the nearby coastal environs. Many went fishing there or had family members who went fishing or gathering, or just enjoyed the beach.

Fishing Ohana.

And we're all fishermen...my uncles...everybody. As long as you reach the age of two or three years old, they throw you in the water. And they were mainly akule fishermen ... all our uncles and aunties...our Uncle George was the captain. Those days we all had a bongo number and that would indicate your fishing license. And we were just helpers...children making trouble, yeah! That was like a tradition and it still exist today. But now my brother, Filimon, he's the commercial fisherman. And he used to work for the plantation and his dream was always to be a fisherman, a full-time fisherman and now that's what he does. His main fishing is akule, and if when there's no more akule running he goes to reef fishing to sustain him and his family, like everybody else. Everybody has a job, and that's his job. And when we have time, we join in because that's how it used to be way back. A lot of our uncles and aunties and cousins, we all had jobs as we grew up...when Uncle George needed help...in those days they're working in the pineapple field they just drop everything...everybody leaves their job, then they go fishing. And they accepted that those days, they accepted that, but not now. Anyway, the tradition still carries on [Sadang].

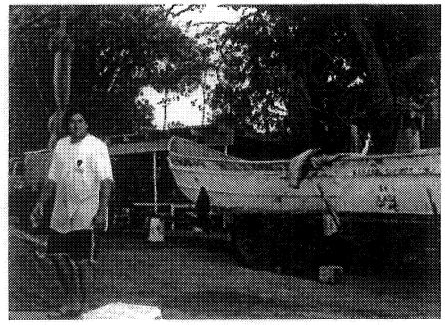
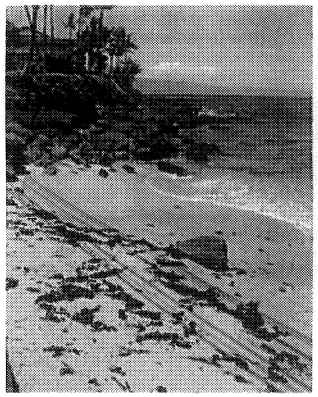


Photo 31. Mr. Sadang's son Jacob helps Uncle Filimon.

Kahawai-Ocean Connection.

In that area [Kahana-Māhinahina], there was always water flowing through the kahawai. It played a very important role in the area where we grew up because it brought in all the mullet, the seaweed, the octopus, and believe it or not, lobsters were on the shore. We used to just walk on the shore at night and harvest lobsters! Our Dad taught us how to fish and he taught us how to respect the ocean. Like the old days, it was a sustain ... like raising pigs and chickens. The ocean was the same thing. You treat it just like that. You take things to sustain your day. We played a lot in the kahawai. Because it's there's always water in there. As I was telling you earlier, that fresh water plays a lot on the ocean. Because that's when certain kind green limu grows when all the fresh water comes down. And all the single fish, like mullet, aholehole, manini...they all come and feed when the fresh water comes down. As so does the seaweed [like the fresh-salt water mixture]. It plays a pretty big role ....I don't know how many people know that but we know because we grew up with it...it's not a study through a book, it's like life! And when they shut off the water and the water stop flowing, it's a drastic change! You still have mullet and things like that because they always come home, fish are like that. But mullet's plentiful. Like us, wherever we grow or you move out, or you hang out there, it's not going to change. Even though fish aren't human, I guess we all react the same [Sadang].



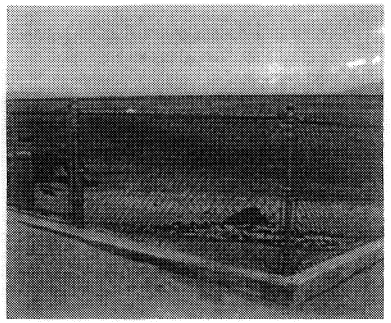


Photo 32. (L) *Limu* on Māhinahina-Kahana area beach.
Photo 33. (R) Kahana Iki drainage borders Māhinahina.

Algae Bloom.

It's interesting, that algae bloom since '89, by the time we formulated the algae committee, most of the algae was already gone. So a scientist and experts were trying to formulate their reasoning for what caused it. I believe the final outcome/statement was that it was a combination of a whole bunch of things. There are actually two types of algae. The first algae was a green filamentous algae, green hairy long strands; it was called Cladophora (*Cladophora Sericea*). It has been around a long time. The theories behind that range from that there were warm ocean currents that moved to the islands that up-welled nutrients or something changed in the temperature of the water to sediments that may, I guess, change the ocean environment, to over-fishing--that we killed the fish that normally would control the algae-- to higher inputs of fertilizers, to agriculture run-off, to ejection wells and sewer cesspools that would inject nutrients into the ground water and cause elevated nutrient levels. Then there was another alga, red algae that is very spotted, it doesn't grow on sand base, it has to grow on rocks. It's called Hypnea (*Hypnea Musciformus*). And Hypnea is an introduced algae--a weed basically. It was brought into Hawai`i and released; actually somebody brought it into Hawai`i for business, to create agar-- it's a gelatin. And I believe, they brought the wrong one and it escaped into the wild in Kane`ohe Bay and eventually it reached every island today. It hooks on to other algae, it's parasitic, and it actually attaches to it. Algae have a root structure base designed to handle tidal energy wave action, but when this Hypnea attaches to a regular weed and it extends it out maybe another five, six, seven inches, all of a sudden that wave action will rip out the other algae then you have huge piles of algae buildup along the coastline. It will build up and start to smell and rot, and the people were complaining about it. It was not good for business, it wasn't good for tourists, and all the recreational users were complaining about it...residents were complaining about it. The breakdown or rotting of the algae would create more nutrients, so therefore it would make it even worse. The Hypnea is a different problem, it was an introduced species. The Alga Committee recommendation was that all land uses seems to have contributed to the buildup of algae. Hypnea was an introduced weed, but there are enough nutrients already there, and plus whatever people add in to the ocean exacerbates the growth of the algae weed and further enhances the problem. Recommendation was better practices by agriculture, by golf courses, by municipal waste water management, by residents, educating people about proper things to do and things not to do in your watershed like drop things down storm drains, dump oils, over irrigate, use excess amounts of fertilizers, those kind of things [Nohara].

Limu or Seaweed

The common one [*limu*], is *ogo*. But right there you have the long rice *limu*, the *ogo limu*, the *lipepe`e*, the chop chop-- like a long black hair it grows about that tall [about 8" long], sometimes longer. Cause you only harvest what you're going to eat, so if you're not going to eat often, then the thing just grow wild. [Taste like] strong iodine. [Mix with food], mostly with opihi, with crab … just like that. You just boil it. Add a little spice to that and you got a salad--pepper and salt, tomato. Comes from right in front here [Sadang].

Photo 34. *Limu* on rocks-low tide.

Fish, Squid & Turtle.

Mähinahina-Kahana Fishing.

Had a lot more fish. My Dad…he used to catch ulua, papio, everyday during the summers. `Oama by the hundreds. He used to throw nets, because it was legal in those days to throw net on the water. Just throw blind and you catch a couple hundred, easy. Tons of `opae. Before we used to go fishing bamboo, you go get your bait first and you get your scoop net and you go around a couple of rocks, check out the limu. We used to have more than one if we need to go pole fishing. And then you go pole fishing you catch your fish…and the rules here are what you catch, you clean and you eat. So you catch your fish in the morning, you clean them and my Mom would cook it for lunch. And whatever `opae you have left, you eat them instead of throwing them back in. We used to lay net almost every night, if the weather was nice….parallel to the beach. We used to catch all kinds of fish. It was plenty…lots of fish. `Oama's. Tons of `oama's.Oama, we freeze some for future bait. We keep some live for live bait right away. And then we take so much of it, depending on how much we catch, and my Mom would deep-fry it. So deep fried `oama and poi that night for dinner! Nehu. We get a lot of nehu. `O`ama. You know you sit down here you see all kind of action. Big splashes. You go, 'Oh, what was that!' Could be barracuda. My brother went diving or go look for squid with the squid box. Lay a net, bamboo fishing. My Dad would go with the `ulua pole…and that was every day [Pohaku].

Photo 35. Pohaku's front yard with view of Molokai sunset.

Kahana-Molokai Fishing.

The stories that I heard …my grandfather and his glass-bottomed canoe ….used to paddle from our property here to Molokai. I never heard of him going to Lanai, but they have family in Lanai and Molokai so I would think he probably would [Pohaku].

Fishing Makai of Pulelehua.

The *makai* [side of Pulelehua] is basically an area that we know as "S" turns. There's a park there called Pohaku Park, which is fairly recent. It was donated by Maui Land & Pine to the County of Maui. That whole area from Kahana to S-turns was not a very desired recreational location for the most part. It was heavily inundated by sediments. Before the construction of the sediment and catchments basins, Kahana Bay, particularly, was a very, very turbid, dirty ocean front. Not to say it wasn't of value. That area of Kahana was known for its *`opae*, salt water shrimp, and *nehu*, which is a small fish that fishermen use for bait. Since the ocean has cleared up, my understanding is that it's hard to find *nehu* and *`opae* anymore. So, somewhat, building sediment retention basins have cleaned up the water drastically-- quality and sustainability of the marine life -- but that area people used to catch *tako*, octopus, fishing-- today people use that area for surfing. Way back when, no one used to surf there, as far as I knew. I know my father folks used to do some netting--used to catch *akule* out there-- migratory mackerel. I remember surrounding *weke* fish. I did some diving for octopus out there. I did some surfing out there, I know that I see people surfing out there. My dad used to cast from the shoreline for various types of fish, so fishing was a recreational activity along that coastline there. They used to gather *limu, ogo* [Nohara].

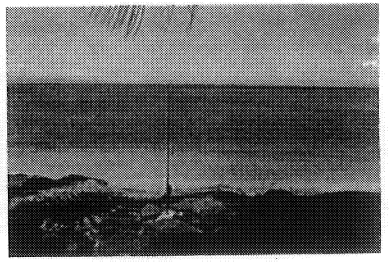


Photo 36. Fishing off "S-Turns" at Pohaku Park.

Division of Labor.

[Women did] pretty much the same, but not as much the heavy duty stuff. Everybody kind of did a little bit of everything when I was growing up. You know *kapu* say the man can only do this or women can only do this, but then the change was happening already. Well, [women did] the cooking and stuff, take care of the family--the kids. The men would go and gather. Give protection, be warriors. The women did more of the building of the *hale*, because they were more particular on how it was set. They had the more patience, they had a better touch for it. My sisters had their own families, so their kids would come up--they were busy working. We pretty much do everything, whatever needs…clean the net, clean fish…go fishing…[girls too]. Yeah, what you catch, you clean [Pohaku].

I don't think so [no difference between men and women]. I think all our relatives do what they could do. Because my aunties, they dive, they went lobster diving. They don't like to go work with nets, but yet they could. They throw net; they do mostly shore line fishing. When they go *hukilau* everybody's involved. But it's usually the men is the one that stay out in the ocean and work the net. The women they do lunch, take care the children. help with the mending--you know the net. Because those days the akule net, even now, they're about fifty to sixty feet tall and they usually run about 1800 to about 2000 feet long. So that's a lot of work when they get snagged on the coral. But when they go akule fishing, in those days there was so much fish so you would just wait for the fish to just settle on the sand. Because there's no boats to run them over or people swimming over it. When the fish come in there's just no interruption. Schools of fish was big those days! Oh, my goodness! [Cleaning fish] that was everybody's job [Sadang].

Backyard Marine Resources

We get people who think this [ocean front yard] is a park. We get haole's that rent those two big houses, like three thousand, four thousand a month kind of deal. They come over here with their kayaks and they land on the beach and then my son-in-law's dog starts barking, and then they leave. Always something going on. We had to put the rocks in because it was getting too much erosion. We used to lay net across the bay going to the beach. They had enough nets to do that. [Catch] all kind--lobster, slipper lobster, all kind fish. Easy to lay net summer time because miles of water, no storm yeah. The reef kind of goes out, turns, and then it goes out at an angle. And we would go down on the rocks and make [wana/poke] and [clean] them in the salt water [Pohaku].

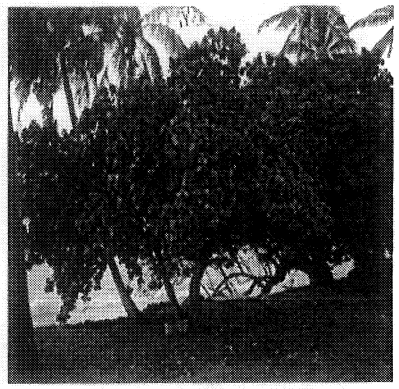


Photo 37. Beach area of Pohaku's front yard.

Commercial Fishing.

My uncle, he was a commercial fisherman--Uncle George. He had his own hukilau nets, his own akule nets, he owned his own boat. The plantation before they used to spray chemicals on top of the sugar cane to dry up the leaves so that they could burn it, and they used the double-winged airplanes. That's what they used to spot akule too. Everybody worked together in the community. It didn't matter what kind of business you had, they just utilized what they got and they work out things together.

Turtle & Tiger Shark Connection.

We have had a couple turtles wash up dead. All tumors. Ugly. We call the Fish & Wild Life. They came and turn it over and hit the stomach and said, 'Oh, this thing never eat long time.' But now that we get more turtles, we get more tiger sharks. That's what tiger sharks eat. In the old days, we never had too many turtles. Never had tiger sharks [Pohaku].

Because now they cannot harvest turtle, there's a lot; a lot of turtles. And there's a lot of sharks! More than before! I'm not just saying that. We have dinner, potluck, family gathering and we're sitting there and we're watching these sharks come up to the shoreline; you can almost touch it without touching the water...that's how close they come. And that used to be a rare occasion! All I know is there's more sharks and there's more turtles. [Turtle] one of their food. Sharks eat fish is their diet too yeah.

Turtle as Food.

Turtles--that used to be our diet. It's good food. They make good steak. That was one of my jobs, to clean turtles. You know the bottom ...they have glands on the four corners and when you cut on the soft shell, you watch for the four corners and just go along side the line on the soft shell and you peel that off...and it takes everything off. First, you cut the neck off, that's what I do...cut the neck off and follow the shell...the soft part...and that's all edible, the soft part ...and you peel it off...you're taking the back...and it's all fat around here...on the edge of the shell...turtle fat [Sadang].

Turtle as Medicine.

That's medicine you know. I don't know how they prepare it. But I remember this boy, Darrell Johnson, he lives in Wailuku, and they use this turtle oil to help this skin rash on his face and on his body. I don't know how they prepare it. But they used it daily, rub it on him...I don't know if they mixed it or cooked it or something...but I know the...you know the Mahi family...they talk about that medicine...they're the one who prepared it...and they used the oil...and completely cured him [Sadang]

Monk Seals

We had the monk seal visit us a couple of times over the last couple of years. Just one. I would think it's the same one. Sometimes we get thirty foot waves out here too [Pohaku].

There's a Hawaiian monk seal that comes every year. I think the month of February or March. Just one monk seal. It's a big one. I think it's the same one everybody sees over here. He comes in, right in our bay, and he passes by our house and just before the rock wall, he goes on the shore sometime, or he just goes past by [Sadang].

Work Not Recreation

Those days [ancient] you didn't go down the beach to go swim and go play. You went down the beach to go gather your food, not to go swimming. You had to be ali`i [to go surfing]. Like the mountains, you don't go to the mountains just to go hiking--everything had a purpose...what you did [Pohaku].

Whales

Yeah, [whales come in] but because of the reef they're kind of maybe another forty yards outside of the swell where it's a little bit deep. But at nighttime we hear them slapping the water. Can hear them splashing during the day. I saw one splash, way outside, it was a huge splash...and then about a few seconds later then I heard it. When the whale season starts they migrate through the channel, they're all going down. And then when they start leaving, you see them all going this way and back out. You see whales all the time before it was popular to go whale watching [Pohaku].

Whales getting closer to shore. They used to hang around in the blue water, then the green water. And they look like their almost 30 feet long [Sadang].

Whales

Not in that area because it's mostly sand. You know how the place looks now [Sadang beach house]...we lost over sixty feet of beach rocks at the end of the property and the rest was all sand about sixty feet out. But now it's like ten feet...twenty feet. So `opihi came from "S" turn or about...you know where the Robbinson's live, from there head up north. Like I say right in front of our house is just sand...so there's no rocks for *`opihi* to grow on or *pipipi* [Sadang].

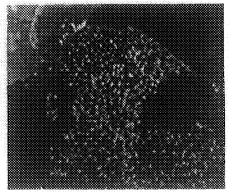
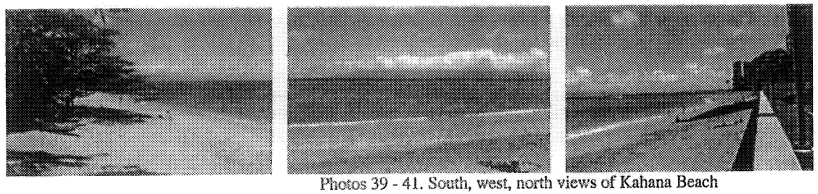


Photo 38. Pipipi on rock.

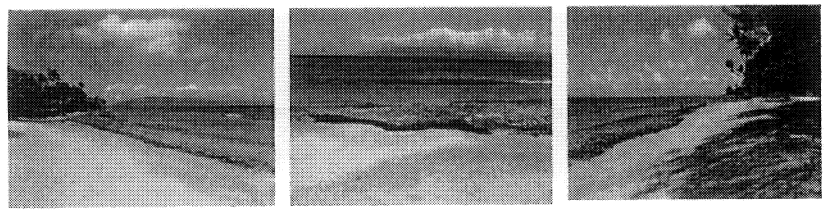
Neighborhood Beaches.

It all depends on the season. Summer usually have more sand...that's ocean activity ...kind of northwest ... winter we get a lot of the big waves, currents... so we loose a lot of the sand during the winter. And as the seasons change the sand comes back in the summer. And it's that way every year. Some years a little bit more, some years a little bit less. But we never put in rock walls or stuff...just left it natural. There's more erosion now, much like the whole world, I think. The water levels is higher. We had unusual very high tides at a time when we had a big north swell that caused a lot of erosion, which is not too often at all that we have that situation. So, very unusual [Pohaku].



Photos 39 - 41. South, west, north views of Kahana Beach

Photos 42 - 44. South, west, north views of Māhinahina fronting a condo.



Photos 45 - 47. South, west, north views of Honokōwai Beach

E. Cultural Resources and Use

This category represents Traditional Hawaiian cultural resources and practices and other ethnic resources and practices. The Traditional Hawaiian cultural resources and practices, includes the pre-contact era, as well as cultural practices after contact. Cultural Resources can be the tangible remains of the ancient past or the traditional *wahi pana* or sacred places, or any cultural gathering place. One of the most significant traditional Hawaiian cultural resources are the *heiau* or places of worship. Other places of great significance for all cultures are the burial places of loved ones. Unfortunately with the massive transformation of the landscape as a result of the many western industries [i.e., provisioning, sandalwood, sugar, tourism, urban development] coupled with the secretive nature of ancient burial practices, most of the ancient burial places are unknown or forgotten and are easily disrupted and disturbed by subsurface activity.

Māhinahina-Kahana

I haven't paid much attention to that. I haven't seen any petroglyphs or bones...I haven't noticed [house sites]. Because there are some mango trees in Kahana Nui, I think ... and I believe I heard that there were some residents, actually homes there at one time, but I haven't seen them. Whenever you build a basin of that size like the ones in Māhinahina and Kahana, there is I believe an environment assessment process that you go through which includes archeological studies. I would believe that there would be an archeological study for Kahana Basin and Māhinahina Basin either accessible through the County of Maui or to NRCS [Nohara].

The only Hawaiian stuff that we were told about was in the Kahana Gulch. That would be right where the highway is, just above the highway, if you look up on the hill, some of the property over there is owned by the Smith family. Also a woman looked for it, but there's some Hawaiian burial ground and some of them is like--oh, this is way back though--some of them the graves were like a regular grave in the ground and some of them were up in the like a cliff. You know how the Hawaiians used to bury their ... in the rocks. And if you are walking in towards the mountain it's on the left side. When we were little, they were showing us, but now I can't [remember]. We used to go up there because there was...there used to be an old house and church in there. They were way back ... Because way back, there were people living inside the gulch. And I know one of the families are the Smith's because their children were planning to come back and build a home in there. But they needed to build a water tank [Sadang].

F. Anecdotal Stories.

Consultants usually have many stories to share. However, some of these stories are not always germane to the research categories. Yet they are too precious not to share as they give a broader view of life in the area, usually in an earlier time period.

Childhood Games.

Bows and Arrows. But we had time to play! Common games. Depends what's on television, in those days' lots of cowboys and Indians. That's the kind of game we played. We made bows and arrows from kiawe trees, you know the roots? Made the bows out of that, and then we had our own feathers from the chickens. You now the common koa [*haole koa*], we put the straight stick, take off the skin and then split one end; because the inside is hollow, it's just right for the feather--the bow fits right in--and we get our Mom's sewing thread and we tie both ends to keep the feather intact and we just sharpen the end! And we shoot each other like that. That time we had the 'Running of the Arrow" the show on TV, black and white. We put a rag on the end, then we shoot the arrow as far as we can, then you have to run and you chase it. Because that's what we had. But if you go in Lahaina, they use the date tree because they have that natural bend. That's one of the games [Sadang].

Chase and Marbles. Chase-master, playing with marbles--fire hole. It's like a "T" or a plus +. At each point there's a hole and in the middle there's another hole. There's five holes. And you draw the line wherever you want…in back of that…five feet away…ten feet away…and the first one [marble] in the hole can progress to the middle…go left or right…go back to the middle …go to the end and reverse the hole…and once you're finished reversing to the beginning, then you're the "king"…so you can prevent anybody from progressing. [And there's] the ring…your marble goes out of the ring, the next person starts [Sadang].

G. Project Thoughts/Concerns.

Most of the consultants expressed at least one concern about the project and/or the problems that may ensue. The primary concern that indirectly involves a cultural practice was runoff into the ocean, but also about chemical seepage. Other issues involved the airport, additional traffic and population.

Airport Issues

I know that it was an issue, people didn't want the airport noises and lengthening of the runway…they don't want big jets to come through or helicopters. That still echoes till today [Nohara].

Run-off Issues

Runoff from the airport is a serious problem. You know when you build an impervious, hard surface like that--it's paved--generally you get heavy runoff. The water has to go somewhere and there really isn't subsurface drains as far as I know, to handle the bulk of the runoff so it goes straight down, that's why the basins play such a major role. Pohaku Ka`anapali Basin handles a bunch of it, but what it has to handle from the airport it probably needs to be enlarged. Especially if they build more homes there in that area they would have to deal with runoff. The other two basins Kahana and Māhinahina, I think, were more able to handle what's already there [Nohara].

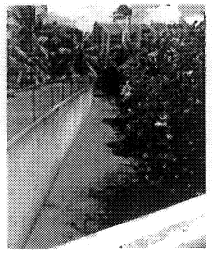


Photo 48. Māhinahina drainage to ocean.

We fish all inside here, Māhinahina-Kahana to Lana`i and run-off is a problem. Runoff hurts fishing, kills *limu*; from there once the *limu* goes, the fish and `ōpae. *Limu* and moi and mullet all need fresh underground water, not run-off dirty water or water contaminated with chemicals from sugar cane and pineapple [Nalei`cha].

I think that's the only concern, to me. Cause when you talk abut the ocean, somebody has to mess it up before…because the ocean is natural…the only way it's going to be messed up is by humans. And what can humans do? They can over fish it … or they can kill it by chemicals [Sadang].

But man, the ocean is dying. I don't know what the problem. As they say the fisherman is fishing it out. I don't think so. They've not fools. Like I say, the coral--you can tell a live coral from a dead coral--all in the Honokawai area all dying off. All the coral there are dying off. Parts of Kahana are beginning to die off. Up in this area, right by Alaeloa are dying off. Right here by Napili Bay is alright so far. You know most of the houses that are going to be built over there [Pulelehua], the sewer is controlled because it goes to a sewer lines. Just think there no was….everything else gets controlled…except the yard; that we cannot control [Sadang].

Water Issues

Some of them [`auwai] has changed over the years, but they cannot get enough water. Because who controls the water? Maui Land & Pine. It's a double sword out there. They say they need more water because the taro is getting rotten in the warm water. But they're not growing enough taro to justify the amount of water they need. So a lot of land has been bulldozed and they're building houses instead of growing the taro. In my family I think I have about 12 acres out there that's in taro; the lo`i--some has been reverted back to taro and some is not really doing anything right now. It's just lands. I'm trying to get people to work the land, but it's hard. There's no more water [Pohaku].

Nobody does that [dry land taro] really…too much dry land because the whole issue's the water. If you go dry land, then they can cut the water. Because that's [Honokohau] the last river that's alive yet. They had so many run-ins with Maui Land & Pine, and with Wes…and I keep telling these guys that Wes just works for them … so he's got to do what they tell him to do. And the State …I think it was something to do with the Kauai issue on the water … who owns the water? … it was supposed to have been the people own the water or the State owns the waters … so we don't know why Maui Land still controls it because they made the dam … or they're controlling the dam … or they sell the water to Maui County. And that's the water that goes to Lahaina. So they'd rather divert the water to Lahaina than have the water run out the ocean and waste, but you're not really wasting because with that fresh-water, you can get *weke* and all. The *moi* and all that happens, so transitions there. It's kind of like a no win situation. So it's a whole other ball game, Honokōhau Valley [Pohaku].

Traffic/Overpopulation Problems

Well, my concern was from when Kahana Ridge came in because now we're adding more cars to the road, more people. And when you have more people, everything else increases. You get people that you don't know that move here, that may attract other kinds of people that usually wouldn't be here if those types of people weren't here to begin with. That was a big concern. Of course when you get more people, you gotta to provide. So then you have a McDonalds, you have these convenience stores. Well, it's good and it's bad. It's good because you don't have to drive to Lahaina to go to a store--it's down the street. It's bad because in order to have that kind of store in your neighborhood, that means you have to have enough people to support it or else they wouldn't be able to make something like that. Same with all these condos. The roads in the old days was no shoulders, no sidewalk. Cause nobody walked. Nobody jogged because that was like recreation, nobody had time for that. Then as the condos came in, the tourists came…'Oh, we need sidewalks, we can't walk over here!' or 'The roads too bad!' So they repaired the road, they made the sidewalks. Not for the locals, it's for all the haoles. And then when you repave the road…because the road's so smooth now … your traffic speed limit goes up. Before they paved it in '73...'74… it was so bad that you had to drive slow. Once they paved it, the traffic increased, speed increased--you can just sit here and listen to the cars go by. It's fast. Nobody's cruising any more. Everyone is in a rush to go somewhere. If you want to go that fast, go the highway. We told at the meetings, who are the sidewalks for? The tourists. Well, we say we've got a highway with a wide shoulder, a 15' shoulder, they should be walking up there and jogging up there. Not on the low road. Cause to put in a sidewalk; you gotta condemn the land. So that means taking away land from the local people, that's all they have left. Of course, they're going to pay you, but they're taking. For who? The haoles. A big development is good and bad. It comes down to whose it for? Who are you trying to reach out for? Who is it going to benefit? The locals? The locals that live here now or people that are moving to Maui from other islands [Pohaku]?

They took all these camps, they condemned them, they shut them down, they gave everybody new houses up Lahainaluna. One road, too many schools up there, two lanes, too much traffic--it's crazy everyday. All day it's crazy. That's the kind of planning the County has been doing. So we was telling them we want four lanes. Well, Kihei got four lanes and we're still waiting. We say we want the bypass. They're still studying it. I don't know what there is to study. It's the way they

plan stuff and it takes them so long to do stuff, by the time they do it, it's obsolete. Missed its point and cost so much money and it doesn't work. It's government [Pohaku]!

Development/Outsider/Traffic Issues

We still got a lot of good country that's not developed yet. I like to see things less developed, less concrete. It's almost impossible to stop development, but it's possible to limit the type of development and the impact. If there's something for the locals to benefit from, then that's good. Kahana Ridge, there's local people up there, but when you look at the price of a lot and you still got to make a house, you're talking $500,000 or more--to $750,000. You can't afford it, so who comes in? The rich people. The non-residents. They come in, they buy it. They got their nice Mercedes. They come in, they got their money.... 'We don't like how this place is. We want to change it to how we want it.' So that brings a (disgruntled local?) 'Haole's go home!' Instead of coming here and saying, 'I'm an outsider. You're the local, you show me how I'm supposed to treat the `aina and adapt to this lifestyle.' Versus their bringing their lifestyle and they want everybody else to adapt to their style. Those are the people that really don't get along with the locals. Versus if you get an outsider that comes in and says, 'Well, I don't really know. Please teach me.' People will take 'em in and say, 'OK. This is how we do stuff and this is why we do stuff.' And this is what you got to be aware of, your neighbor. And who you're hurting and who you're not going to hurt; and who you're providing for. And it comes back to what is aloha. Is it just a word? But it's actually genuine concern of your neighbor, family, friend, to where you go out of you way to do something, and not expect anything in return. That is true aloha. Give what you can and help what you can. Nowadays people, you go help them or they come help you...they want you to return the favor...they expect it...but that's not how it is [Pohaku].

It should be giving and not expect to receive. But this is the way the County wanted to go ... to have a tourist income when they decided to give these developers the permits to build. In those days, you only had "x" amount of hotel rooms, you had "x" amount of plane seats empty coming in. So you couldn't really fill them up. So they decided what if we make more hotels...we could fill up the small hotels. If we added more rooms, we'll make more money. OK. So then who's going to work the hotels? So then we've got all these other people coming in to work the hotels. No place for these people to live. So then you have this whole problem of housing. And they're making hourly wages, so they they're not making a lot of money. Then you get the tourists who come here to visit and never leave [Pohaku].

You get more and more and more [tourists], and then the roads don't get adjusted to the amount of cars and the traffic. Basically, all you have to do is go on Lahainaluna Road...that intersection...in the morning...between 7:00 and 8:00...and between 1:30 and 2:30 ... and see the traffic they've created. That's everyday! So where's everybody going? There's no accident! Its one stupid light causing the back up...it's backed up to the Pali. You know 15 or 20 miles away, it's backed up bumper to bumper. It's ridiculous! The whole problem I see, the history of this island is West Maui, Lahaina, has always been the stepchild of Maui County. West Maui, Lahainaluna High School, never gets the recognition. We get the junk stuff. Our gym is the low bid gym and it's falling apart [Pohaku].

Diminishing Open Spaces

I remember growing up everything was separated; we had Honokowai--houses separated by cane fields; then Kahana--just a few houses separated by cane fields; and then as you got further north you had pineapple. Few houses next to the road and then separated again by pineapple. So every community, every area had their own store, their own school--it was separated. Now when you drive through it's all connected—Lahaina--there's no open area now.

Everybody wants like North Beach, Ka`anapali, they agreed to have that one time share that's going in right now. And then they're going to use the whole other area as park. Well, that's not what I heard they're going to do. They're going to develop more of that land. That's prime location for a park. We don't need more condos, more time share. Enough! They can't fill them up as it is now. Because the developers are not from here, they come in, develop something, sell it, make their money, and leave [Pohaku].

Photo 49. Limited open spaces.

Swimming Pool/Illegal Dumping Issues

Swimming pools. We've seen a lot. They put swimming pool water in the ocean. It should go in the sewer line... but they put em all in the ocean. Some guys they go the easy way out. Sometimes you see the water just turn color [Sadang].

Future References.

I was thinking more about who else you could ask. I don't know if he's willing to do an interview, they guy who has been around a long time is Hideo Kurose. Hideo Kurose was like the plantation superintendent, like the manager of this farm two generations before me. He actually was a supervisor for my Mom, when she worked in the fields. He's been around a long time. He's still alive. He lives down the road here. He knows a lot about the area and history. I haven't talked to him in a long time, so I'm not sure how sharp his mind is. I know that he...just a few years ago his mind was still very sharp. He might be a good resource for you. I know that every now and then I send people to talk with him because you're not the first to do these cultural assessments [Nohara].

Photo 50. Akule nets being cleaned and hung to dry.

SUMMARY
CULTURAL IMPACT STUDY/ASSESSMENT

This cultural impact study is based on two guiding documents, Act 50 and OEQC Guidelines [see Appendices A & C], as well as the *Criteria for Historic Preservation* cited below.

Act 50 [State of Hawai`i 2000]. H.B. NO. 2895 H.D.1 was passed by the 20th Legislature and approved by the Governor on April 26, 2000 as *Act 50*. The following excerpts illustrate the intent and mandates of this Act:

> The legislature also finds that native Hawaiian culture plays a vital role in preserving and advancing the unique quality of life and the "aloha spirit' in Hawai`i. Articles IX and XII of the state constitution, other state laws, and the courts of the State impose on government agencies a duty to promote and protect cultural beliefs, practices, and resources of native Hawaiians as well as other ethnic groups.
>
> Moreover, the past failure to require native Hawaiian cultural impact assessments has resulted in the loss and destruction of many important cultural resources and has interfered with the exercise of native Hawaiian culture. The legislature further finds that due consideration of the effects of human activities on native Hawaiian culture and the exercise thereof is necessary to ensure the continued existence, development, and exercise of native Hawaiian culture.
>
> The purpose of this Act is to: (1) Require that environmental impact statements 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.
>
> SECTION 2. Section 343-2, Hawai`i Revised Statutes, is amended by amending the definitions of "environmental impact statement' or "statement" and "significant effect", to read as follows:
>
> > "Environmental impact statement" or "statement" means an informational document prepared in compliance with the rules adopted under section 343-6 and which discloses the environmental effects of a proposed action, effects of a proposed action on the economic [and] welfare, social welfare, and cultural practices of the community and State, effects of the economic activities arising out of the proposed action, measures proposed to minimize adverse effects, and alternatives to the action and their environmental effects....

State Historic Preservation Division Draft Rules (1989)
Criteria for Historic Preservation. The "significance" of a site is determined by a set of criteria. The following is the State of Hawai`i criteria for historic preservation:

Criterion A:	Be associated with events that have made an important contribution to the broad patterns of our history.
Criterion B:	Be associated with the lives of persons important in our past.
Criterion C:	Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; or possess high artistic value.
Criterion D:	Have yielded, or be likely to yield, information important for research on prehistory or history.
Criterion E:	Have an important historical cultural value to an ethnic group of the state.

SUMMARY OF FINDINGS.

The following summaries are based on the information presented in the previous sections: the traditional and historical literature review in Part III and the ethnographic data and analyses in Part IV. References are not cited here unless it is new information and not already cited in the text above. These summaries condense the information above, but also serve to focus on a few significant individuals and events in West Maui's history in relation to the *ahupua`a* of Māhinahina (and indirectly, Kahana) in the traditional district of Kā`anapali, as well as give a broad overview of land, water and marine resources and uses in the general area, as they reflect cultural properties and practices and access to them.

Summary of Significant People and Events.

According to traditional and historical archival material, West Maui, the Kā`anapali District, and specifically the lands of Pulelehua in the Māhinahina Ahupua`a have gone through a number of significant changes over time, and may have witnessed the comings and goings of many significant people. Some of these people contributed substantially not only to the history of West Maui, but of Maui Island and the rest of the Hawaiian Islands as well. There were several people and events noted in the oral histories and later recorded by explorers, missionaries, native Hawaiian scholars and ethno-historians, from the time of Hua and Haho to Pi`ilani, who ruled Maui in peace, to Kamehameha I who waged war and conquered the various island kingdoms and brought them under one realm, with the exception of Kaua`i. Some of these significant people lived in West Maui and vicinity, were responsible for land modifications, shifts in polity and commerce, the gene pool of Hawai`i's people and are noted below.

Ali`i nui.

One of the first legendary people or families who impacted the history of Hawai`i was the Nanaula family who came from the south of Hawai`i around the 6th century along with other families from Tahiti or Samoa and brought their Polynesian traditions. They peopled all the islands for thirteen or fourteen generations. During the 10th century the Paumakua family arrived from Tahiti. They too are the ancestors of many of the families of the islands. During the 11th century the Nanamaoa family from the Society Islands established families on the islands of Hawai`i, Maui and O`ahu. During this period the descendants of Paumakua (who was buried in `Īao): Haho (who started the *Aha-ali`i*), Palena, Hua, Hanala`anui, Hanala`aiki (twins and progenitors of Maui and Hawai`i Island *ali`i nui*), and Mauiloa, were well established on Maui and Hawai`i Island. The Nanamaoa families were shortly followed by Pa`ao and Pili who came (some say Society Islands, other say Samoa) during the reign of Kapawa, grandson of Nanamaoa, and changed the religious and social structures of the island chiefdoms, bringing with them the Kū cult and the concept of human sacrifice. Around the beginning of the 12th century great voyages took place to and from the southern islands, but stopped abruptly around the end of that century, during the time of Wakalana around AD 1175, right after the arrival of white foreigners, possibly from Japan.

Most of the islands were ruled by the southern families with the exception of Molokai (Kamauaua family) and parts of O`ahu (Maweke family) who were descendants of the ancient Nanaula line. During the 15th century many of Maui's ruling chiefs who are written about in the oral histories, such as Kamalo`ohua, Ka`ulahea I, Kaka`e and his brother Kaka`alaneo who co-ruled Maui (ca. AD 1450) [Kaka`alaneo preferred to rule from Pu`u Keka`a], and Kahekili I (ca. AD 1475), father of Kawaokaohele and grandfather of Pi`ilani (ca. AD 1525) who ruled during the 16th century. Pi`ilani was noted in the oral traditions to have been a wise and peaceful ruler, whose ancestral homeland was Hana, but who chose to rule from Lahaina (Moku`ula) and whose realm included all the bays beginning with "Hono" [Honokōwai, Honokeana, Honokahua, Honolua, and Honokōhau], which included the majority of the traditional Kā`anapali District.

Pi`ilani was followed by his sons Lono-a-Pi`ilani (who ruled Maui from Wailuku), and Kiha-a-Pi`ilani, who wrested the power from his brother Lono with the help of their sister Pi`ikea and her husband `Umi-a-Liloa, the ruling chief of Hawai`i Island during this period. Later, Pi`ilani's grandson Kama-lala-walu ruled around (ca. AD 1575).

During the 17th century the most significant Maui *ali`i nui,* descendants of both Lono-a-Pi`ilani and Kiha-a-Pi`ilani via inter-marriage, were Ka-uhi-a-Kama I (ca. AD 1600), Lonohonuakini (ca. AD 1650), and Ka`ulahea II (ca. AD 1675). During the 18th century the ruling chiefs of Maui were also descendants of Pi`ilani: Kekaulike II (ca. AD 1700), Kamehameha-nui (ca. AD 1736), Kahekili II (ca. AD 1765 who set up his court in both Lahaina and Wailuku when it suited him), and Kahekili's son Kalanikūpule (ca. AD 1795). Other significant *ali`i* associated with West Maui are Ka-uhi-`aimoku-a-Kama, older brother of Kamehamehanui (sons of Kekaulike II) and their uncles Alapa`inui, ruling chief of Hawai`i island and Pele-io-holani, ruling chief of Kauai and O`ahu. Their uncles each sided with a different brother in the Maui civil war of 1738, which took place in the districts of Kā`anapali and Lahaina and ended in Pu`unene. Pele-io-holani landed his forces at Honolua and Honokahua and fighting started at Honokōwai.

Another chief during that period was Kalani`opu`u (older brother of Keoua, father of Kamehameha I), son of Pele-io-holani, nephew of Alapa`inui and later his war chief. When Keoua died, Kalani`opu`u blamed his uncle Alapa`inui, who was also accused of killing their father and uncle, the rightful heirs of Hawai`i Island. When Alapa`inui died Kalaniopu`u became ruling chief of Hawai`i Island. He subsequently attacked Maui several times, even though his wife was Kalola, sister of Maui ruling chiefs Kamehamehanui and Kahekili; as did his nephew Kamehameha I. After Kamehameha I conquered the island kingdoms (except Kaua`i), he returned for a while to Lahaina (Lahaina later became the capitol of the Kingdom until AD 1845). Then during the reign (AD 1825-1854) of his son, Kamehameha III, most of the lands of the Kā`anapali District, including Māhinahina became Crown Lands, the personal property of the King, during the re-distribution of lands in the Great Mahele (AD 1848).

Historic People

During the Mahele period (ca. AD 1846-1856) when lesser chiefs and *konohiki* were claiming or being assigned lands, the register and testimony to the Land Commission provided information as to the people of the project area, as well the resources and use. Much of West Maui was given to L. Konia, granddaughter of Kamehameha I, wife of Abner Paki, mother of Princess Bernice Pauahi Bishop, and *hanai* mother of Kamaka`eha (Queen Liliuokalani). However, Māhinahina 4 was awarded to Charles Cocket (LCA 75) by Maui Governor Hoapili (Hoapili was the companion of Kamehameha I and following Kamehameha's death Hoapili became the husband of Keopuolani) even though Paki claimed they were his lands. Other lands within Cocket's lands were awarded to: Hoonoho (LCA 6539); Kaukau (LCA 4239); and Kekalohe (LCA 4248). Māhinahina 1, 2 & 3 (Grant 1166) was awarded to missionaries Dr. Dwight Baldwin, John Fawcett Pogue, and Sereno Edwards Bishop (son of Artemas and Elizabeth Edwards Bishop); all three had been missionaries in Lahaina and involved with Lahainaluna School.

Significant Events.

The most significant ancient event in Māhinahina was mostly likely the war of 1738, which commenced at Honokōwai, which borders Māhinahina to the south. It is highly likely that the troops of Peleioholani, who landed at Honolua and Honokahua, passed through Māhinahina on the way to Honokōwai. Other shared events would have been the construction of the railway for the Lahaina, Kā`anapali & Pacific Railroad (ca. AD 1887), and the Honokōhua (AD 1904) and Honolua (AD 1912) Ditches; all of these structures traversed parts of Māhinahina (the ditches *mauka* of the project area, and the railway just *makai* of Pulelehua Community project lands).

Summary of Land, Water and Marine Resources and Use

Various land use patterns are recounted in the literature, legends, maps and legal documents, but are not always physically evident on the landscape. This is the case with the ancient land use of Māhinahina and the project area, which would have followed the *ahupua`a* system of resources from mountain to the sea and overseen by a *konohiki.*

Ancient Land, Water and Marine Resources and Use

The traditional literature has a sparse amount of information about Māhinahina; the goings and comings of various *ali`i nui,* their families and their adventures and the *maka`āinana,* the people who cared for the land. Archaeological studies have revealed that fishing villages or settlements were along the coastal lands of the Kā`anapali District (Appendix I). The earliest dates (ca. AD 610) where in Honokahua. This area of Honokahua and Honolua has perennial streams that supported *kalo lo`i* (wet land taro terraces), as did neighbor *ahupua`a* Honokōwai. Other streams in the district had seasonal flows of water. According to native and foreign Land Commission Awards (LCA)testimonies, these valley/gulch and *kula* lands appeared to have supported the cultivation of *mai`a* or banana (*Musa xparadisiaca* spp), olonā (*Touchardia latifolia*), sweet potato, dry land taro, *hala* (*Pandanus spp*), *kukui* (*Aleurites moluccana*), *milo* (*Thespesia populnea*) and *kou* (*Cordia subcordata*).

There were only two recorded fishponds in the Kā`anapali District, one was at Honokōwai, bordering Māhinahina and the other was at the mouth Kahana Nui Stream. However, both Māhinahina and Kahana had *kahawai* (stream, creek, valley, gulch, whether wet or dry) where fresh water drained into the ocean supporting the life cycles of the several species of fish and *limu* (seaweed); referred to as Māhinahina Gulch, Kahana Nui Gulch and Kahana Iki Gulch).

The district also had several known *heiau* (structure of worship), alluding to organized and complex social and religious systems, above the ordinary scope of the personal and occupational *ko`a* (shrines). However, by the time researchers were able to study the area in the late 1800s and early 1900s many more were suspected to have been destroyed by historic use of the lands. According to previous archaeological surveys, almost all traces of the ancient period in Māhinahina-Kahana have been destroyed with the exception of a few stone remnants in the Kahana Gulches and a cultural deposit in the Māhinahina Gulch. Carbon dating analysis of charcoal specimen from Site #255 in Māhinahina Gulch indicates an occupation date of AD 1150, with a pre-contact occupational time span of AD 1150 to 1778.

Historic Land, Water & Marine Resources and Use.

The native (NT/NR) and foreign (FT/FR) testimonies and registers of the Mahele land claims process provide a view of lands already in transition. Seventy years had passed since first contact by Captain Cook, and twenty-eight years had passed since the missionaries arrived. The devastating sandalwood era was winding down, but not before heavily modifying the landscape by denuding the upper forests and *kula* lands. According the testimonies, much of the *kula* lands were converted to pasture (ca. AD 1850-1915); this was followed by mono-crop agricultural practices--the cultivation of sugar cane (ca. AD 1915-1986) and pineapple (ca. AD 1986-2004), which also radically modified the natural landscape with infrastructural roads, railways, bridges, ditches, tunnels, plowing and rock crushing. This was the land history of Māhinahina as well. The Māhinahina house lots mentioned in the testimonies were either destroyed before or during the sugar plantation era. One modified house from the sugar plantation's Māhinahina Camp is currently utilized by Honolua Plantation employees, along with two transported houses from Fleming's Beach (Honolua area). However, these are *mauka* and outside of the Pulelehua lands.

The Pulelehua lands were at one time leased by Pioneer Mill Company and cultivated with sugar cane. In the late 1980s the lands were part of a land exchange and subsequently cultivated with pineapple. The project lands now border the Kapalua West Maui Airport (*mauka*) and the Cane Haul Road (parallel to the Hono-a-Pi`ilani Highway) and straddle Akahele Road that leads to the airport. The northern boundary is the Kahana drainage (Kahana Iki Gulch). Both parts of the property, on either side of Akahele Road are currently fallow pineapple fields. A portion of the project area is located south of the Māhinahina Gulch drainage and is currently being cultivated in pineapple.

The Māhinahina-Kahana drainages (valleys, gulches, gullies, streambeds) were seasonal and fell victim to the alien vegetation transported as seeds by cattle, goats and pigs, etc. Today they are inundated with predominantly alien grasses, shrubs and trees; a few *kukui* trees were observed in the gulches within the project lands. However, the upper gulches and lands still have cultural resources in the way of flora, fungus, and feral pigs. The Kahana drainage has a few remnants of the early historic period (stone animal pens); and the Māhinahina drainage has a remnant wooden flume from the sugar plantation period. The Honolua Ditch continues to traverse Māhinahina (underground and *mauka*). Desiltation basins were constructed in both the Māhinahina Gulch and Kahana Iki Gulch, and in the section north of Akahele Road (Pohakukaanapali Basin).

Marine resources in the project vicinity have a long history of prolific marine resources (fish, turtles, lobster, crabs and seaweed). The waters of Māhinahina-Kahana are still fished by families representing several generations in the area, as well as by newcomers. However, the consultants stress that the ocean is dying (diminished resources--fish, lobster, crabs, seaweed--and coral is dying).

Summary of Survey Findings (Cultural Practices)

It is evident that at one time the lands of Māhinahina-Kahana, which include the Pulelehua lands, were part of an ancient Hawaiian life system. Previous archaeological surveys revealed evidence of possible burials, hearths, temporary habitation shelters (Kahana Gulch) and cultural deposits (Māhinahina Gulch), indicating a multi-use of the lands here. A cultural practice of these lands at one time was growing sweet potato, a staple for the ancient people of this area, as well as cultivating bananas, *olonā*, *hala* and possibly dry land taro. There are no traces of these plants now in the project area. Hawaiians also made use of the flora that grew in the gulches, valleys and mountains, such as *kukui*, *`ohia*, fungus, and *lama,* for medicines, food, crafts, and lumber. These resources are still sought after today. However, other than a few *kukui* trees in the gulches, none of these flora exist today on Pulelehua Community project lands.

The pig (*Sus scrofa*) was brought to Hawaii by the early Polynesians. Some of them managed to escape from pens and later inter-mixed with domestic species who also managed to escape. These are known today as feral pigs. The cultural practice of hunting these animals continues today, both for sustenance and for sport.

The most significant cultural practices in the vicinity of the Pulelehua Community project area are the fishing and sea-gathering (i.e., *limu*/seaweed, *`opihi*, *wana*/sea urchins, and sea cucumber) practices that continue today. While these resources are outside of the project lands, the cultural consultants feel that any construction activity that occurs on project lands could adversely affect or impact these resources.

Summary of Consultants Concerns/Considerations.

Two consultants have some reservations regarding the proposed Pulelehua Community and all the consultants shared the concerns and thoughts that they would like to see be considered. These concerns are "categorized" according to "cultural properties or practices" or "general" and if they directly or indirectly will be affected by the proposed project.

Cultural Properties/Practices Directly Affected by the Proposed Project:

- Fishing and other marine resources are threatened and/or depleted
- Inadequate desilting basin system; size and removal of silt
- Runoff created by development may be killing marine resources
- Uncontrolled pesticides/fertilizers in private yards (bad for aquifer and ocean)
- Airport runoff is a big problem--no adequate subsurface drainage

Cultural Properties/Practices Indirectly Affected by the Proposed Project:

- Water issue, not enough going to taro farmers in the North
- Outsiders lack the "aloha spirit"

General Concerns Regarding the Proposed Project:

- The airport noise is still an issue
- Lengthening the airport is an issue, big jets and helicopters are not wanted
- Traffic problems already an issue, more people, more traffic
- Overpopulation of West Maui--more people, more problems
- History of County planning very poor
- Development will take away needed open spaces
- New development raises the property values--unaffordable
- County has not provided adequate infrastructure for West Maui
- County has not provided school, public improvements for West Maui
- New, outsider teachers, etc. who don't adapt, create conflicts with students
- Recreation (i.e., surfing) areas are already overcrowded
- Outsiders don't know/care about recreation (surfing) curtsies
- Tourist industry creates ill-paying service jobs, can't afford housing

Cultural Resources. This category entails sites or places associated with significant events and/or people important to the native Hawaiian patterns of prehistory; embody distinctive characteristics; or are likely to yield information important for research on the prehistory of Hawai`i. It also includes sites that yield resources important for native Hawaiian Cultural Practices, past and present; and items that are part of a cultural context. *Wahi Pana* or sacred places are important cultural resources to native Hawaiians regardless that the original sites that may have been there no longer exist. Often it is not the lack of interest but the lack of knowledge of whereabouts or more likely, lack of access that prevent native Hawaiians from visiting these sites. Other than the *kukui* trees in the gulches adjacent to the project area, there are no known cultural resources located on the Pulelehua Community project lands. However, there are cultural resources in the upper gulches and lands (mountains), and the ocean is considered to be a cultural resource, which will be addressed below.

Cultural Practices. This category includes items that are essential to the gathering practices that have cultural value to either native Hawaiians or other ethnic groups. This category may overlap Cultural Resources in that the practice of gathering (land and ocean) resources may be affected by the project. It is not known if people of West Maui specifically use the *kukui* nuts from trees in Māhinahina or Kahana drainages (gulches), however, the practice of gathering *kukui* nuts continues today for making the condiment *inamona*, for medicinal purposes, for lei, and for *kukui* nut oil, which has several uses including *lomilomi* (Hawaiian massage). It is also a Hawaiian tradition to gather flora from the upper gulches and mountains for *lei, hula*, food, medicine and crafts; just as it is a traditional practice to hunt for feral pigs in the upper gulches and mountains. The consultants grew up in West Maui and recollect playing or gathering things from the gulches; one especially mentioned Kahana Iki more so than Māhinahina. They also spoke of pig hunting that was practiced by members of their families or friends. While there are no cultural practices on Pulelehua Community lands to be adversely impacted, there is potential that access to gathering and hunting practices in the upper gulches/mountains may be compromised during the construction phase of the proposed Pulelehua Community. However, concerns

regarding access to upper gulches/mountain resources would be mitigated upon completion of the project and the subsequent dedication of the project streets as public thoroughfares.

According to consultants, the cultural fishing practices of Hawaiians in Māhinahina-Kahana area, while not located specifically on Pulelehua Community lands, have potential for being adversely affected by the proposed Pulelehua Community, due to runoff and non-removal of silt collected in the Māhinahina, Kahana and Pohakukaanapali Basins. West Maui, including Māhinahina and Kahana drainages have been known to experience periods of heavy rainfall that overflows into the ocean bringing with it silt (*lepo*) that dirties the waters and adversely impacts the marine resources.

The consultants also believe there is reasonable potential for these fishing practices being adversely impacted by uncontrolled private (residential/business) use of pesticides and fertilizers, in the way of groundwater seepage, if a large number of people with yards move into the Pulelehua Community.

Historic Resources. This category entails sites associated with significant events and/or people important to the broad patterns of history [post Western contact], which also includes other ethnic groups; embodies distinctive characteristics of an historic era or a master [e.g., noted architect]; or are likely to yield information important for research on the history of Hawai`i. With the exception of a remnant of an old wooden flume in Māhinahina Gulch, and the stone pens in Kahana Iki Gulch, there are no historic resources in the proposed Pulelehua Community.

CULTURAL IMPACT ASSESSMENT

- **Cultural Resources (Land) Impact.** The lands within the project area were heavily impacted by the historic activities of the 19th and 20th centuries. Any cultural sites and/or resources would have been destroyed or buried by ranching, sugar and pineapple plantation activities; therefore there will be no adverse impact to any cultural resources on Pulelehua lands (except for the gulches). However, it should be noted that cultural sites (i.e., hearths/*imu*) have been found below the plow zone in other areas (islands) of sugar cultivation.

- **Cultural Practices/Access (Land) Impact.** Since there are no cultural resources on Pulelehua lands, there will be no adverse effects to cultural practices on Pulelehua lands. However, there are cultural resources in the gulches and access to these areas may be adversely impacted or compromised by the Pulelehua Community.

- **Cultural Practices: Indirect Adverse Impact.** According to consultants interviewed, there are two conditions that have the potential to create an adverse effect or impact on the cultural fishing practices and resources *makai* of the proposed Pulelehua Community; over-flow runoff and contaminated groundwater seepage. Given the propensity for runoff problems in West Maui, unless they are adequately addressed, development activities for this project may adversely impact both traditional cultural marine resources and practices by the silt-laden overflow into the ocean from both the drainages and surface runoff. One suggested solution was to periodically remove dried sediment from the desilting basins before any heavy rain fall can create overflows taking the collected sediment/silt with it into the ocean. The condition of the contaminated groundwater seepage into the ocean is created by the continuous use of pesticides and fertilizers leaching into the aquifer or groundwater. While this may be mitigated by a change from agricultural use to urban use, unless private (residents/business) and public (open spaces/parks) activity is monitored, this problem could persist.

- **General Concerns**. While many of the concerns of the consultants do not involve traditional cultural resources or practices, they are valid points that also warrant some consideration.

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APPENDIX A

A BILL FOR AN ACT RELATING TO
ENVIRONMENTAL IMPACT STATEMENTS
[UNOFFICIAL VERSION]

HOUSE OF REPRESENTATIVES H.B. NO, 2895 H.D.1
TWENTIETH LEGISLATURE, 2000
STATE OF HAWAI`I

A BILL FOR AN ACT
RELATING TO ENVIRONMENTAL IMPACT STATEMENTS.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF HAWAI`I:

SECTION 1. The legislature finds that there is a need to clarify that the preparation of environmental assessments or environmental impact statements should identify and address effects on Hawai`i's culture, and traditional and customary rights.

The legislature also finds that native Hawaiian culture plays a vital role in preserving and advancing the unique quality of life and the "aloha spirit' in Hawai`i. Articles IX and XII of the state constitution, other state laws, and the courts of the State impose on government agencies a duty to promote and protect cultural beliefs, practices, and resources of native Hawaiians as well as other ethnic groups.

Moreover, the past failure to require native Hawaiian cultural impact assessments has resulted in the loss and destruction of many important cultural resources and has interfered with the exercise of native Hawaiian culture. The legislature further finds that due consideration of the effects of human activities on native Hawaiian culture and the exercise thereof is necessary to ensure the continued existence, development, and exercise of native Hawaiian culture.

The purpose of this Act is to: (1) Require that environmental impact statements 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.

SECTION 2. Section 343-2, Hawai`i Revised Statutes, is amended by amending the definitions of "environmental impact statement' or "statement" and "significant effect", to read as follows:

"'Environmental impact statement" or "statement" means an informational document prepared in compliance with the rules adopted under section 343-6 and which discloses the environmental effects of a proposed action, effects of a proposed action on the economic [and] welfare, social welfare, and cultural practices of the community and State, effects of the economic activities arising out of the proposed action, measures proposed to minimize adverse effects, and alternatives to the action and their environmental effects.

The initial statement filed for public review shall be referred to as the draft statement and shall be distinguished from the final statement which is the document that has incorporated the public's comments and the responses to those comments. The final statement is the document that shall be evaluated for acceptability by the respective accepting authority.

"Significant effect" means the sum of effects on the quality of the environment, including actions that irrevocably commit a natural resource, curtail the range of beneficial uses of the environment, are contrary to the State's environmental policies or long-term environmental goals as established by law, or adversely affect the economic [or] welfare, social welfare[.], or cultural practices of the community and State."

SECTION 3. Statutory material to be repealed is bracketed. New statutory material is underscored.

SECTION 4. This Act shall take effect upon its approval.

Approved by the Governor as Act 50 on April 26, 2000

APPENDIX B

Scope of Work (SOW)

Cultural Impact Assessment [in accordance with OEQC Guidelines]

1. identify and consult with individuals and organizations with expertise concerning the types of cultural resources, practices and beliefs found within the broad geographical area, e.g., district or ahupua`a;

2. identify and consult with individuals and organizations with knowledge of the area potentially affected by the proposed action;

3. receive information from or conduct ethnographic interviews and oral histories with persons having knowledge of the potentially affected area;

4. conduct ethnographic, historical, and other culturally related documentary research;

5. identify and describe the cultural resources, practices and beliefs located within the potentially affected area; and

6. assess the impact of the proposed action, alternatives to the proposed action, and mitigation measures, on the cultural resources, practices and beliefs identified.

Methods

The specific tasks listed below expand on the above scope of work:

- Conduct historical and cultural background research (i.e., business records, land records; archival documents, literature, reports, letters, photographs, journals, or newspaper files) to locate material that will provide broad patterns of the history of the project area such as subsistence, religious, recreational, and commercial uses of the land; as well as settlement and residential patterns of the area and region; major family groups that inhabited, used or controlled lands within the project area and region; documented legends, myths, or traditional histories associated with the area; and descriptions of traditional practices, customs and beliefs associated with identified traditional cultural practices;

- Prepare a semi-structured ethnographic research instrument that will include questions that will generate general biographical information, association with and knowledge of the project area, its history and use

- Prepare a consent form to be used as written agreement with any individual interviewed concerning the review of content and use of information recorded during the interview

- Identify individuals knowledgeable with the project area e.g., Māhinahina-Kahana; West Maui; ML&P.

- Conduct and record ethnographic interviews with knowledgeable individuals. If feasible individuals shall participate in field inspections (Makana to be given)

- Transcribe recorded interviews (Approximate time, 6-8 hrs/per hr of recording)

- Prepare a report that will include an overview of the archival material, and an analysis of the ethnographic data;

APPENDIX C

Guidelines for Assessing Cultural Impacts

Adopted by the Environmental Council, State of Hawai`i
November 19, 1997

I. INTRODUCTION

It is the policy of the State of Hawai`i under Chapter 343, HRS, to alert decision makers, through the environmental assessment process, about significant environmental effects which may result from the implementation of certain actions. An environmental assessment of cultural impacts gathers information about cultural practices and cultural features that may be affected by actions subject to Chapter 343, and promotes responsible decision making.

Articles IX and XII of the State Constitution, other state laws, and the courts of the state require government agencies to promote and preserve cultural beliefs, practices, and resources of native Hawaiians and other ethnic groups. Chapter 343 also requires environmental assessment of cultural resources, in determining the significance of a proposed project.

The Environmental Council encourages preparers of environmental assessments and environmental impact statements to analyze the impact of a proposed action on cultural practices and features associated with the project area. The Council provides the following methodology and content protocol as guidance for any assessment of a project that may significantly affect cultural resources.

II. CULTURAL IMPACT ASSESSMENT METHODOLOGY

Cultural impacts differ from other types of impacts assessed in environmental assessments or environmental impact statements. A cultural impact assessment includes information relating to the practices and beliefs of a particular cultural or ethnic group or groups.

Such information may be obtained through scoping, community meetings, ethnographic interviews and oral histories. Information provided by knowledgeable informants, including traditional cultural practitioners, can be applied to the analysis of cultural impacts in conjunction with information concerning cultural practices and features obtained through consultation and from documentary research.

In scoping the cultural portion of an environmental assessment, the geographical extent of the inquiry should, in most instances, be greater than the area over which the proposed action will take place. This is to ensure that cultural practices which may not occur within the boundaries of the project area, but which may nonetheless be affected, are included in the assessment. Thus, for example, a proposed action that may not physically alter gathering practices, but may affect access to gathering areas would be included in the assessment. An ahupua'a is usually the appropriate geographical unit to begin an assessment of cultural impacts of a proposed action, particularly if it includes all of the types of cultural practices associated with the project area. In some cases, cultural practices are likely to extend beyond the ahupua'a and the geographical extent of the study area should take into account those cultural practices.

The types of cultural resources The historical period studied in a cultural impact assessment should commence with the initial presence in the area of the particular group whose cultural practices and features are being assessed. The types 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 Environmental Council recommends that preparers of assessments analyzing cultural impacts adopt the following protocol:

1.identify and consult with individuals and organizations with expertise concerning the types of cultural resources, practices and beliefs found within the broad geographical area, e.g., district or ahupua`a;

2.identify and consult with individuals and organizations with knowledge of the area potentially affected by the proposed action;

3.receive information from or conduct ethnographic interviews and oral histories with persons having knowledge of the potentially affected area;

4.conduct ethnographic, historical, anthropological, sociological, and other culturally related documentary research;

5.identify and describe the cultural resources, practices and beliefs located within the potentially affected area; and

6.assess the impact of the proposed action, alternatives to the proposed action, and mitigation measures, on the cultural resources, practices and beliefs identified.

Interviews and oral histories with knowledgeable individuals may be recorded, if consent is given, and field visits by preparers accompanied by informants are encouraged. Persons interviewed should be afforded an opportunity to review the record of the interview, and consent to publish the record should be obtained whenever possible. For example, the precise location of human burials are likely to be withheld from a cultural impact assessment, but it is important that the document identify the impact a project would have on the burials. At times an informant may provide information only on the condition that it remain in confidence. The wishes of the informant should be respected.

Primary source materials reviewed and analyzed may include, as appropriate: Mahele, land court, census and tax records, including testimonies; vital statistics records; family histories and genealogies; previously published or recorded ethnographic interviews and oral histories; community studies, old maps and photographs; and other archival documents, including correspondence, newspaper or almanac articles, and visitor journals. Secondary source materials such as historical, sociological, and anthropological texts, manuscripts, and similar materials, published and unpublished, should also be consulted. Other materials which should be examined include prior land use proposals, decisions, and rulings which pertain to the study area.

III. CULTURAL IMPACT ASSESSMENT CONTENTS

In addition to the content requirements for environmental assessments and environmental impact statements, which are set out in HAR §§ 11-200-10 and 16 through 18, the portion of the assessment concerning cultural impacts should address, but not necessarily be limited to, the following matters:

1.A discussion of the methods applied and results of consultation with individuals and organizations identified by the preparer as being familiar with cultural practices and features associated with the project area, including any constraints or limitations which might have affected the quality of the information obtained.

2.A description of methods adopted by the preparer to identify, locate, and select the persons interviewed, including a discussion of the level of effort undertaken.

3.Ethnographic and oral history interview procedures, including the circumstances under which the interviews were conducted, and any constraints or limitations which might have affected the quality of the information obtained.

4.Biographical information concerning the individuals and organizations consulted, their particular expertise, and their historical and genealogical relationship to the project area, as well as information concerning the persons submitting information or interviewed, their particular knowledge and cultural expertise, if any, and their historical and genealogical relationship to the project area.

5.A discussion concerning historical and cultural source materials consulted, the institutions and repositories searched, and the level of effort undertaken. This discussion should include, if appropriate, the particular perspective of the authors, any opposing views, and any other relevant constraints, limitations or biases.

6.A discussion concerning the cultural resources, practices and beliefs identified, and, for resources and practices, their location within the broad geographical area in which the proposed action is located, as well as their direct or indirect significance or connection to the project site.

7.A discussion concerning the nature of the cultural practices and beliefs, and the significance of the cultural resources within the project area, affected directly or indirectly by the proposed project.

8.An explanation of confidential information that has been withheld from public disclosure in the assessment.

9.A discussion concerning any conflicting information in regard to identified cultural resources, practices and beliefs.

10.An analysis of the potential effect of any proposed physical alteration on cultural resources, practices or beliefs; the potential of the proposed action to isolate cultural resources, practices or beliefs from their setting; and the potential of the proposed action to introduce elements which may alter the setting in which cultural practices take place.

11.A bibliography of references, and attached records of interviews which were allowed to be disclosed.

The inclusion of this information will help make environmental assessments and environmental impact statements complete and meet the requirements of Chapter 343, HRS. If you have any questions, please call 586-4185.

APPENDIX D

Agreement to Participate in this Cultural Impact Assessment

Project Title: **Pulelehua Community**
Māhinahina Ahupua`a, District of Ka`anapali
[between Honoapi`ilani Hwy & Kapalua Airport
Maui Land & Pineapple
Investigator: Maria E. Ka`imipono Orr, M.A.

You are being asked to participate in a cultural impact assessment/study [CIS] conducted by an independent investigator contracted by *Maui Land & Pineapple Company* as part of a larger study of the proposed *Pulelehua Town*, "a compact, sustainable community" with mix uses and housing types, to be located on approximately 300 acres between Honoapi`ilani Hwy and Kapalua Airport in the Māhinahina Ahupua`a, District of Ka`anapali, Maui. This CIS will be included in a larger Environmental Assessment by *PBR Hawaii*. The investigator will explain the purpose of the study, the procedures to be used, the potential benefits and possible risks of participating. You may ask the investigator any question(s) in order to help you to understand the study or procedures. A basic explanation of the study is written below. If you then decide to participate in the study, please sign on the second page of this form. You will be given a copy of this form to keep.

I. Nature and Purpose of the Study

The purpose of this cultural impact assessment is to gather information about the project lands and vicinity in the Māhinahina Ahupua`a, District of Ka`anapali, through interviews with individuals who are knowledgeable about this area, and/or about traditional and historic information such as legends, songs, chants or other information. The objective of this study is to facilitate in the identification and location of any possible pre-historic and/or historic cultural resources, or traditional cultural practices in the area mentioned above, in accordance with applicable historic preservation laws, regulations, and guidelines, including:

Office of Environmental Quality Control [OEQC] *Guidelines and Act 50 HB2895* [A.D.2000], *HRS Chapter 343*

II. Explanation of Procedures

After you have voluntarily agreed to participate and have signed the consent page, the investigator will tape record your interview and transcribe it later. Data from the interview [ethnographic research] will be used as part of the background historical summary for this project. The investigator may also need to take notes and/or ask you to spell or clarify terms or names that are unclear.

III. Discomforts and Risks

Foreseeable discomforts and/or risks may include, but are not limited to the following: having to talk loudly for the recorder; being recorded and/or interviewed; providing information that may be used in reports which may be used in the future as a public reference; knowing that the information you give may conflict with information from others; your uncompensated dedication of time; possible miscommunication or misunderstanding in the transcribing of information; loss of privacy; and worry that your comment(s) may not be understood in the same way you understand them. It is not possible to identify all potential risks, however reasonable safeguards have been taken to minimize risks.

IV. Benefits

This study will give you the opportunity to express your thoughts (*mana`o*), and your opinions will be listened to and shared; your knowledge may be instrumental in the preservation of significant resources and information.

V. Confidentiality

Your rights of privacy, confidentiality and/or anonymity will be protected **if you so desire**. You may request, for example, that your name and/or sex not be mentioned in write-ups, such as field notes, on tape, on files (disk or folders), drafts, reports, and future works; or you may request that some of the information you provide remain "off-the-record" **and not be recorded in any way**. In order to ensure protection of your privacy, confidentiality and/or anonymity, you should immediately advise the investigator of your desires. The investigator will ask you to specify the method of protection, and note it on this form below.

VI. Refusal/Withdrawal

You may, at any time during the interview process, chose to not participate any further and ask the investigator for the tape and/or notes. Please note that you will be given an opportunity to review your transcript, and to revise or delete any part of the interview.

VII. Waiver

Part I: Agreement to Participate

I, _____, understand that Maria E. Ka'imipono Orr, an independent investigator contracted by Maui Land & Pineapple Company will be conducting oral history interviews with individuals knowledgeable about the project lands and vicinity, in the ahupua`a of Māhinahina, District of Ka`anapali, Maui. The oral history interviews are being conducted in order to collect information on possible pre-historic and/or historic cultural resources associated with these lands, as well as traditional cultural practices.

I understand I will be provided the opportunity to review my interview to ensure that it accurately depicts what I meant to say. **I also understand that if I don't return the revised transcripts after two weeks from date of receipt, my signature below will indicate my release of information for the draft report. I also understand that I will still have the opportunity to make revisions during the draft review process.**

_____ I am willing to participate.
_____ I am willing to participate, under the following conditions:

_____

Consultant Signature **Date**

_____

Print Name **Phone**

_____

Address

MAHALO NUI LOA

Part II: Personal Release of Interview Records

I, _____, have been interviewed by Maria E. Ka'imipono Orr, an independent investigator contracted by Maui Land & Pineapple Company. I have reviewed the written transcripts of tape recordings of the interview, and agree that said documentation is complete and accurate except for those matters specifically set forth below the heading "CLARIFICATION OR CORRECTIONS."

I further agree that Orr, Maui Land & Pineapple and/or PBR Hawaii. may use and release my identity and other interview information, both oral and written, for the purpose of using such information in a report to be made public, subject to my specific objections, to release as set forth below under the heading "SPECIFIC OBJECTIONS TO RELEASE OF INTERVIEW MATERIALS."

CLARIFICATION OR CORRECTIONS:

SPECIFIC OBJECTIONS TO RELEASE OF INTERVIEW MATERIALS:

_____

Consultant Signature **Date**

_____

Print Name **Phone**

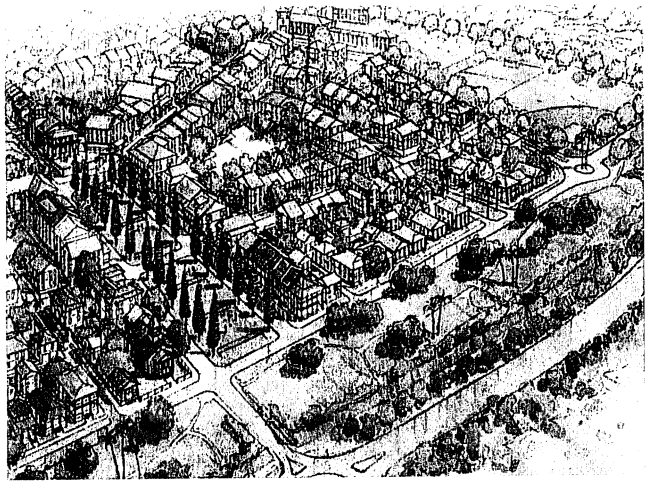
MAHALO NUI LOA

H

Transportation Report

PULELEHUA

TRANSPORTATION REPORT



Submitted to:

MAUI LAND & PINEAPPLE COMPANY, LTD.
1000 KAPALUA DRIVE
KAPALUA, MAUI, HI 96761

Prepared by:

Hall Planning & Engineering, Inc.
1237 North Adams Street
Tallahassee, FL 32303
(850) 222-2277

March 2, 2005

Transportation Report

For

The Town of Pulelehua

Prepared For

Maui Land & Pineapple Company, Ltd.
1000 Kapalua Drive
Kapalua, Maui, HI 96761

By

Hall Planning & Engineering, Inc.

1237 North Adams Street
Tallahassee, FL 32303
(850) 222-2277

March 2, 2005

EXECUTIVE SUMMARY

Project Description

Pulelehua, located mauka of Honoapiilani Highway in the Mahinahina area of West Maui, is a proposed walkable community designed following traditional town planning concepts. Pedestrian mobility is a key design assumption for this traditional style community. Walking will again be a way of life for people who move to Pulelehua.

All transportation design for Pulelehua assumes that pedestrian movement is the key function for the town's streets. In addition, cars and trucks fulfill an essential part of the traveler's day, in ways that do not threaten walkers and bicyclists. Pedestrian-friendly car and truck speeds of 15-30 mph are accomplished with **walkable thoroughfares** as described in detail in the body of this report.

Pulelehua will connect to existing development makai of the Honoapiilani Highway, increasing the level of walkability in this portion of West Maui. Pulelehua has a mix of land uses, including agricultural, conservation, residential, commercial and civic uses; this mix furthers the walkability of the town. Eight different dwelling types make up the 895 primary units. Additionally, as many as 318 Ohana units may be built in Pulelehua by future owners. Just under 175,000 square feet of live-work, mainstreet and edge commercial provide goods and services within walkable and bikeable distances for all Pulelehua residents. A variety of churches, schools and civic uses will round out the mix of land use. The total project area is approximately 312 acres. Pulelehua is scheduled to be built out by 2011.

Transportation Analysis Methods

This Transportation Report estimates the impacts of Pulelehua on the regional transportation system. It reviews the methods used to perform the transportation analysis, then describes Pulelehua in greater detail, including a complete description of the walkable thoroughfares transportation network.

Existing transportation conditions in the area are analyzed, followed by the most comprehensive analysis of West Maui's proposed future development to date. Twenty-four proposed projects are analyzed to estimate the "background" traffic growth; then Pulelehua's projected trips are determined and added to "background" traffic to evaluate the future traffic network.

Finally, the report summarizes the findings of the transportation analysis and makes recommendations for mitigating Pulelehua's transportation impacts. The outcome of each of these steps is summarized below.

Existing Conditions Summary

Pulelehua will occupy both sides of Akahele Street, mauka of the intersection with Honoapiilani Highway. These are both two-way, two-lane, undivided roads, with posted speeds of 30 mph and 45 mph, respectively. Honoapiilani Highway is intersected by several other roads in the vicinity of Pulelehua, including Napilihau Street, Hoohui Road, and Lower Honoapiilani Road.

Regarding current travel quality for the 11 segments along Honoapiilani Highway selected for more general analysis, from Office Road on the north to Aholo Road, south of Lahaina, all operate at or better than LOS C (level of service) with brief slowdowns during peak hours of the day. This is exclusive of traffic accidents that occasionally congest West Maui roads. Existing traffic counts and standard engineering analysis methods are the foundation of these conclusions.

Walkability is a key element of the transportation system for a traditional town such as Pulelehua. Currently, the Honoapiilani Highway corridor is pedestrian-unfriendly, due to a lack of sidewalks and relatively high traffic speeds. The area makai of the Akahele/Honoapiilani intersection on Lower Honoapiilani Road does display some walkable features, including sidewalks and crosswalks, but even in this area high speeds hamper pedestrian comfort.

Regional Impacts Summary

Due to a concern with overall traffic growth in West Maui, a comprehensive look at expected regional growth was undertaken in this study. The Transportation Report identifies 25 developments, including Pulelehua, that are projected to be built or under construction by 2011. Taking Pulelehua out of the mix, the traffic impacts of these developments were analyzed using generally accepted planning and engineering methods described in this report.

For the Honoapiilani Highway corridor, trip generation analysis determined that future projects would generate 1,765 new external trips during the AM peak hour and 1,736 new external trips during the PM peak hour. These non-Pulelehua trips impact Honoapiilani Highway as "background" traffic growth that is assumed to occur, with or without the construction of Pulelehua. The traffic analysis indicates that Honoapiilani Highway will continue to function adequately with these developments through the 2011 build out year.

The overall trip analysis for potential 2011 West Maui developments adds approximately 200 peak hour trips to Honoapiilani Highway. LOS analysis shows that sufficient capacity exists to absorb these new trips into the Honoapiilani corridor.

Pulelehua Transportation Analysis Summary

When built as planned, by 2011, Pulelehua will generate 745 new AM peak hour external trips, and 987 new PM peak hour external trips. These are conservative estimates, i.e., actual trip generation may be much lower. Due to the walkability of Pulelehua's traditional town plan, many of these trips will be captured on-site, rather than become external trips. Since the ITE (Institute of Transportation Engineers) trip-generation rates are based on data collected in suburbs where automobiles are essential for every trip, these rates underestimate the number of trips that will remain on-site in a walkable community such as Pulelehua, which in turn overestimates the number of trips that will travel the public roadway network, primarily Honoapiilani Highway. Below are several additional site-specific conditions which further contribute to the conservative estimate of trip generation:

- The unit count used in the report for Pulelehua assumes all 318 Ohana units that can be built by future residents will be built by 2011. However, these Ohana units will be constructed at the discretion of the lot purchaser, and it is unlikely that all 318 units will actually be built.

- Currently, some Kapalua employees reside outside of West Maui, and it is expected that a percentage of these employees will move to Pulelehua, reducing the vehicle trips on Honoapiilani Highway (based on information from Maui Land & Pineapple Company.) This work trip shift is not included in the analysis.

- Trips generated by Pulelehua parents taking their children to school may be overstated due to the on site elementary school.

- The Honoapiilani Highway four-laning and the Lahaina Bypass roadway projects programmed by the Hawaii Department of Transportation have been reviewed and considered in the preparation of this report. No construction schedule has been set for these projects, so their impacts have not been included. However, if constructed, these projects will have a mitigating effect on any Pulelehua transportation impacts.

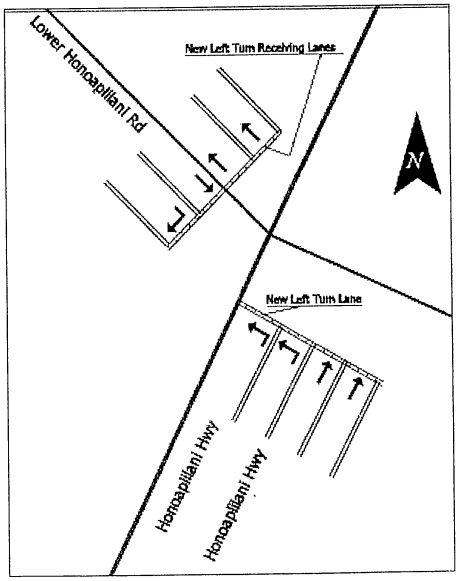
Findings Summary

The traffic analysis indicates that peak hour traffic will continue to operate at acceptable levels of service, as long as the following improvements are made:

- Maui Land & Pineapple Company will add four additional, non-signalized, well-spaced intersections along Honoapiilani Highway to adequately distribute in and outbound trips. Left turn storage lanes and right turn deceleration lanes will be included. These intersections are in the Pulelehua plan and vital to proper operation of both the traditional town street system and Honoapiilani Highway.

- The existing intersection at Honoapiilani Highway and Akahele Street is recommended as either a double-lane roundabout or a standard signalized intersection. The roundabout is more pedestrian-friendly and would provide greater walkability in the area at a later stage.

- If PM peak traffic reaches projected levels, the intersection of Lower Honoapiilani Road and Honoapiilani Highway will require an added left turn lane on the south approach due to the projected traffic queues for that



Intersection Improvements at Honoapiilani Hwy

movement. To receive the two lanes of turning traffic, an additional westbound lane would be needed on the west leg. The intersection diagram above illustrates this mitigation.

The Pulelehua community will change area traffic flow. However, estimates of future traffic indicate the community will not create adverse traffic conditions. To the contrary, the walkable community design pattern established for Pulelehua will encourage walking, biking and transit as added modes of travel that will support the motor vehicle travel mode. This increase in travel choices will increase overall mobility in this sector of West Maui.

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I. INTRODUCTION

A. Study Purpose

The purpose of this study is to identify and assess transportation requirements resulting from the Pulelehua community, planned for the Mahinahina area of West Maui. These requirements are presented in several ways. The importance of walking as a daily transportation option is discussed and the internal thoroughfares designed for Pulelehua are fully presented. Regarding external travel, future roundabout design features to assist with pedestrian connections across Honoapiilani Highway are explained. Based on transportation analysis and network design, other external street recommendations are provided for future implementation.

B. Study Scope/Methodology

To estimate project transportation requirements, this study includes the following data development and analysis steps:

1) Evaluation and specification of internal thoroughfare design to meet walkability goals.
2) Evaluation of current roadway and existing traffic operations were conducted through the collection of data regarding traffic volumes and signal timing on Honoapiilani Highway and intersecting roads between Aholo Road and Office Road.
3) Transportation analysis, includes the following tasks:
   a) Generate trips based on land uses planned for Pulelehua build out in 2011.
   b) Determine which trips will actually stay on-site (internal capture) and which trips will use the road network in traveling to a different location. Local land use patterns were studied through a review of proposed plans and interviews with local police and observations of traffic patterns. Additional data collection included traffic counts and signal timing studies.
   c) Determine the internal capture rate. Not all trips generated by an on site land use will yield automobile trips on the external roadway network. Some individuals will travel to other on-site land uses. Still others will travel by walking or bicycling instead of by automobile. The "internal capture" rate is applied to account for those trips not loaded to the roadway network. Pulelehua is built with walkability as a primary consideration, so a higher than average internal capture rate of 30% is expected which should yield a more conservative estimate of traffic loadings. For the entire analysis, internal capture rates ranged from 0%, for standard subdivisions, to 25%, for mixed use sites expecting high capture.
   d) Distribute the trips along the roadway network using generally accepted analysis methods, informed by experience, local knowledge and observation of traveler behavior.
4) Evaluation of future external roadway network operations "after" project trips are added (using the same procedures described in (3) above.)
5) Development of recommended improvements, where necessary, to mitigate external project impacts. Not all impacts require mitigation. Impacts are evaluated by the extent to which they are both "significant" and "adverse".

"Significant" means that Pulelehua related trips increase at an intersection or street segment by more than 1-5% by the time of project buildout. Significant means that the increase in trips is attributable to Pulelehua specifically, and not simply due to the growth in background traffic. "Adverse" means the arterial section is below LOS "D". For a roadway segment or intersection to merit mitigation by Pulelehua, the impact must be both significant and adverse.

C. Key Terms and Concepts

Generally accepted traffic analysis procedures are applied to determine how well public streets will operate after new trips are added to the surrounding network. The approximate level of service for motor vehicles traveling on area roadways is estimated and reported by arterial section. Intersections control this flow quality for arterial roadways like Honoapiilani Highway. General ranges of the LOS (Level of Service) grades are listed below.

1. Level of Service Concept

"Level of Service" is a term which quantifies a number of traffic operating conditions that may occur on a given lane or roadway when it is subjected to certain traffic speeds and volumes. Level of service (LOS) is a qualitative measure of the effect of a number of factors which include speed, travel time, traffic interruptions, freedom to maneuver, safety, driving comfort and convenience.

There are six levels of service, A through F, which relate to driving conditions from best to worst, respectively. The characteristics of traffic operations for each level of service are summarized in **Table 1**. In general, LOS A represents free-flow conditions with no congestion. LOS F, on the other hand, represents severe congestion with stop-and-go conditions. Level of service D is typically considered acceptable for peak hour conditions in urban areas.

There is a common misconception that LOS designations are like school grades, in which D is worse than C, C is worse than B, and A is best of all. In fact, however, LOS C or D is actually a more desirable LOS than A or B in most communities. This is because roads are very expensive to build, and once built, they must be heavily used in order to help justify the cost of their construction.

A road that operates at LOS A is really a road that has been over-built for local traffic conditions. Even during peak traffic hours, a road at LOS A carries only a fraction of its vehicle capacity, which is a highly inefficient use of scarce transportation funding. A road at LOS A is like throwing a banquet for 20 people, and having only 5 guests arrive – there will be a lot of waste that could probably have been put to better use elsewhere.

A road at LOS C or D, on the other hand, carries a lot of trips for its size and represents a more efficient use of transportation funding. At this LOS, the road will be congested during peak travel times, but will also carry a measurable

amount of traffic during off-peak times as well. Such roads represent a better fit between the desire to travel freely on the road and the expense of building new roads. For this reason, many communities adopt LOS D as their standard LOS for roads and streets.

Table 1: Level of Service Definitions for Urban Arterial Segments

Level of Service	Interpretation	% of Free Flow Speed	Signal Delay Time (Seconds)
A	Vehicles completely unimpeded in ability to maneuver w/in traffic stream. Signal delay minimal.	>90%	< 10.0
B	Ability to maneuver in traffic stream slightly restricted, signal delays not significant.	70%-90%	10-20
C	Ability to maneuver and change lanes more restricted than LOS B; longer queues at signals.	50%-70%	20-35
D	Range at which small increases in flow may cause substantial increases in delay and decreases in travel speed. Signal progression and timing become important factors in maintaining flow.	40%-50%	35-55
E	Significant delays at critical intersection; ability to maneuver highly restricted.	33%-40%	55-80
F	Urban street flow at extremely low speeds. Extensive queuing at intersections, long delays, high volumes.	> 33%	> 80.0

Source: *Highway Capacity Manual, 2000*

2. Arterial Level of Service Methodology

To estimate the effect of project trips on Honoapiilani Highway, two types of arterial level of service analysis were performed: one utilizing *Synchro 6.0* (Trafficware, Inc.) and the other using ARTPLAN, developed by Florida DOT.

Synchro analyzes a large data base of traffic and roadway characteristics, simulates traffic flow using nationally accepted formulae and design practice and finally produces estimates of traffic delay and performance of the arterial highway and its component intersections. Input data include signal location, directional turns, seconds of green time by phase, cycle length and many other items. The resulting information can be summarized to report the level of service achieved on the section of arterial.

ARTPLAN, a simplified LOS tool that also uses Highway Capacity Manual procedures, has assumptions that allow for LOS analysis when only limited data are available. ARTPLAN is applied to the sections of Honoapiilani Highway near Lahaina.

Synchro Procedure

To determine Honoapiilani Highway arterial level of service, eight *Synchro* runs were performed. Two initial runs tested the 2004 existing conditions for AM and PM. Six other runs tested the AM and PM periods, with and without Pulelehua. *Synchro* runs for the existing conditions are year 2004 for the base and for the future projects are year 2011 for the base. The runs are:

- AM Peak Hour Existing Conditions 2004
- PM Peak Hour Existing Conditions 2004
- AM Peak Hour Future Projects 2011, Future Projects w/o Pulelehua w/Akahele Signal
- PM Peak Hour Future Projects 2011, Future Projects w/o Pulelehua w/Akahele Signal
- AM Peak Hour Future Projects w/Pulelehua with the Akahele roundabout 2011
- PM Peak Hour Future Projects w/Pulelehua with Akahele roundabout 2011
- AM Peak Hour Future Projects w/Pulelehua with Akahele traffic signal 2011
- PM Peak Hour Future Projects w/Pulelehua with Akahele traffic signal 2011

Synchro runs were based on the following procedural steps:

- Current through and turn movements are the foundation of the traffic operations analysis
- Current traffic signal timing is added, including phasing and times in seconds
- AM Peak Hour and PM Peak Hour background trips are determined from base counts

II. PULELEHUA PROJECT SUMMARY

A. Location

Pulelehua site is located in the Mahinahina area of West Maui, mauka of Honoapiilani Highway (see **Figure 1**).

B. Character and Design

Pulelehua will provide a substantial number of affordable, moderately priced homes for the working families of West Maui and has been designed as a walkable community following traditional town planning concepts. Pulelehua is characterized by a rich mix of land uses, including agricultural, conservation, residential, commercial and civic uses. The total project area is approximately 312 acres in size, and Pulelehua will include 882 homes with the potential for 318 Ohana units, over 174,000 square feet of commercial space (divided among main street, live-work, and workplace edge uses), a wellness center, civic uses, places of worship, and a school. Many of the primary necessities for daily life can be found somewhere in Pulelehua.

Transportation issues related to the Pulelehua Master Plan fall into two categories; 1) internal street design standards and 2) external travel requirements as project trips blend with the surrounding street system. The internal street design standards are addressed below; external travel requirements will be addressed in Section III.

C. Internal Street Design Standards

Pedestrian mobility is a key design assumption for this traditional style community. Walking will again be a way of life for residents of Pulelehua. As **Figure 2** indicates, Pulelehua is not planned as a contemporary patterned community, but as a walkable town. All transportation design for Pulelehua assumes that pedestrian movement is the key function for the town's streets. Motor vehicle mobility is also an important street function, but no design decision favors the vehicle at the expense of reasonable pedestrian comfort and safety. For this reason, some of the standard suburban street design features that encourage higher travel speeds have been modified to match the design safety requirements for pedestrian friendly environments. Pedestrians flourish where vehicle speeds are lower, thus mobility is encouraged through design speeds that range from 15 to 30 miles per hour. These speeds are accomplished through design features known as **walkable thoroughfares (Figure 3)**.

Walkable thoroughfares are described in greater detail below, but their primary purpose is to serve pedestrian mobility. To the extent that pedestrian mobility is not impaired, walkable thoroughfares also serve motor vehicle mobility, and they in fact form the automobile road system within Pulelehua. With the stated functional emphasis on pedestrian mobility, design/posted speed is the controlling design consideration for the width of the walkable thoroughfares. In contrast, contemporary transportation planning looks to estimates of future vehicle demand to determine roadway width.

Therefore, internal street design elements within the Pulelehua master plan require slightly narrower dimensions than contemporary County practice. Several street dimensions from the County regulations contrast with the Pulelehua master plan dimensions, as shown in **Table 2**, below. The table compares the Urban Collector Street and Urban Minor Street dimensions with Pulelehua's street system. Specifically, street widths and parking lanes in the master plan are narrower than the dimensions called for in the Maui County Subdivision Regulations, Chapter 18-16.

More thoroughfares are specified in the Pulelehua Plan and they are specifically designed to serve pedestrian mobility by achieving lower, safer, motor vehicle speeds within the community. This is often called traffic calming by design, thus preventing the need to install traffic humps and other devices later. Short block faces and parallel parking on most streets allow more efficient use of paved surfaces. Short blocks, buildings closer to the sidewalk, and on street parking, all contribute to the traditional traffic calming effect.

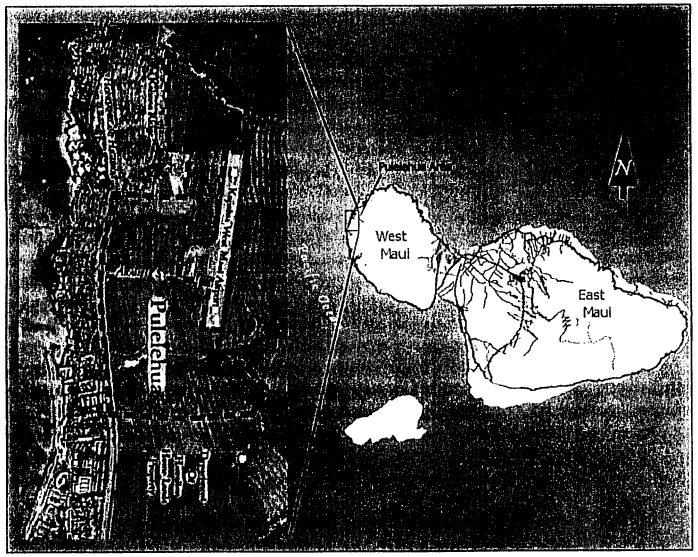


Figure 1: Site Map for Pulelehua

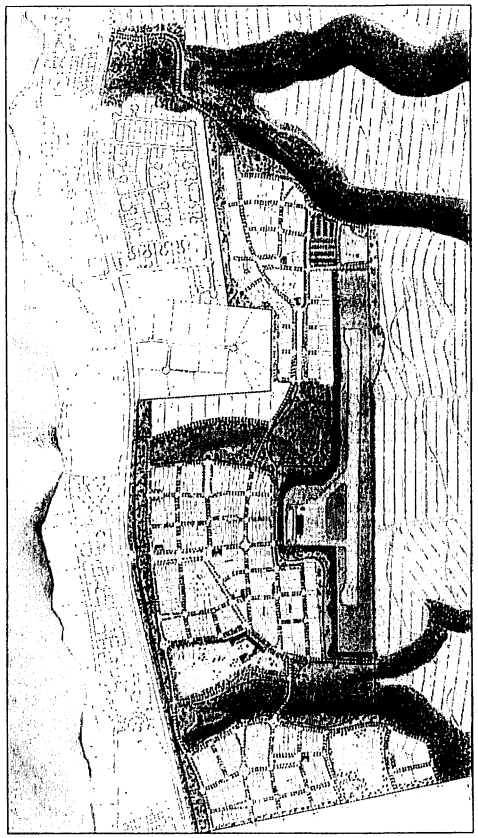


Figure 2: Plan of Pulelehua

Table 2: Street Dimension Comparison

Street Types	ROW	Pavement Width	Traffic Lane	Parking Lane
Maui County Code, Ch. 18-16				
Urban Collector Streets	56'	36'	10'	8'
Urban Minor Streets	44'	28'	10'	8'
Pulelehua Plan				
Avenue	Varies	17'per side	10'	7'
Main Street	64'	34'	10'	7'
Street	44'	32'	9'	7'
Drive w/ Parking	57'	23'	8'	7'
Drive w/o Parking	50'	16'	8'	NA

These walkable thoroughfare designs are not intended for use in communities with contemporary patterns and features. Areas designed with cul-de-sacs, single land use types (such as residential only), garages facing the street, and long dead end streets encourage higher vehicle speeds, not walking. The higher vehicle speeds in contemporary subdivisions require wider streets. Thoroughfares designed using traditional, more narrow dimensions, however, will only function properly within developments adhering to Traditional Neighborhood Design (TND) patterns, such as Pulelehua.

Figure 3: Pulelehua will have Walkable Thoroughfares

New, walkable thoroughfare definitions should be adopted for the Pulelehua community. Transportation design engineers will have greater professional guidance when implementing the thoroughfares if the County Council adopts the Walkable Thoroughfare Definitions, which will be included as the Project District Ordinance for Pulelehua. For the purpose of this Transportation Report, a description of Walkable Thoroughfares is included below.

Walkable TND Thoroughfares

The primary purpose of Walkable Thoroughfares is to serve pedestrian mobility and, to the extent that pedestrian mobility is not impaired, to also serve motor vehicle mobility. Pedestrians flourish where vehicle speeds are lower, thus mobility is encouraged through design speeds that range from 15 to 30 miles per hour. With the stated functional emphasis on pedestrian mobility, design/posted speed becomes the

controlling design consideration for walkable thoroughfares. In contrast, contemporary transportation planning looks to estimates of future vehicle demand to determine roadway width.

Thoroughfares within walkable districts are built to either two or (in rare instances) four lanes. Higher demand is handled by an increased number of streets and reliance on walking, biking and transit to help handle total future travel demand. On-street parking and sidewalks are the standard, not the exception, and the grid pattern allows multiple ways to get to a destination. Landscaping, building frontage, drainage and parking intensity are designed based on area context. These functionally classified thoroughfares, serving pedestrians, are in contrast to the functionally classified roadways established to primarily serve motor vehicle mobility.

Walkable Thoroughfare Definitions

Lane – A traditional, walkable thoroughfare serving the pedestrian mobility and access needs at the rear of residential units in areas other than the town center. Other functions include trash removal and utility service. Utilities are usually placed in lanes. Drainage runs to swales with grass strips at the edges of the travel way. Pavement is generally 9 to 12 feet wide with two way "yield street" traffic flow at 10 to 15 mph. Windows facing the lane are essential to security. **Figure 4** illustrates a Pulelehua Rear Lane section.

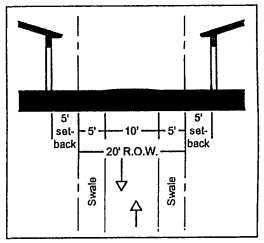


Figure 4: Rear Lane Section

Alley – A traditional, pedestrian scale thoroughfare serving working functions of loading, service and employee pedestrian access at the rear of commercial buildings. Utilities are usually placed in alleys. Ornamentation is minimal to reduce costs. Subsurface drainage allows full pavement from wall to wall. Windows must open to alleys to provide higher security. **Figure 5** illustrates a Pulelehua Alley section.

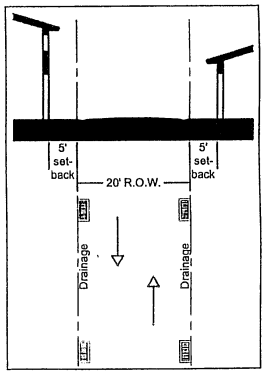


Figure 5: Alley Section

Road – A general traditional thoroughfare at the edge of a community or in a rural setting. Typically, parking is not adjacent to the travel way and curbs are rare; storm water drains to a swale. Pedestrian mobility is secondary. **Figure 6** illustrates a Pulelehua Road section.

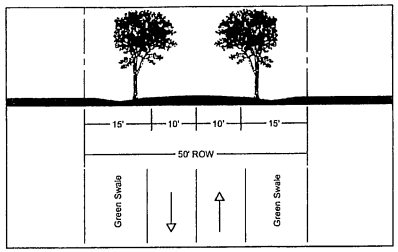


Figure 6: Road Section

Drive – A special traditional thoroughfare serving pedestrian mobility, similar to a Street, with developed, urban character on one side and natural area on the other (such as a gulch). Auto mobility is secondary. **Figure 7** illustrates a Pulelehua Drive section.

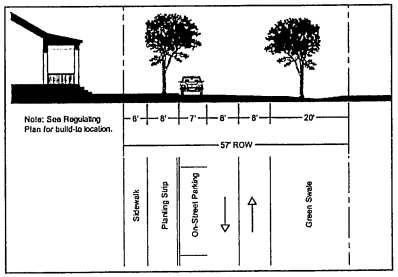


Figure 7: Drive Section

Street – A general, traditional thoroughfare serving pedestrian mobility, with two or four travel lanes and parking generally on one or two sides. Motor vehicle mobility is vital, but subordinate to pedestrian mobility. **Figure 8** illustrates a Pulelehua Street section.

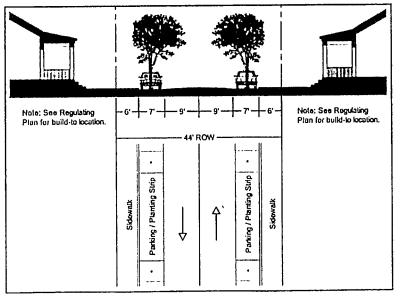


Figure 8: Street Section

Main Street – A traditional, pedestrian serving thoroughfare with features that encourage pedestrian movement, serving a compact mix of land uses, potentially including retail, office and residential. Main Streets have parallel parking on both sides and, where the uses are more compact and activity is more intense, angle (or diagonal) parking is specified. Buildings front the sidewalk to optimize pedestrian access to commercial establishments. Motor vehicle mobility is important, but subordinate to pedestrian mobility. **Figure 9** illustrates a Pulelehua Main Street section.

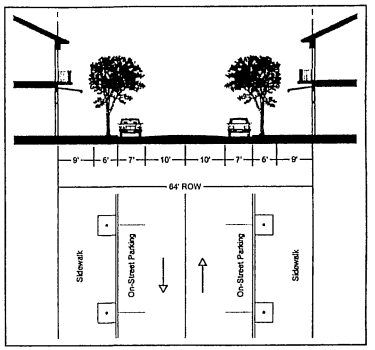


Figure 9: Main Street Section

Avenue – A principal traditional thoroughfare designed to encourage pedestrian mobility and connecting centers within communities. Avenues generally serve multiple land uses and have center medians, street trees, sidewalks and parallel parking. Buildings front the sidewalk to optimize pedestrian access and mobility. Auto mobility is secondary. **Figure 10** illustrates a Pulelehua Avenue section.

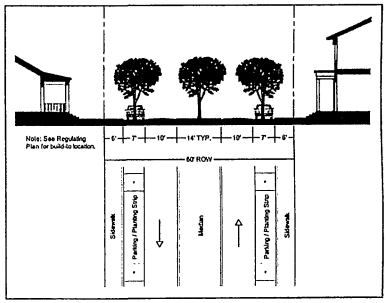


Figure 10: Avenue Section

III. EXISTING CONDTITIONS

A. General Walkability

Access to and from the Pulelehua community is primarily through Honoapiilani Highway, the primary arterial roadway in the region. The main intersection is located at Akahele Street. Neither road includes sidewalks.

Design issues external to Pulelehua center on the future character of Honoapiilani Highway. When development existed only on the makai side of the highway, traffic speed posed a less serious problem for pedestrian mobility. Now that urban development, in a walkable pattern, is occurring on the mauka side as well, through the development of Pulelehua, certain elements of the highway must be adapted, in a context sensitive way, to accommodate increased pedestrian crossings. Fundamentally, vehicle speeds must be controlled where pedestrians and bicyclists cross to and from the makai (west) side.

B. Area Roadway System

In Pulelehua's vicinity, Honoapiilani Highway is a two-way, two-lane facility (undivided) with a 45 mph posted speed with most vehicles actually running at higher speeds, based on observations made by Hall Planning & Engineering (HPE). The Pulelehua site is bisected by Akahele Street, a two-way, two-lane State of Hawaii street with a 30 mph posted speed. The Honoapiilani Highway/Akahele Street intersection is signalized and has auxiliary right turn lanes on all approaches. **Figure 11**, below, is a photograph of this intersection. **Figure 12**, below, illustrates the intersections along the Honoapiilani Highway that were used as segment endpoints for the analysis. Additional roads, such as Lahainaluna Road, that are not shown on this figure were included in the appropriate segment for analysis.

The Honoapiilani Highway intersections closest to Pulelehua include the following:

- Napilihau Street - North of Akahele Street, two-way; two-lane; 20 mph posted speed; Maui County facility; signalized intersection (Number 10 in **Figure 12**)
- Hoohui Road - North of Akahele Street, two-way; two-lane; 20 mph posted speed; private road; signalized intersection (Number 9 in **Figure 12**)
- Akahele Street – Bisects Pulelehua. As described above, this is two-lane, two-way; 30 mph posted speed; State facility; signalized intersection (Number 8 in **Figure 12.**)
- Lower Honoapiilani Road - South of Akahele Street, two-way; two-lane; Maui County facility; signalized intersection (Number 7 in **Figure 12**)

These are the primary intersections likely to be affected by Pulelehua.

C. Traffic Counts

Honoapiilani Highway intersection turning movement counts were utilized in the analysis of Pulelehua traffic impacts. AM and PM peak hour intersection turning movement counts were conducted for the following Honoapiilani Highway intersections by Phillip Rowell and Associates on May 14-17, 2004:

- Napilihau Street
- Hoohui Road
- Akahele Street
- Kaanapali Parkway
- Leialii Parkway

Office Road intersection AM and PM peak hour turning movements were projected to 2004 from 2001 estimates by Parsons Brinckerhoff.

Lower Honoapiilani Road AM and PM peak hour turning movement counts were conducted on October 6-7, 2004, by LSC Transportation Consultants, Inc.

D. 2004 LOS Analysis

Currently, the Honoapiilani Highway, close to the Pulelehua site, operates well in the critical peak hours. Key intersections along this section of Honoapiilani Highway do not experience high delay values. The PM peak hour design traffic level is generally assumed as the 30th highest hour of the 2004 year. *Synchro* analysis, with current traffic counts and optimized signal timings, show level of service "A" for the arterial sections studied, except for the sections between Hoohui Road, Akahele Street and Lower Honoapiilani Highway, which have a Level Of Service "B". Intersections along this section experience maximum delay of 33.1 seconds and maximum mainline V/C ratio of 0.89. The full set of existing condition *Synchro* reports are located in Appendices B and C.

A traffic operations summary is provided in **Table 3**. The summary shows the 2004 performance of the intersections of Honoapiilani Highway and Napilihau Street, Hoohui Road, and Akahele Street during the PM peak hours. These are the intersections and highway segments closest to the Pulelehua site.

Table 3: LOS Summary 2004 Honoapiilani Highway Near Pulelehua

Honoapiilani Hwy Signalized Intersection	Signal Delay	Arterial Speed	Arterial LOS PMHr/Pk Dir (SB)	Intersection LOS PM
Lower Honoapiilani Road	33.1	34.1	B	C
Akahele St.	17.2	33.3	B	B
Hoohui Rd.	6.2	42.1	A	B
Napilihau St.	13.7	39.4	A	B
TOTAL	**70.2**	**37.3**	**A**	**N/A**

The highest intersection delay is Lower Honoapiilani Highway at Honoapiilani Highway with an average signal delay of 33.1 seconds. A 40 second delay is deemed acceptable. Running speeds are also high at a total of 37.3 mph for the entire segment in the peak direction.

Another intersection of local concern is Lahainaluna at Honoapiilani Highway, located approximately 6.5 miles south of Pulelehua. This intersection is included in the arterial level of service analysis for the southern part of Honoapiilani Highway, covered in Sections IV and VI of this report. The arterial level of service indicates that while congestion exists at this intersection today and will continue to exist in the future, Pulelehua will not contribute significantly to that congestion.

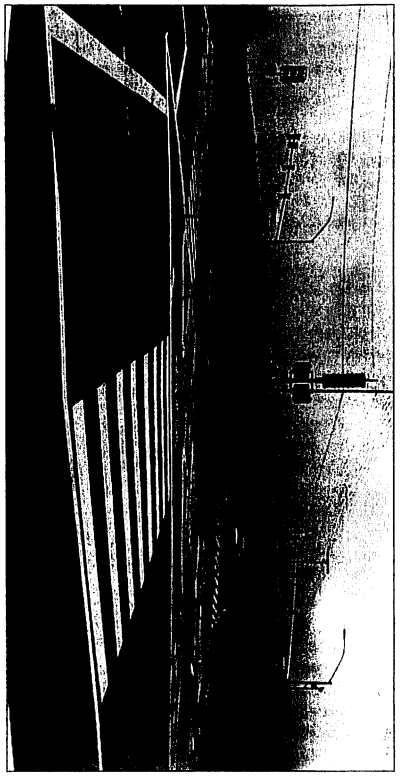


Figure 11: Channelized Intersections at Akahele Street and Honoapiilani Highway

IV. TRANSPORTATION ANALYSIS OF FUTURE REGIONAL DEVELOPMENT

A. West Maui Traffic Growth

Several methods are available to forecast future traffic levels within a region, including past trends methods and comprehensive methods. Traditionally, the "past trends" analysis methods have employed historical traffic count data to establish a growth rate for use in extrapolating current counts. This past trends method is effective when future growth rates are expected to match past growth levels. While past trends projections are often valid, the recent surge in total projected growth in the greater West Maui area calls for a more comprehensive analysis. A comprehensive look at West Maui growth was undertaken for this report and is described in the balance of the report. The results of the past trends method are described first, below.

1. Traffic Growth: Past Trends Method

For comparative purposes only, the past trends analysis was calculated for a section of the Honoapiilani Highway near Pulelehua. A primary indicator of past traffic growth trends in the area is derived from historical Hawaii DOT records. Analysis performed by the Wilson Okamoto Corporation in their April 2004 report for Maui Preparatory Academy used data from HDOT count station number C-12-F located at Honoapiilani Highway at Napilihau Street. An annual growth rate of 2.76 percent was calculated for 2004 to 2005, 2.66 percent was calculated for 2005 to 2011, and 2.50 percent was calculated to the year 2013. Thus, the past trends analysis yields an overall growth rate of 1.18 for traffic increases from 2004 to assumed Pulelehua buildout in 2011 (1 year x 2.76% + 3 years x 2.66% + 3 years x 2.50% = 18.24% or a factor of 1.18).

See **Table 4** and **Appendix L** for traffic count details. The table shows the current traffic, projected traffic in 2011 without Pulelehua ("background traffic"), and projected growth in 2011 with Pulelehua. This information is presented for the Northbound (NB) and Southbound (SB) through movements for each of three key intersections with Honoapiilani Highway – Napilihau Street, Hoohui Road, and Akahele Street, for both the AM and PM peak hours.

This simple methodology results in somewhat lower growth projections than the West Maui Comprehensive analysis based on 24 other development projects. **Table 4** shows a range of background traffic increases from approximately 50 to 150 peak hour trips from 2004 to 2011. The Comprehensive West Maui growth projections, described in subsequent sections, yields a traffic growth range of approximately 200 to 300 peak hour trips in this section of Honoapiilani Highway.

Figure 12: Intersections Marking the Endpoints of Highway Segments Used in Trip Distribution Analysis

Table 4: Past Trends Honoapiilani Highway Traffic Projections at Selected Intersections

Honoapiilani Highway Intersection	2004 Background Traffic		2011 Background Traffic (2004 x 1.18)		2011 Background + Pulelehua Traffic	
	AM Pk Hr	PM Pk Hr	AM Pk Hr	PM Pk Hr	AM Pk Hr	PM Pk Hr
Napilihau Street						
North Bound (NB) Thru	261	218	308	257	478	405
South Bound (SB) Thru	155	312	183	368	261	537
Hoohui Road						
North Bound (NB) Thru	453	498	535	588	694	743
South Bound (SB) Thru	360	490	424	578	530	768
Akahele Street						
North Bound (NB) Thru	517	800	610	944	709	1,063
South Bound (SB) Thru	624	855	736	1,009	799	1,115

2. Traffic Growth: Comprehensive Method – Review of Proposed Developments

To achieve a more complete picture of West Maui's traffic growth, future new developments were investigated, involving a comprehensive traffic analysis procedure having three major steps:

a. Review of proposed developments for likelihood of construction by 2011
b. Generation of potential AM and PM peak hour travel
c. Distribution of peak hour trips along Honoapiilani Highway

After extensive screening of known development proposals, HPE analyzed the potential impact of twenty-five projects---including Pulelehua---planned for development in West Maui by the Pulelehua assumed buildout year of 2011 (see **Table 5,** which is a summary of the West Maui Future Projects). The table assigns a project reference number to each project and indicates the project name, location, proposed buildout size (in lots, Square Feet (SF) or dwelling units), and estimated level of development by 2011. First, a determination was made whether developments will be open in 2011. Then, the expected number of units and floor area were estimated based on the best information available and confirmed by the County Planning Department.

These projects were reviewed in detail to determine their contribution to AM and PM peak traffic flow on Honoapiilani Highway. As a result of this analysis, traffic along portions of Honoapiilani Highway is expected to increase at a rate somewhat higher than the historic rate of 18% growth projected using past trends analysis. The degree of difference varies depending on the type and scale of the development associated with a given segment of the highway.

Table 5: Summary of West Maui Projects

Project #	Project Name	Location	Proposed Buildout	Estimated Development by 2011
1	Honolua Ridge	North of Kapalua	Phases I & II; 49 SF lots	25 units
2	Kapalua Mauka	Kapalua; mauka of Honoapiilani Hwy.	690 units; 390 SF; 300 MF most units resort residential	75 SF 90 MF
3	Pailolo	North Kahana/Napili	25 SF units	25 SF units
4	Maui Preparatory Academy	Mauka of Honoapiilani Hwy; Mahinahina area	540 students; pre-K to Grade 12	540 students; pre-K to Grade 12
5	Villas at Kahana Ridge	Kahana Ridge	117 MF units	117 MF units
6	Pulelehua	Mahinahina mauka of Honoapiilani Hwy	882 mixed residential units; 318 potential Ohana units, commercial, public. (1,218 units residential units were assumed for the transportation analysis, based on initial development scenarios)	882 mixed residential units; 318 potential Ohana units, commercial, public. (1,218 units residential units were assumed for the transportation analysis, based on initial development scenarios))
7	Maui Breakers	Mahinahina	90 MF units	90 MF units
8	DHHL Honokowai	Honokowai/next to Pulelehua	411 SF units	0 units
9	Marriott expansion	Kaanapali	303 addl. timeshare units; 336 fewer hotel rooms	457 timeshare units; 55 hotel rooms
10	Hyatt expansion	Kaanapali	173 lockout units and 153 timeshare	153 timeshare and 43 lockout units
11	Kihune	Napili	20 MF units	20 MF units
12	Intrawest	North Beach Lot 4	700 MF units	700 MF units

Project #	Project Name	Location	Proposed Buildout	Estimated Development by 2011
13	Ka'anapali 2020	Kaanapali; mauka of Honoapiilani Hwy.	1,257 SF; 1,163 MF; 390 mixed-use MF; commercial; public; golf	200 SF; 200 MF
14	Starwood	North Beach Lot 2	258 MF units + 258 lockout units	258 MF units + 65 lockout units
15	Palisades at Ka'anapali	Kaanapali mauka of Honoapiilani Hwy,	132 SF units	132 SF units
16	Land Tech	Kaanapali	18 SF units	18 SF units
17	Villages at Leialii	West Maui	4,846 units; 2006 SF 2840 MF	104 SF
18	West Maui Resource Center -- Phase II	Above Lahaina Regional Park	16 units transitional housing; 10 units long-term housing	26 units
19	Lokahi Pacific	Lahaina	12 SF units	12 SF units
20	Wainee Village	Lahaina mauka of Honoapiilani Hwy	575 units; 400 SF; 175 MF	100 SF; 60 MF
21	Plantation Inn	Lahaina	14 MF units	14 MF units
22	Puunoa Village	Lahaina, mauka of Honoapiilani Hwy	268 SF units	0 units
23	Makila	Launiupoko	40 SF units + 40 Ohana units	40 SF units + 40 Ohana units
24	Olowalu	Olowalu	20 SF units + 20 Ohana units	20 SF units + 20 Ohana units
25	Ukumehame	Ukumehame	46 SF units + 46 Ohana units	46 SF units + 46 Ohana units

More specifically these new developments include the following (arranged in order from north to south):

1. *Honolua Ridge*

   Honoula Ridge is located north of Kapalua and will consist of 49 single-family detached dwelling units constructed in two phases. It is estimated 25 dwelling units will be constructed by 2011. This is a single use development. No internal capture is expected.

2. *Kapalua Mauka*

   The Kapalua Mauka development will occupy 925 acres on the mauka side of Honoapillani Highway. The 690 dwelling unit project will be comprised of

180 single-family rural lots on 275.3 acres, 510 single and multiple family units on 515 acres of urban land, commercial uses, and 18 holes of golf. Primary access will be via a main entrance opposite Office Road and Honoapiilani Highway. A 20-year buildout period is expected.

It is estimated 75 single family and 90 multifamily units will be constructed by 2011.

Project data and traffic projections were drawn from the Traffic Impact Assessment Report for Kapalua PD-2 Development (Parsons Brinkerhoff; December, 2001)

3. *Pailolo (formerly Pu'u Kahana)*

   Pu'u Kahana is located in North Kahana/Napili and will consist of 25 single family dwelling units. Development completion is expected prior to 2011.

4. *Maui Preparatory Academy*

   This project will occupy a 15 acre site on the mauka side of Honoapiilani Highway. The first phase is planned to open in Fall 2005, with an anticipated enrollment of 90 students in grades 6, 7 and 8. In 2007, four classes of pre-Kindergarten will be added, and in 2011, an additional primary grade (36 students) will be added. The school is expected to add an additional primary grade level each succeeding year to reach full enrollment of 540 students by 2013 in grades pre-Kindergarten through grade 12.

   2011 AM and PM peak hour trips were estimated by determining the average annual growth rate of trips projected from 2008 to 2013, and then applying that growth rate to the intervening years to 2011.

   Project data and traffic projections were drawn from the Traffic Impact Report for Maui Preparatory Academy (Wilson Okamoto Corporation; April, 2004)

5. *Villas at Kahana Ridge*

   This development is located at Kahana Ridge and will consist of 117 multiple-family dwellings. These units are under construction now and are expected to be completed by 2005.

   Because this is a single use development, no internal capture is expected.

6. *Pulelehua*

   Project data and traffic projections were drawn from the Pulelehua-specific sections of this report.

7. *Maui Breakers*

Project is located makai the highway between Pulelehua and DHHL Honokowai. It currently has 24 condominium units and plans to add 90 units in Phase I. The trip generation figures for this development were taken from the Nov. 8, 2004 transportation analysis conducted by LSC Transportation Consultants, Inc.

8. *DHHL Honokowai*

DHHL Honokowai is located adjacent to Pulelehua and will consist of 411 single-family dwelling units. It is estimated these units will not be constructed by 2011.

9. *Marriott Expansion*

This is an addition of the Marriott Hotel to the Marriott Ocean Club at Kaanapali. The project is located along the makai side of Nohea Kai Drive.

As proposed, the project will consist of 457 timeshare units and an estimated 55 "lock out" units for a new total 512 units. The result is that AM and PM peak hour trip generation increases only marginally.

Project data and traffic projections were drawn from the Traffic Impact Assessment Report for Maui Marriott Ocean Club (Philip Rowell and Associates; December 10, 2002)

10. *Hyatt Expansion*

This is an expansion of an existing Hyatt development located at Kaanapali and consisting of 153 timeshare units and 173 lock-out units. For this traffic analysis, it was estimated 25% of the lock-out units would be occupied (43 units) for a total 196 occupied dwelling units. Due to the resort nature of this development, 25% internal capture is assumed.

11. *Kihune*

The Kihune development is located in Napili and consists of 20 multiple-family dwelling units. Project completion is expected by 2011. Due to the single use character, no internal capture is expected.

12. *Intrawest*

The Intrawest development is located at North Beach (Lot 4) and consists of 700 multiple-family dwelling units. All dwelling units are expected to be completed by 2011. Due to the resort nature of this area, 25% internal capture is assumed.

13. *Ka'anapali 2020*

This 4,000 acre project is also located on the mauka side of Honoapiilani Highway. Ka'anapali 2020 is expected to be implemented over a 25-year buildout period. Included is a mix of residential, recreational, open space, golf course, public/quasi public and commercial uses. Present plans show 1,257 single family units, 1,163 multi-family units, and 390 mixed use/multiple-family units.

It is estimated 200 single family and 200 multiple family units will be constructed by 2011.

14. *Starwood*

Starwood is located at North Beach (Lot 2) and consists of 258 multiple family dwelling units and 258 lockout units. Project completion is expected prior to 2011. For this analysis, it is assumed 25% (65) of the lock-out units will be occupied, yielding 323 total occupied units. Due to the resort nature of this area, 25% internal capture is assumed.

15. *Palisades at Kaannapali*

The Palisades at Kaannapali project is located mauka of Honoapiilani Highway, across from Kaanapali Resort. It consists of 132 single-family dwelling units, constructed in several phases, with an estimated completion by 2010. This is a curvilinear, suburban-style single use development. No internal capture is expected.

16. *Land Tech*

Land Tech is an 18 single-family dwelling unit project located in Kaanapali. Completion is expected by 2011. Due to the coastal resort nature of this area, 25% internal capture is assumed.

17. *Villages at Leialii*

The Villages at Leialii project is located in West Maui and, at buildout, is planned for a total 4,846 dwelling units; 2,006 single-family and 2,840 multiple family. By 2011, it is estimated 104 single-family dwelling units will be constructed. Due to the single use nature of this project (by 2011), no internal capture is utilized.

18. *West Maui Resource Center Phase II*

West Maui Resource Center Phase II is located above Lahaina Regional Park and consists of 16 units of traditional housing and 10 units of long term housing. It is estimated all dwelling units will be constructed by 2011.

19. *Lokahi Pacific*

Lokahai Pacific is located in Lahaina and consists of 12 single-family dwelling units. Project completion is expected by 2005. Due to the single-use nature of this project, no internal capture is utilized.

20. *Wainee Village*

The Wainee Village project is located in Lahaina, mauka of Honoapiilani Highway. Although 575 dwelling units are planned for buildout; 400 single-family and 175 multiple family, it is estimated 100 single-family and 60 multiple family units will be constructed by 2011. Due to the location of this project, 15% internal capture has been utilized.

21. *Plantation Inn*

This project involves adding 14 additional units to an existing 17 unit hotel located along the south side of Lahainaluna Road, midway between Luakini Street and Wainee Street.

Project data and traffic projections were drawn from the Traffic Impact Assessment: Proposed Expansion of Plantation Inn (Philip Rowell and Associates; May 8, 2002)

22. *Puunoa Village*

This project is located south of Lahaina, between Honoapiilani Highway and the Pu'u Noa Agricultural Subdivision. It will include development of 268 single-family residential units.

It is estimated these units will not be constructed by 2011.

23. *Makila*

The Makila project is located in Launiupoko and consists of 40 single-family dwelling units and 40 Ohana units. It is estimated all dwelling units will be constructed by 2011. Due to the single use nature of this project, no internal capture is utilized.

24. *Olowalu*

The Olowalu project is located in Olowalu and consists of 20 single-family dwelling units and 20 Ohana units. It is estimated all dwelling units will be constructed by 2011. Due to the single use nature of this project, no internal capture is utilized.

25. *Ukumehame*

The Ukumehame project is located in Ukumehame and consists of 46 single-family dwelling units and 46 Ohana units. It is estimated all dwelling units will be constructed by 2011. Due to the single use nature of this project, no internal capture is utilized.

3. Generation of Potential AM and PM Peak Hour Travel

Estimated new trips generated in the Honoapiilani Highway corridor were calculated separately for each development based on the expected number of units and/or floor area in 2011. Trip rates and equations from ITE *Trip Generation* (Institute of Transportation Engineers; 7th Edition; 2003), were applied to these expected units. PM peak hour expected trips, for example, totaled 1,736 and AM trips totaled 1,765 trips. The ITE manual also provides factors for entering and exiting travel from each site by type of land use.

Tables 6 and 7, respectively, indicate the AM and PM peak hour trip generation. The tables show the number of trips entering and exiting for each project in 2011, as well as the total trips for each project and for all the projects together. Table 6 shows the AM data, and Table 7 shows the PM data. The tables indicate the name of the development, the number of trips entering, the number of trips exiting, and the total number of trips. The last row of each table is total of the trips in each column.

Due to the mixed use nature of many proposed developments, it is necessary to apply internal capture rates to simulate trip interchange between the multiple uses on one site. This internal trip interchange encompasses walking, biking, motor vehicle, and, where applicable, transit trips. Coastal resort oriented developments have a 15% capture rate due to the recreational nature of the on-site travel. Other sites with great variety in uses have a 25% capture rate applied. Single family developments away from the coast have no internal capture.

4. Distribution of Peak Hour Trips Along the Honoapiilani Highway

Trips generated in the previous step were distributed to the corridor based on local knowledge of travel patterns and trip generation attractors. This distribution was accomplished at the scale of 5% increments. This level of accuracy is in line with the certainty of the land use values assumed for the trip generation step. **Tables 8 and 9** respectively indicate the AM and PM peak hour trip distribution. **Note** that **Tables 8 and 9** include the totals **with and without** Pulelehua. The tables show, for each project, the trip distribution along each segment of the study corridor. The segments are illustrated in Figure 12 found in Section III. The tables indicate northbound (NB) and southbound (SB) trips in each segment in 2011.

As an example, Project Number 17, the Villages at Leialii, generates 40% northbound and 60% southbound trips in the PM peak hour. **Figure 13** shows the 40/60 north and south split and the percentage of trips on each major link along Honoapiilani Highway with assumed entering and exiting trip percentage. Other sites' distribution maps are included in **Appendix A**.

Table 6: West Maui Developments AM Peak Hour Trip Generation

Development	Entering	Exiting	Total
Honolua Ridge	7	20	27
Kapalua Mauka	25	85	110
Puu Kahana	6	17	23
Maui Preperatory Academy	199	134	333
Villas at Kahana Ridge	12	49	61
Maui Breakers	7	33	40
DHHL Honokowai	0	0	0
Mariott Expansion	7	13	20
Hyatt Expansion	11	55	66
Kihune	3	11	14
Intrawest	163	164	328
Kaanapali 2020	43	145	188
Starwood	20	78	98
Palisades at Kaanapali	21	25	46
Land Tech	4	12	17
Villages at Leialii	21	62	82
W. Maui Resource Ctr Ph II	7	21	28
Lokahai Pacific	4	13	18
Wainee Village	23	73	96
Plantation Inn	2	4	6
Puunoa Village	0	0	0
Makila	14	47	61
Olowalu	9	28	37
Ukumehame	16	52	68
Total Trips	**623**	**1,142**	**1,765**

Note: Apparent addition errors are due to rounding of trip numbers.

Table 7: West Maui Developments PM Peak Hour Trip Generation

Development	Entering	Exiting	Total
Honolua Ridge	19	11	31
Kapalua Mauka	88	50	139
Puu Kahana	16	10	26
Maui Preparatory Academy	27	45	72
Villas at Kahana Ridge	53	29	82
Maui Breakers	33	16	49
DHHL Honokowai	0	0	0
Mariott Expansion	-2	3	1
Hyatt Expansion	52	26	78
Kihune	8	4	12
Intrawest	196	106	302
Kaanapali 2020	157	89	246
Starwood	95	51	146
Palisades at Kaanapali	24	26	50
Land Tech	11	6	17
Villages at Leialii	70	41	111
W. Maui Resource Ctr Ph II	20	12	32
Lokahai Pacific	10	6	16
Wainee Village	78	45	123
Plantation Inn	6	6	12
Puunoa Village	0	0	0
Makila	46	26	72
Olowalu	24	14	38
Ukumehame	52	30	82
Total Trips	**1,085**	**651**	**1,736**

Note: Apparent addition errors are due to rounding of trip numbers.

Table 8: West Maui Developments AM Peak Hour Trip Distribution

West Maui Developments

AM Peak Hour Trip Distribution

Development	Segment																													
	North-11		11-10		10-9		9-8		8-7		7-6		6-5		5-4		4-3		3-2		2-1		1-South	
	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB
Honolua Ridge	18	6	16	5	10	3	10	3	6	2	4	1	1	1	1	0	1	0	1	0	0	0	0	0
Kapalua Mauka	1	4	68	20	42	13	42	13	25	8	17	5	4	2	1	1	4	1	4	1	0	0	0	0
Puu Kahana	1	2	1	3	10	3	10	3	7	2	5	2	1	1	0	0	1	1	0	0	0	0	0	0
Maui Preperatory Academy	20	13	40	27	94	139	94	139	67	100	54	80	54	80	30	30	20	30	30	30	10	10	7	10
Villas at Kahana Ridge	1	5	2	10	29	7	29	7	20	5	15	4	15	4	1	1	2	1	1	1	0	0	0	0
Pulelehua	26	49	52	97	104	194	104	194	292	155	243	130	243	130	52	52	97	52	52	52	24	13	24	13
Maui Breakers	1	3	1	7	2	10	2	10	4	17	13	3	8	2	1	1	5	1	5	1	2	0	2	0
DHHL Honokowai	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mariott Expansion	0	1	1	1	1	3	1	3	3	5	7	4	7	4	2	1	3	2	3	2	1	0	1	0
Hyatt Expansion	1	3	1	6	2	11	2	11	5	22	6	28	28	6	3	1	3	1	3	1	1	1	3	1
Kihune	0	1	0	1	1	2	1	2	1	4	1	5	5	1	1	0	3	1	3	1	1	0	1	0
Intrawest	8	8	16	16	33	33	33	33	65	66	82	82	82	82	41	11	41	11	41	11	8	8	8	8
Kaanapali 2020	2	7	4	15	9	29	9	29	17	58	22	73	73	39	36	20	36	20	36	20	7	4	7	2
Starwood	1	4	2	8	4	16	4	16	8	31	10	39	39	10	20	5	20	5	20	5	4	1	4	1
Palisades at Kaanapali	1	1	2	3	4	5	4	5	8	10	11	13	11	13	6	5	6	5	6	5	1	1	1	1
Land Tech	0	1	0	1	1	2	1	2	2	5	2	6	3	6	3	1	3	1	3	1	1	0	1	0
Villages at Leialii	1	2	1	3	2	6	2	6	3	9	3	9	3	9	8	2	37	25	37	12	12	4	12	4
W. Maui Resource Ctr Ph II	0	0	0	0	0	0	0	0	1	1	1	2	1	2	2	1	2	1	2	1	1	1	1	1
Lokahai Pacific	0	0	0	0	0	0	0	0	1	4	2	7	1	7	3	2	7	3	7	2	4	1	4	1
Wainee Village	0	0	0	0	0	0	0	0	1	4	2	7	2	7	8	3	22	8	22	6	3	1	3	1
Plantation Inn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	0	1	0
Puunoa Village	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Makila	0	0	0	0	0	0	0	0	0	2	1	5	1	5	4	1	4	1	4	1	1	0	1	0
Olowalu	0	0	0	0	0	0	0	0	0	1	1	3	1	3	3	1	3	1	3	1	1	0	1	0
Ukumehame	0	0	0	0	0	0	0	0	1	3	2	5	2	5	5	2	5	2	5	2	1	0	1	0
Total Trips	82	110	209	222	348	477	348	477	538	510	500	506	602	399	288	254	317	241	330	237	156	129	142	129
Trips without Pulelehua	56	61	157	125	244	283	244	283	246	355	257	376	359	269	191	202	220	189	233	185	132	116	98	129

Table 9: West Maui Developments PM Peak Hour Trip Distribution

West Maui Developments

PM Peak Hour Trip Distribution

Development	Segment																							
	North-11		11-10		10-9		9-8		8-7		7-6		6-5		5-4		4-3		3-2		2-1		1-South	
	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB
Honolua Ridge	10	17	9	16	6	10	6	10	3	6	2	4	2	4	1	1	1	1	1	1	0	0	0	0
Kapalua Mauka	4	3	40	71	25	44	25	44	15	27	10	18	10	18	3	4	3	4	3	4	0	0	0	0
Puu Kahana	2	1	3	2	6	10	6	10	4	7	3	5	3	5	0	1	0	1	0	1	0	0	0	0
Maui Preperatory Academy	3	5	5	9	32	19	32	19	23	14	18	11	18	11	7	4	7	4	7	4	2	1	2	1
Villas at Kahana Ridge	5	3	11	6	17	32	17	32	11	21	9	16	9	16	1	3	1	3	1	3	0	0	0	0
Pulelehua	85	148	169	148	190	170	106	155	148	218	148	253	148	253	127	225	106	197	84	169	42	113	42	113
Maui Breakers	3	2	7	3	10	5	10	5	17	8	6	13	4	8	2	5	2	5	2	5	1	2	1	2
DHHL Honokowai	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mariott Expansion	0	0	0	0	0	1	0	1	-1	1	2	-1	2	-1	1	-1	1	-1	1	-1	0	0	0	0
Hyatt Expansion	3	1	5	3	10	5	10	5	21	10	26	13	13	26	6	13	6	13	6	13	1	3	1	3
Kihune	0	0	1	0	2	1	2	1	3	2	4	2	2	4	1	2	1	2	1	2	0	0	0	0
Intrawest	10	5	20	11	39	21	39	21	79	42	98	53	53	98	26	49	26	49	26	49	5	10	10	0
Kaanapali 2020	8	4	16	9	31	18	31	18	63	36	78	45	45	78	22	39	22	39	22	39	4	8	4	8
Starwood	5	3	10	5	19	10	19	10	38	21	48	26	26	48	13	24	13	24	13	24	3	5	3	5
Palisades at Kaanapali	1	1	2	3	5	5	5	5	10	10	12	13	12	13	7	6	7	6	7	6	1	1	1	1
Land Tech	1	0	1	1	2	1	2	1	4	3	5	3	5	3	2	3	2	3	2	3	0	1	0	1
Villages at Leialii	2	1	3	2	7	4	7	4	10	6	10	6	10	6	28	16	25	42	25	42	8	14	8	14
W.Maui Resource Ctr Ph II	0	0	0	0	0	0	0	0	1	1	2	1	2	1	6	4	6	4	9	16	2	4	2	4
Lokahai Pacific	0	0	0	0	0	0	0	0	1	0	1	1	1	1	6	4	6	4	3	2	1	2	1	2
Wainee Village	0	0	0	0	0	0	0	0	4	2	8	4	8	4	23	13	23	13	23	13	36	62	9	16
Plantation Inn	0	0	0	0	0	0	0	0	0	0	1	1	1	1	2	2	2	2	2	2	6	6	0	0
Puunoa Village	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Makila	0	0	0	0	0	0	0	0	1	1	5	3	5	3	14	8	14	8	14	8	14	8	37	21
Olowalu	0	0	0	0	0	0	0	0	1	1	2	1	2	1	7	4	7	4	7	4	7	4	19	11
Ukumehame	0	0	0	0	0	0	0	0	3	1	5	3	5	3	16	9	16	9	16	9	42	24	42	24
Total Trips	**142**	**195**	**302**	**287**	**401**	**356**	**317**	**341**	**459**	**437**	**504**	**493**	**385**	**604**	**321**	**438**	**296**	**435**	**275**	**418**	**176**	**267**	**184**	**225**
Trips without Pulelehua	**57**	**47**	**133**	**139**	**211**	**186**	**211**	**186**	**311**	**219**	**356**	**240**	**237**	**351**	**194**	**213**	**190**	**238**	**191**	**249**	**134**	**154**	**142**	**112**

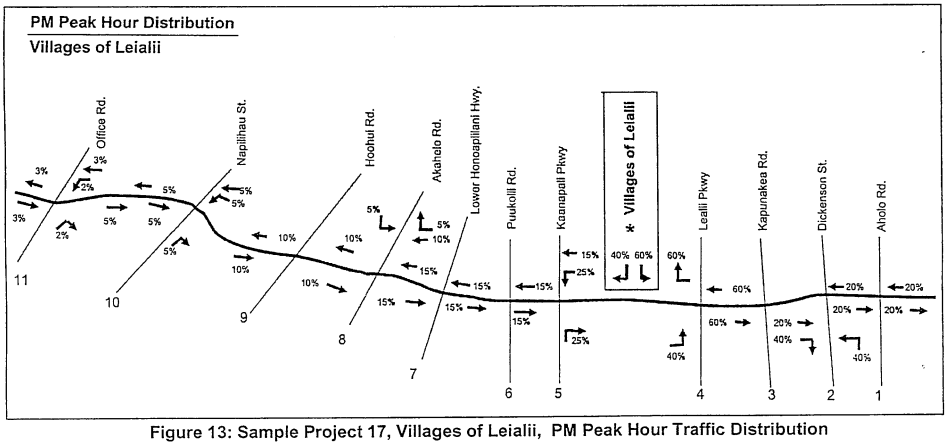


Figure 13: Sample Project 17, Villages of Leialii, PM Peak Hour Traffic Distribution

B. Traffic Signal Timing

In addition to determining the number of trips that will be generated and the distribution of those trips along the transportation system, optimized traffic signal timing is used to determine how the transportation system will function. Traffic signal timing has been incorporated into the *Synchro* computer analysis runs accompanying this report. Timing data for signalized Honoapiilani Highway intersections were obtained from the Hawaii Department of Transportation. Appendix M contains the signal timing data.

C. Future Roadway Projects

Future area roadway projects programmed by the Hawaii Department of Transportation have been reviewed and considered in the preparation of this report. However, no construction schedule has been set for these projects, so their impacts have not been included. The future area roadway projects include Honoapiilani Highway four-laning and the Lahaina Bypass, as follows:

1. Honoapiilani Highway Four-Laning

Hawaii DOT officials are moving forward with plans to widen Honoapiilani Highway between Lahainaluna Road and Aholo Street. Work will include widening of the existing highway from two to four lanes, drainage improvements, relocation of utilities, ADA improvements, adjustment of traffic signals and highway lighting, construction of retaining walls, and installation of signage and pavement markings (Press Release; April 22, 2004; Hawaii DOT).

Although this project will be undertaken approximately six miles south of the Pulelehua community, the four-laning should help to relieve congestion in the Lahaina area. Design for the road widening should be completed within one year. This project was not included in the transportation analysis. Because the project will provide additional capacity when completed, this analysis should be considered a "worst case" scenario, in terms of level of service projections.

2. Lahaina Bypass

The bypass involves construction of a four lane, controlled access highway between Launiupoko and Honokowai, a distance of approximately 9 miles. Other elements include the addition of connector and access roads, as well as modifications to roadway profiles and typical sections.

The bypass highway will originate at Launiupoko, south of the town of Lahaina, and proceed in a northerly direction to Ikena Avenue in Lahaina. From this point, the Bypass will proceed in a northwesterly direction until it reaches Kapunakea Street in Lahaina. The Bypass will then continue in a northerly direction as it passes to the east of the Kaanapali Resort and then proceed in a northwesterly direction until it reaches the terminus near the community of Honokowai, south of Mahinahina Gulch (Supplemental Environmental Impact Statement; Approved April 21, 2002; Hawaii DOT).

Construction of the initial phase of the Lahaina Bypass is scheduled to begin in FY 2004. This first section will run from Lahainaluna Road to an extension of Keawe Street (FY2004 – FY 2006 State Transportation Improvement Program – Amendment #3; Hawaii DOT).

Although the bypass will reduce congestion on Honoapiilani Highway, the timing of construction north of Lahaina has not been set. Therefore, construction of the bypass is assumed to occur after 2011 and no relief is assumed for the level of service analysis in this report, making this analysis a "worst case" scenario in terms of level of service projections.

D. LOS Analysis for Future Regional Development

The West Maui projects combined, not counting Pulelehua, will generate 1,765 new external trips during the AM peak hour and 1,736 new external trips during the PM peak hour. These non-Pulelehua trips impact Honoapiilani Highway as "background" traffic growth that is assumed to occur with or without the construction of Pulelehua. The traffic analysis indicates that Honoapiilani Highway will continue to function adequately with these developments through the 2011 buildout year with these trips. The level of service will not be adversely affected.

The overall trip analysis for potential 2011 West Maui developments shows increases in traffic volume of approximately 200 peak hour trips to any given segment of Honoapiilani Highway (see **Tables 8 and 9**, bottom row.) LOS analysis shows that sufficient capacity exists to absorb these new trips into the Honoapiilani corridor, as shown in **Tables 10 and 11**.

Table 10: 2011 LOS Northern Segments: West Maui Developments w/o Pulelehua, Peak Direction

Honoapiilani Highway Northern Cross Streets	2011 Regional Trips with Akahele Street Traffic Signal	
	AM (NB)	PM (SB)
Lower Honoapiilani Rd.	B	A
Akahele St.	A	C
Hoohui Rd.	A	A
Napilihau St.	A	A
Total Segment LOS	**A**	**A**

Table 11: 2011 LOS Southern Segments: West Maui Developments w/o Pulelehua

Honoapiilani Highway Southern Cross Streets	2011 Regional Trips LOS – Pk Hr/Pk Dir PM (SB)
Lealii Parkway	B
Fleming Rd.	C
Kapuunakea Rd.	C
Lahainaluna Rd.	B
Dickenson St.	E
Total Segment LOS	**C**

V. TRANSPORTATION ANALYSIS OF PULELEHUA

Based on the Pulelehua development parameters described below, HPE prepared traffic estimates of trip generation and distribution. These were then combined with projected trips from the rest of the corridor to determine an overall effect on traffic.

A. Pulelehua Trip Generation

AM Peak Hour and **PM Peak Hour** trip generation analyses (see **Tables 12 & 13** and **Appendix A**) were prepared utilizing rates and equations from *Trip Generation* (Institute of Transportation Engineers, 7th Edition, 2003). The Pulelehua development includes 1,218 dwelling units, plus other commercial and civic uses summarized in **Table 14** (the projected number of dwelling units has been revised to 1,200 since the transportation analysis was conducted. The 1,218 dwelling units used here contribute to the overall conservative nature of the transportation analysis.) These development units, when applied to the generation equations, yield vehicle trip estimates for the AM and PM peak hours, as shown in **Table 12** and **Table 13**. The next step determines how many of these vehicle trips will remain on site, or travel on external streets beyond the development. This step is described below.

1. Capture Rates

a. Internal Capture

In multi-use developments, trips between the given land uses (internal trips) can be accomplished on site without impacting the external road system. Since Pulelehua is a multi-use development, an internal capture rate was applied to reflect internal travel. Internal capture assumptions were applied for each individual land use, based on the degree to which travelers would logically move between origins and destinations on site (see **Appendix A**).

For example, using **Table 13** for reference, most apartment-related trips (ITE Code 220) return home during the PM peak hour. Of the 55 PM peak trips attracted to the 151 apartments, 41 are assumed to drive directly to the apartments from off site. Another 14 are assumed to come from another land use on site such as the commercial center on Main Street, the live work commercial area, the Wellness Center located at Akahele and Main Street or one of several other uses on site.

These 14 trips are only 25 percent of the 55 total attracted trips returning to apartments on site. Visualizing the completed site, it is logical to assume that considerably more than 14 of these trips will stop off or originate at on-site uses before arriving home. Perhaps a school teacher will be fortunate enough to walk home to his or her apartment from the neighborhood school. This example shows that conservative (low) on site capture estimates have been used for the Pulelehua trip generation analysis.

Overall, the mix of land uses and their proximity yield 222 captured PM Peak Hour trips associated with the home end trip activity (or Trip

Producers) and another 222 captured trips for the shopping, school, church and other non-home related trips (Trip Attractors), during the PM Peak Hour. The Producer and Attractor land use groups are located on the upper and lower portions of **Table 13**, respectively.

Estimating the split of pedestrian and bike trips is much more elusive. ITE Trip Generation manuals include the standard suburban auto rates calculated from hose count data submitted to the organization by transportation professionals from across the nation. The internal capture rate for this analysis include not only auto travel, but also pedestrian and bicycle travel for on site and off site destinations. In other words, all internal walking trips and bicycle trips are assumed to be part of the internally captured trips. It is logical to conclude, therefore, that Internal Capture calculations for this highly walkable community are even more conservative, that is, more vehicle trips are assumed than will actually occur.

b. Pass-by Capture

Pass-by trips represent an intermediate stop on the way from an origin to a primary trip destination. These are not "new" trips on the roadway. For the trip generation step, pass-by capture rates were drawn, where available, from *Trip Generation Handbook: An ITE Recommended Practice* (Institute of Transportation Engineers; March, 2001). Commercial uses are expected to draw 15 percent of their trips from Honoapiilani Highway's existing and future traffic flow. These trips will then depart, traveling in the same general direction as the previous leg of their primary trip.

2. Trip Generation Estimates

Pulelehua will generate **745** AM peak hour new external trips, and **986** PM peak hour new external trips. These are derived by combining the Entering and Exiting Net New Trips in the upper and lower portions of **Table 12** for the AM and **Table 13** for the PM (this information is also contained in **Appendix A**).

Table 12: AM Peak Hour Traffic Generation Table for Pulelehua

Trip Producers	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]
Live-Work Units (Residential Component) (ITE Code 230) Res Condo/Townhouse	60 dwelling units	0.44 /unit	Ln(T)=0.80 Ln(X) + 0.26	26	34	34
Residential Above Main St Shops (ITE Code 220) Apartment	20 dwelling units	0.51 /unit	T=0.49(X) + 3.73	10	14	14
Apartments (ITE Code 220) Apartment	151 dwelling units	0.51 /unit	T=0.49(X) + 3.73	77	78	78
Terrace Homes (ITE Code 230) Res Condo/Townhouse	219 dwelling units	0.44 /unit	Ln(T)=0.80 Ln(X) + 0.26	96	97	97
Sideyard Lanai/Cottages (ITE Code 210) Single Family Homes	122 dwelling units	0.75 /unit	T = 0.70(X) + 9.43	92	95	95
Front Lanai Homes (ITE Code 210) Single Family Homes	297 dwelling units	0.75 /unit	T = 0.70(X) + 9.43	223	217	217
Estate Homes (ITE Code 210) Single Family Homes	26 dwelling units	0.75 /unit	T = 0.70(X) + 9.43	20	28	28
Ohana Units (Potential) (ITE Code 230) Residential Townhouse	318 dwelling units	0.19 /unit	Ln(T)=0.86 Ln(X) + 0.92	60	N/A	60
Total Residential Units (Excluding Ohana Units)	895					
Total Residential Units (Including Ohana Units)	1,213					

Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture	Net NewTrips
Entering	17%	6	40%	3	0%	3
Exiting	83%	28	40%	17	0%	17
Entering	20%	3	40%	2	0%	2
Exiting	80%	11	40%	6	0%	6
Entering	20%	16	25%	12	0%	12
Exiting	80%	62	25%	47	0%	47
Entering	17%	16	25%	12	0%	12
Exiting	83%	80	25%	60	0%	60
Entering	25%	24	25%	18	0%	18
Exiting	75%	71	25%	53	0%	53
Entering	25%	54	25%	41	0%	41
Exiting	75%	163	25%	122	0%	122
Entering	25%	7	20%	6	0%	6
Exiting	75%	21	20%	17	0%	17
Entering	16%	10	25%	7	0%	7
Exiting	84%	51	25%	38	0%	38
Entering		135		100		100
Exiting		487		361		361
Total		622		461		461

Producers
Internal Capture Summary
Entering 35
Exiting 127
Captured 161

Trip Attractors	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]
Live-Work Commercial[3] (ITE Code 814) Specialty Retail Center	75,000 ft²	1.03 /1000ft² GLA	Ln(T)=0.60 Ln(X) + 2.29	77	N/A	77
Main Street Commercial (ITE Code 820) Shopping Center	21,475 ft²	1.03 /1000ft² GLA	Ln(T)=0.60 Ln(X) + 2.29	22	N/A	22
Workplace Edge Lots (ITE Code 770) Business Park	78,000 ft²	1.43 /1000ft² GFRA	Ln(T)=0.98 Ln(X) + 0.45	112	112	112
Central (Crossroads) Neighborhood						
Chapel (Akahele St.) (ITE Code 560) Church	4,000 ft²	0.72 /1000ft² GFA	N/A	3	N/A	3
Wellness Center (Akahele & Main St.) (ITE Code 492) Health/Fitness Club	10,000 sq.ft.	1.21 /1000ft² GFA	N/A	12	N/A	12
Church (Triangular Green) (ITE Code 560) Church	6,000 ft²	0.72 /1000ft² GFA	N/A	4	N/A	4
Elementary School (ITE Code 520) Elementary School	50,000 ft²	4.69 /1000ft² GFA	Ln(T)=1.11 Ln(X) + 0.96	235	201	201
Southern (Mahinahina) Neighborhood						
Chapel (On the Green) (ITE Code 560) Church	5,000 ft²	0.72 /1000ft² GFA	N/A	4	N/A	4
Northern (Kahanaiki) Neighborhood						
Chapel (On Small Green) (ITE Code 560) Church	4,000 ft²	0.72 /1000ft² GFA	N/A	3	N/A	3
Civic Use (on Long Green) (ITE Code 730) Government Office Building	4,000 ft²	5.88 /1000ft² GFA	N/A	24	N/A	24
Total Non-Residential Floor Area (sf)	257,475					

Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture	Net NewTrips
Entering	61%	47	55%	21	15%	18
Exiting	39%	30	35%	20	15%	17
Entering	61%	13	55%	6	15%	5
Exiting	39%	9	35%	6	15%	5
Entering	84%	94	44%	53	10%	47
Exiting	16%	18	20%	14	10%	13
Entering	54%	2	25%	1	0%	1
Exiting	46%	1	25%	1	0%	1
Entering	42%	5	30%	4	10%	3
Exiting	58%	7	20%	6	10%	5
Entering	54%	2	25%	2	0%	2
Exiting	46%	2	25%	1	0%	1
Entering	54%	108	40%	65	0%	65
Exiting	46%	92	15%	79	0%	79
Entering	54%	2	25%	1	0%	1
Exiting	46%	2	25%	1	0%	1
Entering	54%	2	25%	1	0%	1
Exiting	46%	1	25%	1	0%	1
Entering	84%	20	30%	14	0%	14
Exiting	16%	4	30%	3	0%	3
Entering		295		168		158
Exiting		166		131		125
Total		462		299		284

Attractors
Internal Capture Summary
Entering 127
Exiting 35
Captured 163

Overall Capture
30%

Notes:
Apparent discrepancies, if any, are due to rounding.
[1] Rates and equations are from *Trip Generation* (ITE, 7th Edition, 2003), Peak Hour of Adjacent Street Traffic, One Hour Between 7 and 9 a.m.
[2] For greatest accuracy, where an equation is available, equation-generated trips are typically utilized unless "Y" intercept is much higher than the number of units
[3] There is no AM peak hour rate for Code 814. Rate/equation from Code 820 (Shopping Center) utilized as a similar use.

Table 13: PM Peak Hour Trip Generation for Pulelehua

Trip Producers	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]
Live-Work Units (Residential Component) (ITE Code 230) Residential Condo/Townhouse	60 dwelling units	0.52 /unit	Ln(T)=0.82 Ln(X) + 0.32	31	40	40
Residential Above Main St Shops (ITE Code 220) Apartment	20 dwelling units	0.55 /unit	T=0.53(X) + 4.21	11	15	15
Apartments (ITE Code 220) Apartment	151 dwelling units	0.55 /unit	T=0.53(X) + 4.21	83	84	84
Terrace Homes (ITE Code 230) Residential Condo/Townhouse	219 dwelling units	0.52 /unit	Ln(T)=0.82 Ln(X) + 0.32	114	114	114
Sideyard Lanai/Cottages (ITE Code 210) Single Family Homes	122 dwelling units	1.01 /unit	Ln(T)=0.90 Ln(X) + 0.53	123	128	128
Front Lanai Homes (ITE Code 210) Single Family Homes	297 dwelling units	1.01 /unit	Ln(T)=0.90 Ln(X) + 0.53	300	286	286
Estate Homes (ITE Code 210) Single Family Homes	26 dwelling units	1.01 /unit	Ln(T)=0.90 Ln(X) + 0.53	26	32	32
Ohana Units (Potential) (ITE Code 230) Residential Condo/Townhouse	318 dwelling units	0.52 /unit	Ln(T)=0.82 Ln(X) + 0.32	165	155	155
Total Residential Units (Excluding Ohana Units)	895					
Total Residential Units (Including Ohana Units)	1,213					

Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture	Net NewTrips
Entering	67%	26	40%	16	0%	16
Exiting	33%	13	40%	8	0%	8
Entering	65%	10	40%	6	0%	6
Exiting	35%	5	40%	3	0%	3
Entering	65%	55	25%	41	0%	41
Exiting	35%	29	25%	22	0%	22
Entering	67%	77	25%	57	0%	57
Exiting	33%	38	25%	28	0%	28
Entering	63%	81	25%	61	0%	61
Exiting	37%	47	25%	36	0%	36
Entering	63%	180	25%	135	0%	135
Exiting	37%	106	25%	79	0%	79
Entering	63%	20	20%	16	0%	16
Exiting	65%	21	20%	17	0%	17
Entering	67%	104	25%	78	0%	78
Exiting	33%	51	25%	38	0%	38
Entering		552		410		410
Exiting		310		231		231
Total		863		641		641

Producers
Internal Capture Summary
Entering 142
Exiting 79
Captured 222

Trip Attractors	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]
Live-Work Commercial (ITE Code 814) Specialty Retail Center	75,000 ft²	2.71 /1000ft² GLA	T=2.40(X)+21.48	203	201	201
Main Street Commercial (ITE Code 820) Shopping Center	21,475 ft²	3.75 /1000ft² GLA	Ln(T)=0.66 Ln(X) + 3.40	81	227	227
Workplace Edge Lots (ITE Code 770) Business Park	78,000 ft²	1.29 /1000ft² GFRA	Ln(T)=0.92 Ln(X) + 0.78	101	120	120
Central (Crossroads) Neighborhood						
Chapel (Akahele St.) (ITE Code 560) Church	4,000 ft²	0.66 /1000ft² GFA	N/A	3	N/A	3
Wellness Center (Akahele & Main St.) (ITE Code 492) Health/Fitness Club	10,000 sq.ft.	4.05 /1000ft² GFA	N/A	41	N/A	41
Church (Triangular Green) (ITE Code 560) Church	6,000 ft²	0.66 /1000ft² GFA	N/A	4	N/A	4
Elementary School[4] (ITE Code 520) Elementary School	50,000 ft²	0.2 /1000ft² GFA	N/A	10	N/A	10
Southern (Mahinahina) Neighborhood						
Chapel (On the Green) (ITE Code 560) Church	5,000 ft²	0.66 /1000ft²	N/A	3	N/A	3
Northern (Kahanaiki) Neighborhood						
Chapel (On Small Green) (ITE Code 560) Church	4,000 ft²	0.66 /1000ft² GFA	N/A	3	N/A	3
Civic Use (on Long Green) (ITE Code 730) Government Office Building	4,000 ft²	1.21 /1000ft² GFA	N/A	5	N/A	5
Total Non-Residential Floor Area (sf)	257,475					

Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture	Net NewTrips
Entering	44%	89	35%	58	15%	49
Exiting	56%	113	50%	56	15%	48
Entering	48%	109	35%	71	15%	60
Exiting	52%	118	50%	59	15%	50
Entering	23%	28	15%	23	10%	21
Exiting	77%	92	20%	74	10%	67
Entering	52%	1	25%	1	0%	1
Exiting	48%	1	25%	1	0%	1
Entering	51%	21	15%	18	10%	16
Exiting	49%	20	20%	16	10%	14
Entering	52%	2	25%	2	0%	2
Exiting	48%	2	25%	1	0%	1
Entering	20%	2	30%	1	0%	1
Exiting	80%	8	30%	6	0%	6
Entering	52%	2	25%	1	0%	1
Exiting	48%	2	25%	1	0%	1
Entering	52%	1	25%	1	0%	1
Exiting	48%	1	25%	1	0%	1
Entering	31%	2	30%	1	0%	1
Exiting	69%	3	30%	2	0%	2
Entering		256		177		153
Exiting		360		218		191
Total		616		394		345

Attractors
Internal Capture Summary
Entering 79
Exiting 143
Captured 222

Overall Capture
30%

Notes:
Apparent discrepancies, if any, are due to rounding.
[1] Rates and equations are from *Trip Generation* (ITE, 7th Edition, 2003), Peak Hour of Adjacent Street Traffic, One Hour Between 4 and 6 p.m.
[2] For greatest accuracy, where an equation is available, equation-generated trips are typically utilized unless "Y" intercept is much higher than the number of units
[3] PM peak hour rate not given. Minimal 0.2/1,000 rate assumed to reflect school personnel trips.

Table 14: Producer and Attractor Land Use Groups

Land Use	Units/Floor Area	ITE Code[1]
Trip Producers (Residential)		
Live-work Units	60	**ITE 230** Residential Condo/Townhouse
Residences above Main Street Shops	20	**ITE 220** Apartment
Apartment Units	151	**ITE 220** Apartment
Terrace Homes	219	**ITE 230** Residential Condo/Townhouse
Sideyard Lanai Cottages	122	**ITE 210** Single-family Homes
Front Lanai Cottages	297	**ITE 210** Single-family Homes
Estate Homes	26	**ITE 210** Single-family Homes
Ohana Units (potential)	318	**ITE 230** Residential Condo/Townhouse
Trip Attractors (Non-Residential)		
Live-work Commercial	75,000 sf	**ITE 814** Specialty Retail Center
Main Street Commercial	21,475 sf	**ITE 820** Shopping Center
Workplace Edge Commercial	78,000 sf	**ITE 770** Business Park
Chapel (Akahele St.)	4,000 sf	**ITE 560** Church
Wellness Center	10,000 sf	**ITE 492** Health/Fitness Club
Church (Triangular Green)	6,000 sf	**ITE 560** Church
Elementary School	50,000 sf	**ITE 520** Elementary School
Chapel (on the Green)	5,000 sf	**ITE 560** Church
Chapel (Small Green)	4,000 sf	**ITE 560** Church
Civic Use (Long Green)	4,000 sf	**ITE 730** Government Office Building

[1] From *Trip Generation* (Institute of Transportation Engineers; 7th Edition; 2003)

B. Pulelehua Trip Distribution

From points of project ingress/egress, net new AM peak hour and PM peak hour project trips were distributed to Honoapiilani Highway. This was accomplished based on an interview with a local police officer, observations of traffic patters, Philip Rowell (a local traffic engineer,) and recent traffic counts. In line with the accuracy of traffic estimation practice, trips were distributed across the network in increments of 5 percent, i.e. 5%, 10% or 15%, instead of finer increments of 17% or 31%, for instance.

1. Broad Travel Area

A broad look at trip distribution patterns was undertaken. The broad travel area extends beyond Lahaina on the south, as shown in **Figures 14-16**. New Pulelehua trips traveling Honoapiilani Highway south of Lower Honoapiilani Road will be far fewer in number than in the primary travel area to the north. Distribution patterns for the broad travel area are displayed in **Figures 14-16.**

Of all the trips leaving Pulelehua in the PM peak hour (422 per **Table 13, Net New Trips Entering, Exiting**), 35 percent, or 148 trips will remain on Honoapiilani highway as the four lane section begins at Lower Honoapiilani Road. The next several four lane highway links to the south, before reaching Kaanapali Parkway and Halelo Street, are medium density and will divert few trips off the highway. Kaanapali Parkway, however, with its beach resorts and shopping areas is assumed to take 5 percent of the Pulelehua trips (21 trips) off the highway.

The next concentration of developed land capable of providing substantial destinations for Pulelehua travelers occurs near Fleming Road where Front Street pulls away from the highway and draws another 5 percent of travelers away (21 trips). Dickinson, plus the finer grid of nearby streets such as Papalaua Street and Panaewa Place, filters traffic off Honoapiilani Highway as it approaches destinations in Lahaina. This leaves 10 percent of the Pulelehua trips (42 peak hour trips) remaining on the highway destined for points south of Lahainaluna Road, including travel along the Pali. Some small portion of these pm peak hour trips will finally reach Central Maui as a final destination. Even 5 percent reaching the "valley" would amount to less than 25 peak hour trips.

Given these low levels of trip impact south of Lower Honoapiilani Road where the highway expands to four lanes, the more general ARTPLAN program was applied near Lahaina and the more detailed *Synchro* analysis focused on the network of two lane streets and highways to the north.

2. Pulelehua Local Travel Area

Trips generated using ITE manuals were distributed to the streets surrounding Pulelehua. Pulelehua access points to Honoapiilani Highway utilized in the

distribution step and their percentage of primary off site trip loading include the following:

- North Street – future 20%
- Middle Street – future 10%
- Akahele Street – existing 40%
- School Street - future 10%
- South Street - future 20%

Total 100%

Project trip percentages are translated to turn percentages at the intersections with Honoapiilani Highway, as shown in **Figures 17 and 18.** Since heavier concentrations of development exist to the south of Pulelehua, most traffic is expected to continue to arrive and depart to and from the south. However, many trips with one end in Pulelehua will travel to and from the north due to strong employment, service and recreational ties with Kapalua Nui.

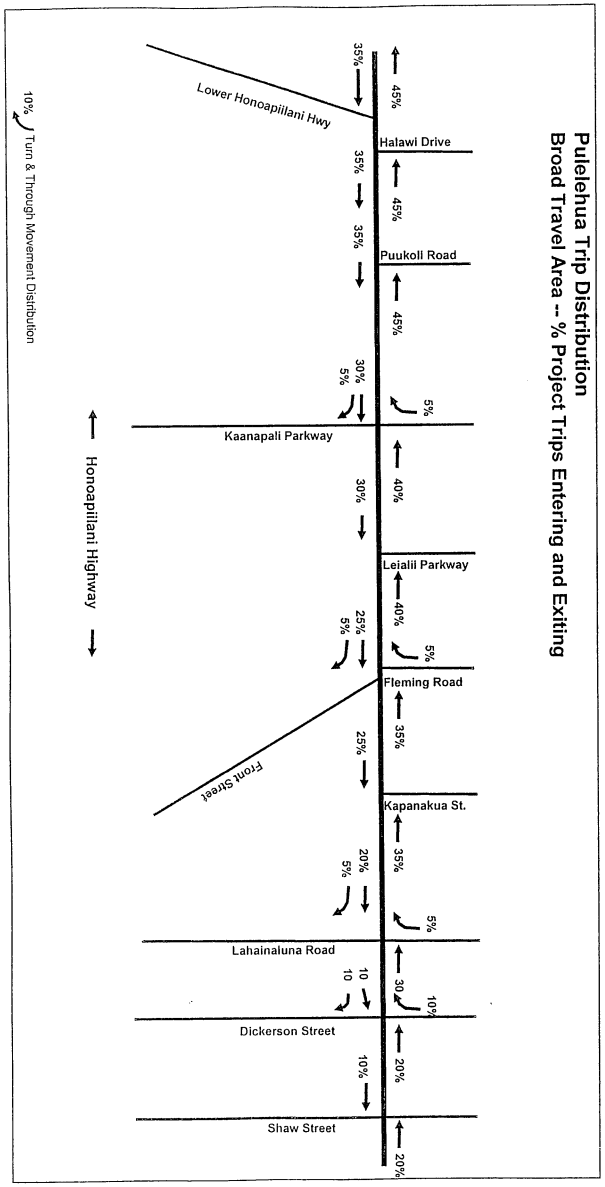


Figure 14: Pulelehua Trip Distribution Broad Area Enter/Exit

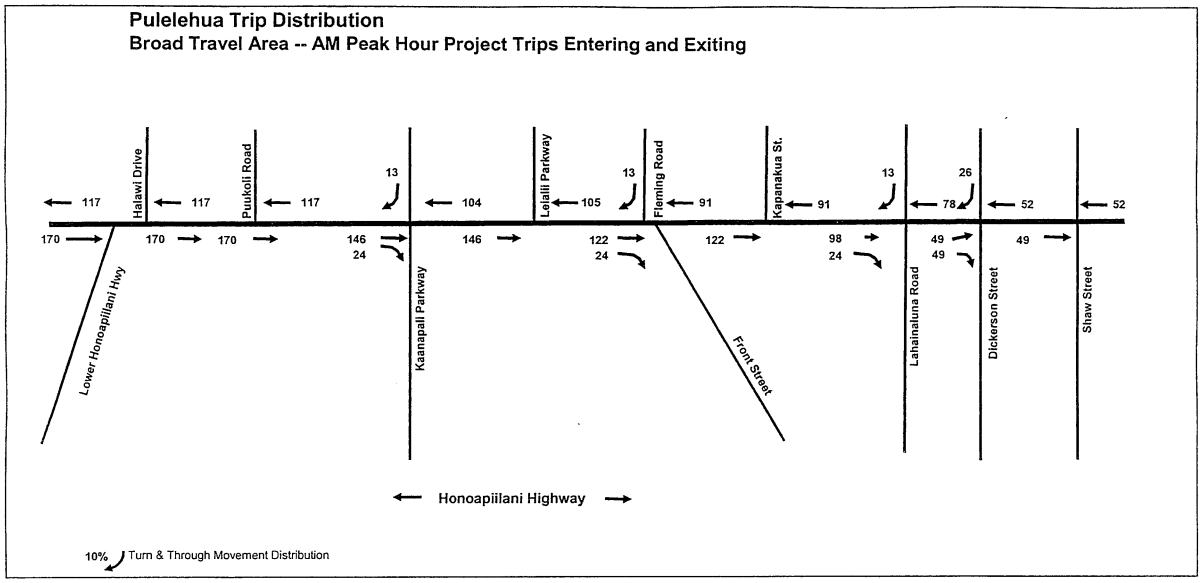


Figure 15: Pulelehua Trip Distribution AM Peak

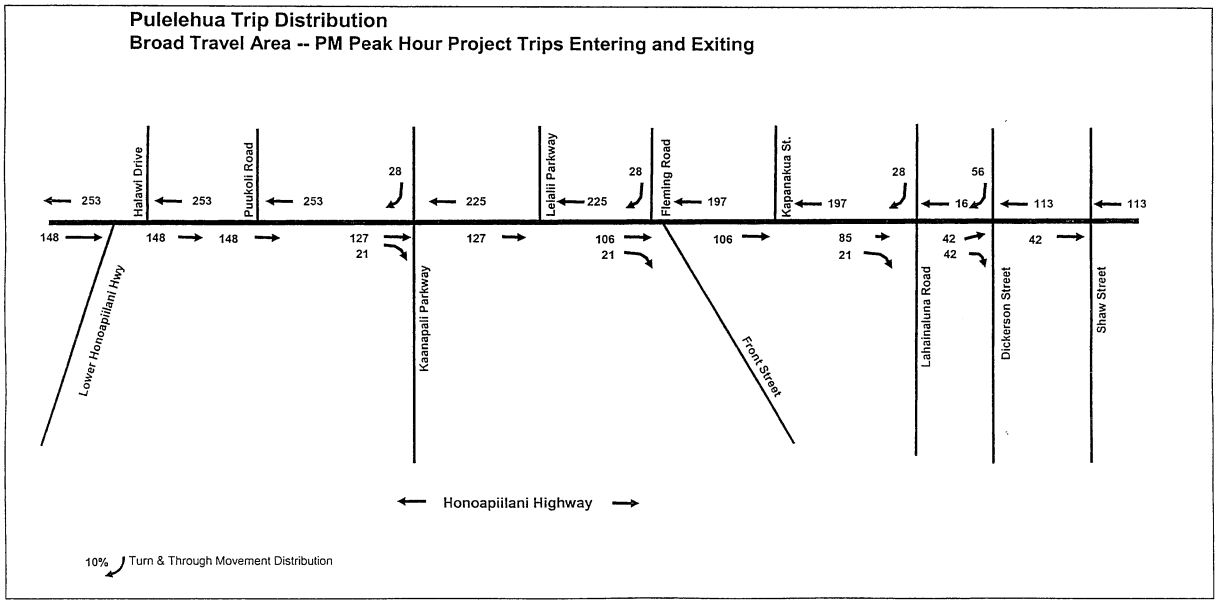


Figure 16: Pulelehua Trip Distribution PM Peak

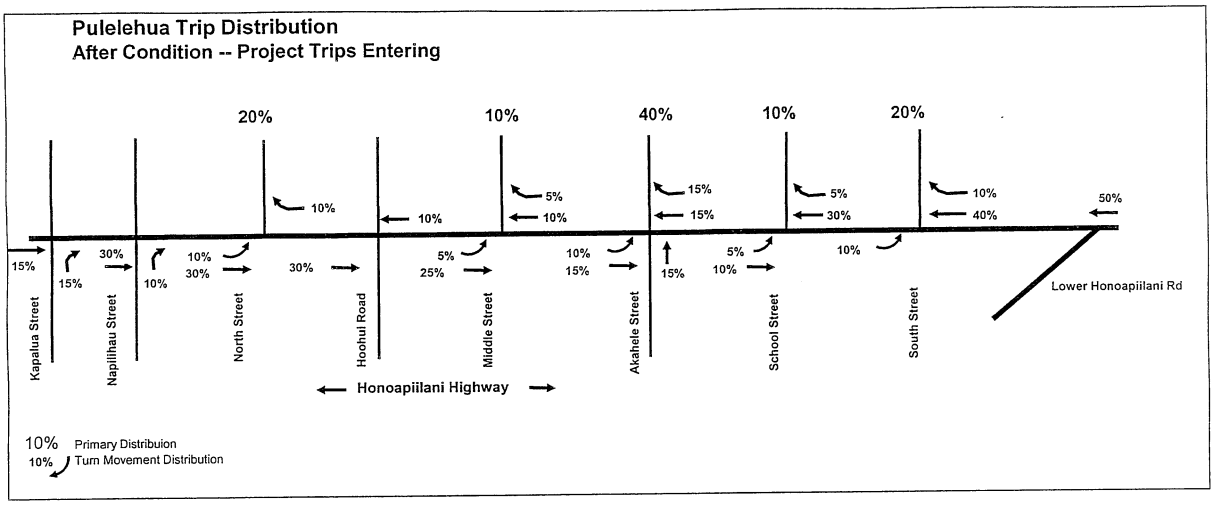


Figure 17: Pulelehua Trip Distribution – Trips Entering

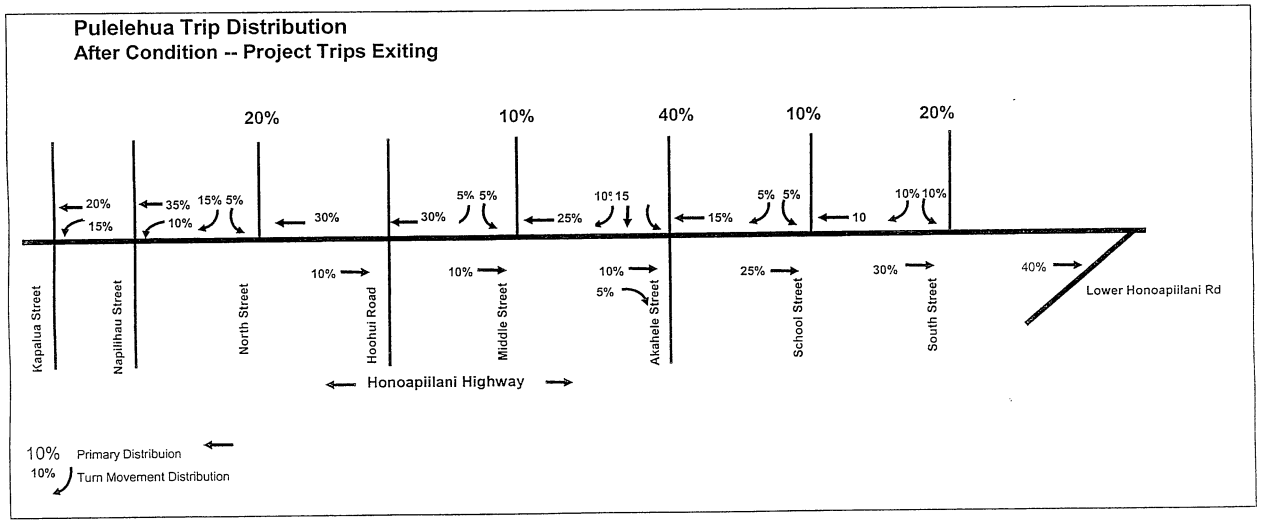


Figure 18: Pulelehua Trip Distribution - Trips Exiting

VI. TRANSPORTATION ANALYSIS OF PULELEHUA AND OTHER DEVELOPMENTS

As with the future development analysis in Section IV and the Pulelehua analysis in Section V, peak hour traffic generally operates at acceptable levels of service for the arterial sections in question when Pulelehua is added to the trips from future developments in the area. This analysis assumes that the developer will add four additional well-spaced intersections along Honoapiilani Highway, as described in the Pulelehua analysis above. When spaced at over 900 feet of separation, intersections have acceptable flow rates. This is described in greater detail under Section VII, Mitigation Measures, below.

A. Combined Trip Generation

AM Peak Hour and **PM Peak Hour** trip generation analyses were prepared utilizing rates and equations from *Trip Generation* (Institute of Transportation Engineers, 7th Edition, 2003), combining the data for the West Maui Developments in Section IV with the data for Pulelehua in Section V. The combined trip generation estimates for the AM and PM peak hours are show in **Tables 15 and 16** and **Appendix A**.

Table 15: Combined AM Peak Hour Trip Generation

West Maui Developments PLUS Pulelehua
AM Peak Hour Trip Generation

Development	Entering	Exiting	Total
Honolua Ridge	7	20	27
Kapalua Mauka	25	85	110
Puu Kahana	6	17	23
Maui Preperatory Academy	199	134	333
Villas at Kahana Ridge	12	49	61
Pulelehua	259	486	745
Maui Breakers	7	33	40
DHHL Honokowai	0	0	0
Mariott Expansion	7	13	20
Hyatt Expansion	11	55	66
Kihune	3	11	14
Intrawest	163	164	328
Kaanapali 2020	43	145	188
Starwood	20	78	98
Palisades at Kaanapali	21	25	46
Land Tech	4	12	17
Villages at Leialii	21	62	82
W. Maui Resource Ctr Ph II	7	21	28
Lokahai Pacific	4	13	18
Wainee Village	23	73	96
Plantation Inn	2	4	6
Puunoa Village	0	0	0
Makila	14	47	61
Olowalu	9	28	37
Ukumehame	16	52	68
Total Trips	**882**	**1,628**	**2,510**

Note: Apparent errors in addition are due to rounding of trip numbers

Table 16: Combined PM Peak Hour Trip Generation

West Maui Developments PLUS Pulelehua PM Peak Hour Trip Generation			
Development	Entering	Exiting	Total
Honolua Ridge	19	11	31
Kapalua Mauka	88	50	139
Puu Kahana	16	10	26
Maui Preperatory Academy	27	45	72
Villas at Kahana Ridge	53	29	82
Pulelehua	564	423	987
Maui Breakers	33	16	49
DHHL Honokowai	0	0	0
Mariott Expansion	-2	3	1
Hyatt Expansion	52	26	78
Kihune	8	4	12
Intrawest	196	106	302
Kaanapali 2020	157	89	246
Starwood	95	51	146
Palisades at Kaanapali	24	26	50
Land Tech	11	6	17
Villages at Leialii	70	41	111
W. Maui Resource Ctr Ph II	20	12	32
Lokahai Pacific	10	6	16
Wainee Village	78	45	123
Plantation Inn	6	6	12
Puunoa Village	0	0	0
Makila	46	26	72
Olowalu	24	14	38
Ukumehame	52	30	82
Total Trips	**1,649**	**1,074**	**2,723**

Note: Apparent errors in addition are due to rounding of trip numbers

B. Combined Trip Distribution

The trips generated above for the AM and PM peak hour were then distributed along each section of the Honoapiilani Highway identified in Figure 12. As described in Section IV, above, the West Maui Regional developments are expected to add an average of about 200 PM peak hour trips to each highway segment. In addition to those 200 trips, Pulelehua is expected to add approximately 150 PM peak hour trips to Honoapiilani Highway by 2011, as described in Section V, above.

Combined, Pulelehua and all other future West Maui Regional Developments will add an average of about 350 trips to each of the 11 segments of Honoapiilani Highway. More specifically, the segments closer to Pulelehua will receive a higher number of trips, on the order of 400 trips, while areas further two the north or south will receive fewer trips from these developments – on the order of 50 trips.

The trip distributions for Pulelehua and the West Maui future developments are shown in **Tables 8** and **9** (A.M. and P.M. peak hours, respectively, located in Section IV.) These tables show total trip distribution along each segment of the study area with and without Pulelehua. The tables indicate that Pulelehua will contribute some additional trips on each segment of Honoapiilani Highway. The magnitude of this impact, expressed as a change in Level of Service (LOS), is described below under LOS Analysis.

This analysis also assumes the existing intersection at Honoapiilani Highway and Akahele Street is constructed as one of two alternatives; 1) a standard signalized intersection, or 2) a double lane roundabout. These alternatives are both described below under part VII, Mitigation Measures.

One existing intersection may require improvement. The Lower Honoapiilani Road and Honoapiilani Highway intersection may require several additional turn lanes to perform adequately in 2011. The southern leg of Lower Honoapiilani Road will require an added northbound left turn lane if PM peak traffic reaches projected levels. Dual left turn lanes will provide the capacity to serve these turns. An additional lane on the west leg, to receive traffic from the dual left turn lanes will be needed to allow balanced operation of the signal. These improvements are described in greater detail under part VII, Mitigation Measures, below.

Complete data tables supporting this analysis can be found in Appendix F through Appendix K. The "Future Projects w/Pulelehua" *Synchro* runs, with Pulelehua trips added, are included in these Appendices. An arterial level of service summary is provided in **Table 17**. This table indicates the level of service in the AM and PM for Honoapiilani Highway in 2004 and in 2011 with a roundabout and a traffic signal (separate options) at Akahele Street.

Table 17: Arterial Level of Service Summary Honoapiilani Highway Segments

Honoapiilani Highway Cross Street	2004 Background Traffic		2011 Including Pulelehua Trips Akahele Street Roundabout		2011 Including Pulelehua Trips Akahele Street Traffic Signal	
To	AM (NB)	PM (SB)	AM (NB)	PM (SB)	AM (NB)	PM (SB)
Lower Honoapiilani Hwy	B	B	B	B	B	B
Akehele St.	A	B	N/A	N/A	B	D
Hoohui Rd.	A	A	A	B	A	A
Napilihau St.	A	A	A	B	A	A
TOTAL	**A**	**A**	**A**	**B**	**A**	**B**

Generally, traffic growth from the 24 proposed developments and new trips from Pulelehua by 2011 will be accommodated on the existing street and highway network.

Unique conditions of increased walkability may require a design for safer pedestrian crossing of Honoapiilani Highway at Akahele Street. If substantial pedestrian demand occurs at the Akahele intersection, a roundabout may help meet this demand.

Emergency vehicle and design issues for the roundabout are discussed below. Finally, street improvements at project entrances are discussed below under Part VII, Mitigation Measures.

C. LOS Analysis for Pulelehua and Regional Development

Table 18 illustrates the combined impacts of Pulelehua and the other West Maui projects on the key road segments surrounding Pulelehua. For these segments, the change in LOS for both the AM and PM peak was determined. In addition, the effects of using either a roundabout or a traffic signal at Akahele were also determined. This table was created using *Synchro* 6 (Trafficware, Inc.). Table 18 is a summary table; the complete *Synchro* results are included in the Appendices.

Table 19 illustrates the combined impacts of Pulelehua and the other West Maui projects on key road segments south of Pulelehua toward Lahaina. These segments were selected to determine whether Pulelehua would affect LOS at the Lahaina end of Honoapiilani Highway. For these segments, the program ARTPLAN was applied, with only the peak hour and peak direction evaluated.

The linear patter of coastal development usually results in light sidestreet volumes and heavier main street volumes. This yields a longer green time for the main direction, resulting in higher levels of traffic service. A main line green time

percentage of 65% was applied to Honoapiilani Highway signals near Lahaina. This reflects the high green time ratios of 62% to 87% found at intersections north of Lower Honoapiilani after optimization by *Synchro* analysis. .

Table 18 indicates that Pulelehua will reduce the LOS by one step (usually A to B) on two of the four segments that were evaluated. The greatest reduction is on the segment between Lower Honoapiilani Road and Akahele Street. On this segment, the LOS drops from B to C during the PM peak under the signal option. The segment between Akahele Street and Hoohui Road drops in LOS from A to B in the AM and PM peak directions under the signal option. On the remaining segments, there is no LOS change attributable to Pulelehua, indicating that these segments have sufficient capacity to absorb Pulelehua's additional 150 trips at this location.

D. Impact of Pulelehua Trips on Lahainaluna Road

Pulelehua will have minimal impact on the Lahainaluna Road/Honoapiilani Highway intersection. According to Pulelehua trip distribution, during the morning peak when the Lahainaluna Road/Honoapiilani Highway intersection is congested by trips to the West Maui elementary, middle and high schools located along Lahainaluna Road, only 24 southbound and 13 northbound Pulelehua trips are distributed to Honoapiilani Highway between Aholo Road and Kapunakea Road (which includes the Lahainaluna Road intersection), and it is probable this is a high estimate. Many Pulelehua students are expected to attend Maui Preparatory Academy at Pulelehua which is scheduled to open in Fall, 2005, with 90 students in grades 6, 7 and 8. Grades and capacity will be added each year with full enrollment scheduled for 2013, housing 540 students in pre-Kindergarten through grade 12.

During the afternoon traffic peak, which occurs after school hours, Pulelehua distributes 42 southbound and 113 northbound trips to Honoapiilani Highway between Aholo Road and Kapunakea Road.

Table 19 indicates that Pulelehua will not affect the LOS on the portion of Honoapiilani Highway just north of Lahaina. There is no change in the LOS with the addition of Pulelehua. This includes the arterial segment containing the Lahainaluna intersection. This intersection currently exhibits delay and congestion, and will continue to do so in the future, but the intersection is located far enough from Pulelehua that Pulelehua trips are not expected to contribute to additional congestion.

VII. MITIGATION MEASURES

Several mitigation strategies can be used to address Pulelehua's impacts on the transportation system. These include new streets and intersections, additional turn lanes at existing intersections, and a roundabout. In addition, there are other mitigating conditions that should be considered as part of Pulelehua's overall impact on the transportation system.

A. New Streets and Intersections

This analysis was conducted with the assumption that Maui Land & Pineapple Company will add four additional well-space intersections along Honoapiilani Highway as part of Pulelehua. When spaced at over 900 feet of separation, these intersections have acceptable flow rates. These intersections are, in fact, an integral part of the walkable thoroughfare network of Pulelehua, and the use of multiple smaller streets instead of a few larger arterials is a standard feature of traditional town planning. These additional intersections will distribute traffic from Pulelehua and provide multiple opportunities for accessing the town, rather than restricting access to a few congested arterials.

B. Roundabouts

In the event that pedestrian volumes grow substantially over time at Akahele, later staging of a pedestrian-friendly roundabout may be considered. Thus, several designs were analyzed to potentially achieve a safer speed at Akahele Street, the primary location where pedestrians cross Honoapiilani Highway. Pedestrian safety is highly related to the management of motor vehicle speeds and adequate pedestrian crossing facilities. While this intersection is currently equipped with essential pedestrian crossing facilities, motor vehicle speeds through the intersection can present a hazard. Speed management in urban settings is most commonly achieved through placement of buildings and trees close to the roadway edge and by reducing block size. One option is a traffic design that safely manages motor vehicle speeds near the future pedestrian crossing area, while maintaining optimal vehicle capacity and flow. A modern roundabout can serve as a viable solution.

Roundabouts have been designed for other streets on Maui with much groundwork laid by others to introduce this efficient, and increasingly common, intersection type. Dramatic reductions in fatalities (down 90%) and decreases in pedestrian accidents (down 30 to 40%) have been achieved elsewhere. Delay is reduced, especially during off peak times, since no driver waits for a red signal while there is no cross street traffic. The unnecessary delay during off peak hours is a common cause for violation of the red signal phase (running red lights,) which creates a potential for motor vehicle crashes.

The basic features of modern roundabouts are displayed in the following drawing from the FHWA document "Roundabouts: An Informational Guide" (FHWA RD-00-067). The outside diameter analyzed for Honoapiilani Highway will be approximately 150 feet. In addition, each approach must have a splitter island that turns the entering vehicles to the right, thus assuring lower entry speed. **Figure 19** is a diagram of a typical roundabout design.

Table 18: 2011 LOS Northern Segments: Pulelehua and West Maui Developments During Peak Hours

Honoapiilani Highway/Northern Cross Streets	2011 Trips w/ Akahele Street Roundabout				2011 Trips w/ Akahele Street Traffic Signal			
	AM (NB)		PM (SB)		AM (NB)		PM (SB)	
	w/o Pulelehua*	w/ Pulelehua	w/o Pulelehua*	w/ Pulelehua	w/o Pulelehua	w/ Pulelehua	w/o Pulelehua	w. Pulelehua
Lower Honoapiilani Rd.	N/A	B	N/A	B	B	B	A	B
Akahele St.	N/A	N/A	N/A	N/A	A	B	C	D
Hoohui Rd.	N/A	A	N/A	B	A	A	A	A
Napilihau St.	N/A	A	N/A	B	A	A	A	A
Total Segment	**N/A**	**A**	**N/A**	**B**	**A**	**A**	**A**	**B**

**Roundabout option was only tested with Pulelehua*

Table 19: 2011 LOS Southern Segments: Pulelehua and West Maui Developments

Honoapiilani Highway Southern Cross Streets	w/o Pulelehua LOS – Pk Hr/Pk Dr PM (SB)	w/ Pulelehua LOS – PK Hr/Pk Dr PM (SB)
Dickenson St.	E	E
Lahainaluna Rd.	B	B
Kapuunakea Rd.	C	C
Fleming Rd.	C	C
Lealii Parkway	B	B
Total Segment	**C**	**C**

Since roundabouts are designed to achieve a consistent, low vehicle speed (15 to 18 mph) to minimize crash potential, they are by nature pedestrian friendly. When traffic volumes are light, many gaps are available for pedestrian crossing. On the other hand, when vehicle volumes are high, more vehicles pause at the yield line, allowing pedestrians to cross safely behind the first vehicle. The pedestrian crosswalk must occur one car length back (approx. 20 feet) from the yield line to place the pedestrian safely in view of the second waiting vehicle's driver. The first driver is busy looking left for a gap in circulating traffic. Again, an appropriately low speed is the key safety element of roundabout design.

Emergency vehicles have equally good or better mobility at roundabouts than signalized intersections. Special features like simpler approaches to the intersection and lower approach speeds actually make for greater safety and little or no added delay. Page 35 of the FHWA Guide says the following about Emergency Vehicle safety and efficiency at modern roundabouts:

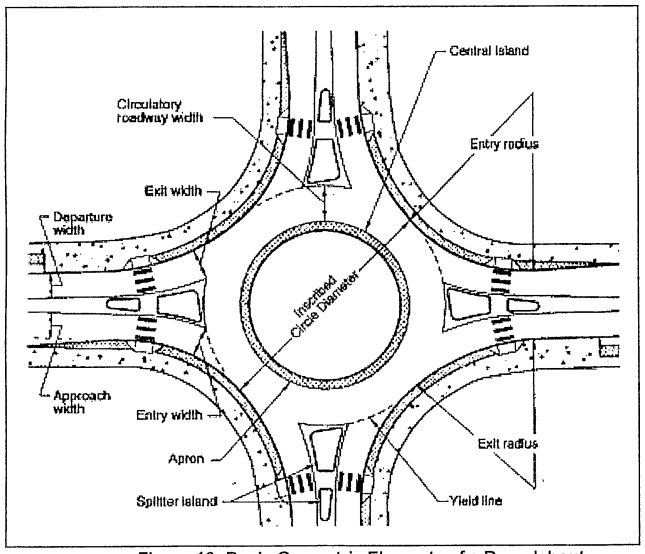


Figure 19: Basic Geometric Elements of a Roundabout

The passage of large emergency vehicles through a roundabout is the same as for other large vehicles and may require use of a mountable apron. On emergency response routes, the delay for the relevant movements at a planned roundabout should be compared with alternative intersection types and control. Just as they are required to do at conventional intersections, drivers should be educated not to enter a roundabout

when an emergency vehicle is approaching on another leg. Once having entered, they should clear out of the circulatory roadway if possible, facilitating queue clearance in front of the emergency vehicle. Roundabouts provide emergency vehicles the benefit of lower vehicle speeds, which may make roundabouts safer for them to negotiate than signalized crossings. Unlike at signalized intersections, emergency vehicle drivers are not faced with through vehicles unexpectedly running the intersection and hitting them at high speed.

-FHWA Publication RD-00-067, p. 35

Signals upstream and downstream of a roundabout effectively compact the traffic into platoons, thus providing gaps for use by side street drivers. Pedestrians are given crossing paths immediately behind the first waiting auto (that driver is looking ahead, while the first waiting driver is looking left, at oncoming traffic. Finally, speed is managed to a level compatible with safe pedestrian and bicycle crossing and intersecting motor vehicles. Circulating vehicles travel at a maximum speed of 25 mph.

Single lane roundabouts have a carrying capacity of over 2,600 entering vehicles per hour. Future traffic projections from the Lahaina Bypass Supplemental EIS Report indicate a total PM peak hour volume of 2,360 vehicles on Honoapiilani Highway (side street volume could contribute another 400 vehicles, yielding approximately 2,800 entering vehicles). Parallel streets within Pulelehua will help reduce the main line highway volumes to a lower level than would otherwise exist.

Based on projections of Honoapiilani Highway volumes, right turn lanes and a second circulating lane in the roundabout are recommended to further boost capacity while maintaining safety. The roundabout design will yield the best balance between the often conflicting highway mobility and mobility for the other three modes including pedestrian, bicycle and transit. Safety is also optimized by reducing the potential for high speed fatal crashes.

C. Auxiliary Turn Lanes

Entrance streets north and south of Akahele Street will require acceleration and deceleration lanes where they connect to Honoapiilani Highway. These four streets, shown in **Figures 17 and 18** (Section V) and temporarily named South Street, School Street, Middle Street, and North Street, will all operate effectively with full access for left turns since their separation is greater than 900 feet in all cases from adjacent intersections.

D. Other Mitigating Conditions

A more detailed inspection of the *Synchro* runs shows that a dual left turn lane will become necessary for the northbound traffic at the intersection of Honoapiilani Highway and Lower Honoapiilani Road. Optimization of the signal split at this intersection resulted in more seconds of green time for NB left turns than SB through movements. This yields an imbalanced signal operation that can be solved with striping of an additional northbound left turn lane. To receive this traffic, an additional

lane will be required at Lower Honoapiilani Road immediately west of the intersection. **Figure 20** illustrates this mitigation.

Several additional site-specific conditions further contribute to the conservative estimate of trip generation:

- The unit count used in the report for Pulelehua assumes all 318 secondary units or Ohana dwellings that can be built will be built by 2011. However, these Ohana units will be constructed at the discretion of the lot purchaser, and thus all 318 units may not exist at build out.

- Currently, some Kapalua employees reside in the valley section of Maui. It is expected that a high proportion of these employees will move to Pulelehua, substantially reducing the vehicle miles of travel on Honoapiilani Highway. This work trip shift is not included in the analysis.

- Trips generated by Pulelehua parents taking their kids to school may be overstated due to the on site elementary school.

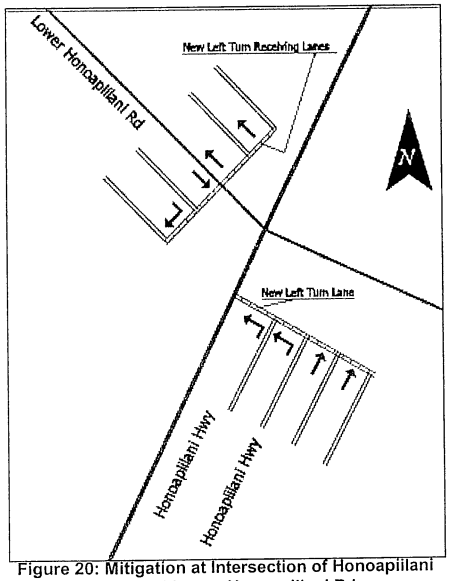


Figure 20: Mitigation at Intersection of Honoapiilani Hwy and Lower Honoapiilani Rd

VIII. CONCLUSION

The traffic analysis indicates that peak hour traffic will continue to operate at acceptable levels of service, as long as the following improvements are made:

- Maui Land & Pineapple Company will add four additional, well-spaced intersections along Honoapiilani Highway to adequately distribute in and outbound trips. These intersections are in the Pulelehua plan and vital to proper operation of both the traditional town street system and Honoapiilani Highway.

- The existing intersection at Honoapiilani Highway and Akahele Street is recommended as either a double-lane roundabout or a standard signalized intersection. The roundabout is more pedestrian-friendly and would provide greater walkability in the area

- If PM peak traffic reaches projected levels, the intersection of Lower Honoapiilani Road and Honoapiilani Highway will require an added left turn lane on the south approach. To receive the two lanes of turning traffic, an additional lane would be needed on the west leg. **Figure 20** (Section VII) illustrates this mitigation.

The Pulelehua community will change area traffic flow. However, estimates of future effects indicate the community will not create adverse traffic conditions. To the contrary, the walkable community design pattern established for Pulelehua will encourage walking, biking and transit as supporting modes of travel. This increase in travel choices will increase overall mobility in this sector of West Maui.

Table 1: AM Peak Hour - Trip Generation
Pulelehua (Maui, HI)

Hall Planning & Engineering, Inc.

The proposed development generates 745 Total AM peak hour trips.
259 Entering Trips
486 Exiting Trips

February 2, 2005

Trip Producers	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture	Net NewTrips
Live-Work Units (Residential Component) (ITE Code 230) Res Condo/Townhouse	60 dwelling units	0.44 /unit	Ln(T)=0.80 Ln(X) + 0.26	26	34	34	Entering	17%	6	40%	3	0%	3
							Exiting	83%	28	40%	17	0%	17
Residential Above Main St Shops (ITE Code 220) Apartment	20 dwelling units	0.51 /unit	T=0.49(X) + 3.73	10	14	14	Entering	20%	3	40%	2	0%	2
							Exiting	80%	11	40%	6	0%	6
Apartments (ITE Code 220) Apartment	151 dwelling units	0.51 /unit	T=0.49(X) + 3.73	77	78	78	Entering	20%	16	25%	12	0%	12
							Exiting	80%	62	25%	47	0%	47
Terrace Homes (ITE Code 230) Res Condo/Townhouse	219 dwelling units	0.44 /unit	Ln(T)=0.80 Ln(X) + 0.26	96	97	97	Entering	17%	16	25%	12	0%	12
							Exiting	83%	80	25%	60	0%	60
Sideyard Lanai/Cottages (ITE Code 210) Single Family Homes	122 dwelling units	0.75 /unit	T = 0.70(X) + 9.43	92	95	95	Entering	25%	24	25%	18	0%	18
							Exiting	75%	71	25%	53	0%	53
Front Lanai Homes (ITE Code 210) Single Family Homes	297 dwelling units	0.75 /unit	T = 0.70(X) + 9.43	223	217	217	Entering	25%	54	25%	41	0%	41
							Exiting	75%	163	25%	122	0%	122
Estate Homes (ITE Code 210) Single Family Homes	26 dwelling units	0.75 /unit	T = 0.70(X) + 9.43	20	28	28	Entering	25%	7	20%	6	0%	6
							Exiting	75%	21	20%	17	0%	17
Ohana Units (Potential) (ITE Code 230) Residential Townhouse	318 dwelling units	0.19 /unit	Ln(T)=0.88 Ln(X) + 0.92	60	N/A	60	Entering	16%	10	25%	7	0%	7
							Exiting	84%	51	25%	38	0%	38
Total Residential Units (Excluding Ohana Units)	895						Entering		135		100		100
Total Residential Units (Including Ohana Units)	1,213						Exiting		487		361		361
							Total		622		461		461

Producers
Internal Capture Summary
Entering 35
Exiting 127
Captured 161

Trip Attractors	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture	Net NewTrips
Live-Work Commercial[3] (ITE Code 814) Specialty Retail Center	75,000 ft²	1.03 /1000ft² GLA	Ln(T)=0.60 Ln(X) + 2.29	77	N/A	77	Entering	61%	47	55%	21	15%	18
							Exiting	39%	30	35%	20	15%	17
Main Street Commercial (ITE Code 820) Shopping Center	21,475 ft²	1.03 /1000ft² GLA	Ln(T)=0.60 Ln(X) + 2.29	22	N/A	22	Entering	61%	13	55%	6	15%	5
							Exiting	39%	9	35%	6	15%	5
Workplace Edge Lots (ITE Code 770) Business Park	78,000 ft²	1.43 /1000ft² GFRA	Ln(T)=0.98 Ln(X) + 0.45	112	112	112	Entering	84%	94	44%	53	10%	47
							Exiting	16%	18	20%	14	10%	13
Central (Crossroads) Neighborhood													
Chapel (Akahele St.) (ITE Code 560) Church	4,000 ft²	0.72 /1000ft² GFA	N/A	3	N/A	3	Entering	54%	2	25%	1	0%	1
							Exiting	46%	1	25%	1	0%	1
Wellness Center (Akahele & Main St.) (ITE Code 492) Health/Fitness Club	10,000 sq.ft.	1.21 /1000ft² GFA	N/A	12	N/A	12	Entering	42%	5	30%	4	10%	3
							Exiting	58%	7	20%	6	10%	5
Church (Triangular Green) (ITE Code 560) Church	6,000 ft²	0.72 /1000ft² GFA	N/A	4	N/A	4	Entering	54%	2	25%	2	0%	2
							Exiting	46%	2	25%	1	0%	1
Elementary School (ITE Code 520) Elementary School	50,000 ft²	4.69 /1000ft² GFA	Ln(T)=1.11 Ln(X) + 0.96	235	201	201	Entering	54%	108	40%	65	0%	65
							Exiting	46%	92	15%	79	0%	79
Southern (Mahinahina) Neighborhood													
Chapel (On the Green) (ITE Code 560) Church	5,000 ft²	0.72 /1000ft² GFA	N/A	4	N/A	4	Entering	54%	2	25%	1	0%	1
							Exiting	46%	2	25%	1	0%	1
Northern (Kahanaiki) Neighborhood													
Chapel (On Small Green) (ITE Code 560) Church	4,000 ft²	0.72 /1000ft² GFA	N/A	3	N/A	3	Entering	54%	2	25%	1	0%	1
							Exiting	46%	1	25%	1	0%	1
Civic Use (on Long Green) (ITE Code 730) Government Office Building	4,000 ft²	5.88 /1000ft² GFA	N/A	24	N/A	24	Entering	84%	20	30%	14	0%	14
							Exiting	16%	4	30%	3	0%	3
Total Non-Residential Floor Area (sf)	257,475						Entering		295		168		158
							Exiting		166		131		125
							Total		462		299		284

Attractors
Internal Capture Summary
Entering 127
Exiting 35
Captured 163

Overall Capture
30%

Notes:
Apparent discrepancies, if any, are due to rounding.
[1] Rates and equations are from *Trip Generation* (ITE, 7th Edition, 2003), Peak Hour of Adjacent Street Traffic, One Hour Between 7 and 9 a.m.
[2] For greatest accuracy, where an equation is available, equation-generated trips are typically utilized unless "Y" intercept is much higher than the number of units
[3] There is no AM peak hour rate for Code 814. Rate/equation from Code 820 (Shopping Center) utilized as a similar use.

APPENDIX A

Trip Generation and Distribution

Table 2: AM Peak Hour - Distribution of Entering Project Trips

Pulelehua Maui, HI

Hall Planning & Engineering, Inc.

February 2, 2005

259 Entering Trips

Intersection with Honoapiilani Hwy (Hwy 30)	Percent Entering Trips												Entering Trips											
	Southbound			Westbound			Northbound			Eastbound			Southbound			Westbound			Northbound			Eastbound		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
	R	T	L	R	T	L	R	T	L	R	T	L	R	T	L	R	T	L	R	T	L	R	T	L
Office Road		15%								15%			0	39	0	0	0	0	0	0	0	39	0	0
Napilihau Street		30%								10%			0	78	0	0	0	0	0	0	0	26	0	0
North Street		30%	10%				5%						0	78	26	0	0	0	13	0	0	0	0	0
Hoohui Road		30%						5%					0	78	0	0	0	0	0	13	0	0	0	0
Middle Street		25%	5%				5%	5%					0	65	13	0	0	0	13	13	0	0	0	0
Akahele Street		15%	10%				10%	10%			15%		0	39	26	0	0	0	26	26	0	0	39	0
School Street		10%	5%				15%	20%					0	26	13	0	0	0	39	52	0	0	0	0
South Street			10%				10%	35%					0	0	26	0	0	0	26	91	0	0	0	0
Lower Honoapiilani Road								45%					0	0	0	0	0	0	0	116	0	0	0	0

Table 3: AM Peak Hour - Distribution of Exiting Project Trips

Pulelehua Maui, HI

Hall Planning & Engineering, Inc.

February 2, 2005

486 Exiting Trips

Intersection with Honoapiilani Hwy (Hwy 30)	Percent Exiting Trips												Exiting Trips											
	Southbound			Westbound			Northbound			Eastbound			Southbound			Westbound			Northbound			Eastbound		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
	R	T	L	R	T	L	R	T	L	R	T	L	R	T	L	R	T	L	R	T	L	R	T	L
Office Road								20%	15%				0	0	0	0	0	0	0	97	73	0	0	0
Napilihau Street								35%	10%				0	0	0	0	0	0	0	170	49	0	0	0
North Street				15%		5%		30%					0	0	0	73	0	24	0	146	0	0	0	0
Hoohui Road		5%						30%					0	24	0	0	0	0	0	146	0	0	0	0
Middle Street		5%		5%		5%		25%					0	24	0	24	0	24	0	121	0	0	0	0
Akahele Street	5%	5%		10%	15%	15%		15%					24	24	0	49	73	73	0	73	0	0	0	0
School Street		20%		5%		5%		10%					0	97	0	24	0	24	0	49	0	0	0	0
South Street		25%		10%		10%							0	121	0	49	0	49	0	0	0	0	0	0
Lower Honoapiilani Road		35%											0	170	0	0	0	0	0	0	0	0	0	0

Table 4: PM Peak Hour - Trip Generation
Pulelehua Maui, HI

Hall Planning & Engineering, Inc.

The proposed development generates 986 Total PM peak hour trips.
563 Entering Trips
February 2, 2005 423 Exiting Trips

Trip Producers	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]
Live-Work Units (Residential Component) (ITE Code 230) Residential Condo/Townhouse	60 dwelling units	0.52 /unit	Ln(T)=0.82 Ln(X) + 0.32	31	40	40
Residential Above Main St Shops (ITE Code 220) Apartment	20 dwelling units	0.55 /unit	T=0.53(X) + 4.21	11	15	15
Apartments (ITE Code 220) Apartment	151 dwelling units	0.55 /unit	T=0.53(X) + 4.21	83	84	84
Terrace Homes (ITE Code 230) Residential Condo/Townhouse	219 dwelling units	0.52 /unit	Ln(T)=0.82 Ln(X) + 0.32	114	114	114
Sideyard Lanai/Cottages (ITE Code 210) Single Family Homes	122 dwelling units	1.01 /unit	Ln(T)=0.90 Ln(X) + 0.53	123	128	128
Front Lanai Homes (ITE Code 210) Single Family Homes	297 dwelling units	1.01 /unit	Ln(T)=0.90 Ln(X) + 0.53	300	286	286
Estate Homes (ITE Code 210) Single Family Homes	26 dwelling units	1.01 /unit	Ln(T)=0.90 Ln(X) + 0.53	26	32	32
Ohana Units (Potential) (ITE Code 230) Residential Condo/Townhouse	318 dwelling units	0.52 /unit	Ln(T)=0.82 Ln(X) + 0.32	165	155	155
Total Residential Units (Excluding Ohana Units)	895					
Total Residential Units (Including Ohana Units)	1,213					

Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture	Net NewTrips
Entering	67%	26	40%	16	0%	16
Exiting	33%	13	40%	8	0%	8
Entering	65%	10	40%	6	0%	6
Exiting	35%	5	40%	3	0%	3
Entering	65%	55	25%	41	0%	41
Exiting	35%	29	25%	22	0%	22
Entering	67%	77	25%	57	0%	57
Exiting	33%	38	25%	28	0%	28
Entering	63%	81	25%	61	0%	61
Exiting	37%	47	25%	36	0%	36
Entering	63%	180	25%	135	0%	135
Exiting	37%	106	25%	79	0%	79
Entering	63%	20	20%	16	0%	16
Exiting	65%	21	20%	17	0%	17
Entering	67%	104	25%	78	0%	78
Exiting	33%	51	25%	38	0%	38
Entering		552		410		410
Exiting		310		231		231
Total		863		641		641

Producers
Internal Capture Summary
Entering 142
Exiting 79
Captured 222

Trip Attractors	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]
Live-Work Commercial (ITE Code 814) Specialty Retail Center	75,000 ft²	2.71 /1000ft² GLA	T=2.40(X)+21.48	203	201	201
Main Street Commercial (ITE Code 820) Shopping Center	21,475 ft²	3.75 /1000ft² GLA	Ln(T)=0.66 Ln(X) + 3.40	81	227	227
Workplace Edge Lots (ITE Code 770) Business Park	78,000 ft²	1.29 /1000ft² GFRA	Ln(T)=0.92 Ln(X) + 0.78	101	120	120
Central (Crossroads) Neighborhood						
Chapel (Akahele St.) (ITE Code 560) Church	4,000 ft²	0.66 /1000ft² GFA	N/A	3	N/A	3
Wellness Center (Akahele & Main St.) (ITE Code 492) Health/Fitness Club	10,000 sq.ft.	4.05 /1000ft² GFA	N/A	41	N/A	41
Church (Triangular Green) (ITE Code 560) Church	6,000 ft²	0.66 /1000ft² GFA	N/A	4	N/A	4
Elementary School[3] (ITE Code 520) Elementary School	50,000 ft²	0.2 /1000ft² GFA	N/A	10	N/A	10
Southern (Mahinahina) Neighborhood						
Chapel (On the Green) (ITE Code 560) Church	5,000 ft²	0.66 /1000ft²	N/A	3	N/A	3
Northern (Kahanaiki) Neighborhood						
Chapel (On Small Green) (ITE Code 560) Church	4,000 ft²	0.66 /1000ft² GFA	N/A	3	N/A	3
Civic Use (on Long Green) (ITE Code 730) Government Office Building	4,000 ft²	1.21 /1000ft² GFA	N/A	5	N/A	5
Total Non-Residential Floor Area (sf)	257,475					

Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture	Net NewTrips
Entering	44%	89	35%	58	15%	49
Exiting	56%	113	50%	56	15%	48
Entering	48%	109	35%	71	15%	60
Exiting	52%	118	50%	59	15%	50
Entering	23%	28	15%	23	10%	21
Exiting	77%	92	20%	74	10%	67
Entering	52%	1	25%	1	0%	1
Exiting	48%	1	25%	1	0%	1
Entering	51%	21	15%	18	10%	16
Exiting	49%	20	20%	16	10%	14
Entering	52%	2	25%	2	0%	2
Exiting	48%	2	25%	1	0%	1
Entering	20%	2	30%	1	0%	1
Exiting	80%	8	30%	6	0%	6
Entering	52%	2	25%	1	0%	1
Exiting	48%	2	25%	1	0%	1
Entering	52%	1	25%	1	0%	1
Exiting	48%	1	25%	1	0%	1
Entering	31%	2	30%	1	0%	1
Exiting	69%	3	30%	2	0%	2
Entering		256		177		153
Exiting		360		218		191
Total		616		394		345

Attractors
Internal Capture Summary
Entering 79
Exiting 143
Captured 222

Overall Capture
30%

Notes:
Apparent discrepancies, if any, are due to rounding.
[1] Rates and equations are from *Trip Generation* (ITE, 7th Edition, 2003), Peak Hour of Adjacent Street Traffic, One Hour Between 4 and 6 p.m.
[2] For greatest accuracy, where an equation is available, equation-generated trips are typically utilized unless "Y" intercept is much higher than the number of units
[3] PM peak hour rate not given. Minimal 0.2/1,000 rate assumed to reflect school personnel trips.

Table 5: PM Peak Hour - Distribution of Entering Project Trips
Pulelehua Maui, HI

Hall Planning & Engineering, Inc.

February 2, 2005 563 Entering Trips

Intersection with Honoapiilani Hwy (Hwy 30)	Percent Entering Trips												Entering Trips											
	Southbound			Westbound			Northbound			Eastbound			Southbound			Westbound			Northbound			Eastbound		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
	R	T	L	R	T	L	R	T	L	R	T	L	R	T	L	R	T	L	R	T	L	R	T	L
Office Road		15%								15%			0	84	0	0	0	0	0	0	0	84	0	0
Napilihau Street		30%								10%			0	169	0	0	0	0	0	0	0	56	0	0
North Street		30%	10%				5%						0	169	56	0	0	0	28	0	0	0	0	0
Hoohui Road		30%						5%					0	169	0	0	0	0	0	28	0	0	0	0
Middle Street		25%	5%				5%	5%					0	141	28	0	0	0	28	28	0	0	0	0
Akahele Street		15%	10%				10%	10%			15%		0	84	56	0	0	0	56	56	0	0	84	0
School Street		10%	5%				15%	20%					0	56	28	0	0	0	84	113	0	0	0	0
South Street			10%				10%	35%					0	0	56	0	0	0	56	197	0	0	0	0
Lower Honoapiilani Road								45%					0	0	0	0	0	0	0	253	0	0	0	0

Table 6: PM Peak Hour - Distribution of Exiting Project Trips

Pulelehua Maui, HI

Hall Planning & Engineering, Inc.

February 2, 2005

423 Exiting Trips

Intersection with Honoapiilani Hwy (Hwy 30)	Percent Exiting Trips												Exiting Trips											
	Southbound			Westbound			Northbound			Eastbound			Southbound			Westbound			Northbound			Eastbound		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
	R	T	L	R	T	L	R	T	L	R	T	L	R	T	L	R	T	L	R	T	L	R	T	L
Office Road								20%	15%				0	0	0	0	0	0	0	85	63	0	0	0
Napilihau Street								35%	10%				0	0	0	0	0	0	0	148	42	0	0	0
North Street				15%		5%		30%					0	0	0	63	0	21	0	127	0	0	0	0
Hoohui Road		5%						30%					0	21	0	0	0	0	0	127	0	0	0	0
Middle Street		5%		5%		5%		25%					0	21	0	21	0	21	0	106	0	0	0	0
Akahele Street	5%	5%		10%	15%	15%		15%					21	21	0	42	63	63	0	63	0	0	0	0
School Street		20%		5%		5%		10%					0	85	0	21	0	21	0	42	0	0	0	0
South Street		25%		10%		10%							0	106	0	42	0	42	0	0	0	0	0	0
Lower Honoapiilani Road		35%											0	148	0	0	0	0	0	0	0	0	0	0

West Maui Developments - Summary
AM Peak Hour Trip Generation

Development	Entering	Exiting	Total
Honolua Ridge	7	20	27
Kapalua Mauka	25	85	110
Puu Kahana	6	17	23
Maui Preperatory Academy	199	134	333
Villas at Kahana Ridge	12	49	61
Pulelehua	259	486	745
Maui Breakers	7	33	40
DHHL Honokowai	0	0	0
Mariott Expansion	7	13	20
Hyatt Expansion	11	55	66
Kihune	3	11	14
Intrawest	163	164	328
Kaanapali 2020	43	145	188
Starwood	20	78	98
Palisades at Kaanapali	21	25	46
Land Tech	4	12	17
Villages at Leialii	21	62	82
W. Maui Resource Ctr Ph II	7	21	28
Lokahai Pacific	4	13	18
Wainee Village	23	73	96
Plantation Inn	2	4	6
Puunoa Village	0	0	0
Makila	14	47	61
Olowalu	9	28	37
Ukumehame	16	52	68
Total Trips	882	1,628	2,510

WEST MAUI DEVELOPMENTS

AM PEAK HOUR TRIP GENERATION AND DISTRIBUTION

West Maui Developments
AM Peak Hour Trip Distribution

Development	Segment North-11		Segment 11-10		Segment 10-9		Segment 9-8		Segment 8-7		Segment 7-6		Segment 6-5		Segment 5-4		Segment 4-3		Segment 3-2		Segment 2-1		Segment 1-South	
	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB
Honolua Ridge	18	6	16	5	10	3	10	3	6	2	4	1	4	1	1	0	1	0	1	0	0	0	0	0
Kapalua Mauka	1	4	68	20	42	13	42	13	25	8	17	5	17	5	4	1	4	1	4	1	0	0	0	0
Puu Kahana	1	2	1	3	10	3	10	3	7	2	5	2	5	2	1	0	1	0	1	0	0	0	0	0
Maui Preperatory Academy	20	13	40	27	94	139	94	139	67	100	54	80	54	80	20	30	20	30	20	30	7	10	7	10
Villas at Kahana Ridge	1	5	2	10	29	7	29	7	20	5	15	4	15	4	2	1	2	1	2	1	0	0	0	0
Pulelehua	26	49	52	97	104	194	104	194	292	155	243	130	243	130	97	52	97	52	97	52	24	13	24	13
Maui Breakers	1	3	1	7	2	10	2	10	4	17	13	3	8	2	5	1	5	1	5	1	2	0	2	0
DHHL Honokowai	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mariott Expansion	0	1	1	1	1	3	1	3	3	5	7	4	7	4	3	2	3	2	3	2	1	0	1	0
Hyatt Expansion	1	3	1	6	2	11	2	11	5	22	6	28	28	6	14	3	14	3	14	3	3	1	3	1
Kihune	0	1	0	1	1	2	1	2	1	4	1	5	5	1	3	1	3	1	3	1	1	0	1	0
Intrawest	8	8	16	16	33	33	33	33	65	66	82	82	82	82	41	41	41	41	41	41	8	8	8	0
Kaanapali 2020	2	7	4	15	9	29	9	29	17	58	22	73	73	22	36	11	36	11	36	11	7	2	7	2
Starwood	1	4	2	8	4	16	4	16	8	31	10	39	39	10	20	5	20	5	20	5	4	1	4	1
Palisades at Kaanapali	1	1	2	3	4	5	4	5	8	10	11	13	11	13	6	5	6	5	6	5	1	1	1	1
Land Tech	0	1	0	1	1	2	1	2	2	5	2	6	2	6	3	1	3	1	3	1	1	0	1	0
Villages at Leialii	1	2	1	3	2	6	2	6	3	9	3	9	3	9	8	25	37	12	37	12	12	4	12	4
W.Maui Resource Ctr Ph II	0	0	0	0	0	0	0	0	0	1	1	2	1	2	2	6	2	6	17	6	4	1	4	1
Lokahai Pacific	0	0	0	0	0	0	0	0	0	1	0	1	0	1	3	8	3	8	1	4	3	1	3	1
Wainee Village	0	0	0	0	0	0	0	0	1	4	2	7	2	7	7	22	7	22	7	22	59	18	15	5
Plantation Inn	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	2	4	0	0
Puunoa Village	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Makila	0	0	0	0	0	0	0	0	2	2	1	5	1	5	4	14	4	14	4	14	4	14	11	37
Olowalu	0	0	0	0	0	0	0	0	0	1	1	3	1	3	3	9	3	9	3	9	3	9	7	23
Ukumehame	0	0	0	0	0	0	0	0	1	3	2	5	2	5	5	16	5	16	5	16	13	42	13	42
Total Trips	82	110	209	222	348	477	348	477	538	510	500	506	502	399	288	254	317	241	330	237	156	129	122	142
Trips without Pulelehua	56	61	157	125	244	283	244	283	246	355	257	376	359	269	191	202	220	189	233	185	132	116	98	129

Table A - 1. AM Peak Hour Trips: Generation

WEST MAUI DEVELOPMENTS

December 2, 2004

HONOLUA RIDGE	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Single-Family Detached Housing ITE Code 210	25 dwelling units	1.01 /unit	T = 0.70(X) + 9.43	25	27	27	Entering	25%	7	0%	7	0%	7
							Exiting	75%	20	0%	20	0%	20
							Entering						
							Exiting						
	25	Total Dwelling Units					Entering		7		7		7
							Exiting		20		20		20
							Total		27		27		27

Notes:
Small discrepancies, if any, are due to rounding.
[1] Rates and equations are from *Trip Generation* (ITE, 7th Edition, 2003), on a weekday.
Peak Hour of Adjacent Street Traffic, One Houe Between 7 and 9 a.m.
[2] For greatest accuracy, where an equation is available, equation-generated trips are typically utilized unless "Y" intercept is much higher than the number of units.
[3]Where available, pass-by capture rates are "average pass-by trip percentages" from *Trip Generation Handbook: An ITE Recommended Practice* (ITE, March, 2001)

Internal Capture Summary

Entering	0
Exiting	0
Captured	0

KAPALUA MAUKA	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Single-Family Detached Housing ITE Code 210	75 dwelling units	0.75 /unit	T = 0.70(X) + 9.43	56	62	62	Entering	25%	15	0%	15	0%	15
							Exiting	75%	46	0%	46	0%	46
Apartment ITE Code 220	90 dwelling units	0.51 /unit	T=0.49(X) + 3.73	46	48	48	Entering	20%	10	0%	10	0%	10
							Exiting	80%	38	0%	38	0%	38
	165	Total Dwelling Units					Entering		25		25		25
							Exiting		85		85		85
							Total		110		110		110

Internal Capture Summary

Entering	0
Exiting	0
Captured	0

PU'U KAHANA	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Single-Family Detached Housing ITE Code 210	25 dwelling units	0.75 /unit	T = 0.70(X) + 9.43	19	27	27	Entering	25%	7	15%	6	0%	6
							Exiting	75%	20	15%	17	0%	17
							Entering						
							Exiting						
							Entering		7		6		6
							Exiting		20		17		17
							Total		27		23		23

Internal Capture Summary

Entering	1
Exiting	3
Captured	4

AM Peak Hour Trip: Synchro Distribution

West Maui Developments

December 2, 2004

Roadway Segment	Link	No. Lanes	Dir	2004 AM Peak Hour Background Traffic[1]	2011 West Maui Development Trips[2]	Total 2011 AM Peak Hour Trips
HONOAPIILANI HIGHWAY						
Office Rd to North of Office Rd	N - 11	2L	SB	184	82	266
North of Office Rd to Office Rd	11 - N		NB	461	110	571
Office Rd to North of Office Rd						
Napilihau St to Office Rd	11 - 10	2L	SB	184	209	393
Office Rd to Napilihau St	10 - 11		NB	461	222	683
Napilihau St to Office Rd						
Hoohui Rd to Napilihau St	10 - 9	2L	SB	425	348	773
Napilihau St to Hoohui Rd	9 - 10		NB	461	477	938
Hoohui Rd to Napilihau St						
Akahele St to Hoohui Rd	9 - 8	2L	SB	670	348	1,018
Hoohui Rd to Akahele St	8 - 9		NB	616	477	1,093
Akahele St to Hoohui Rd						
Lower Honoapiilani Hwy to Akahele St	8 - 7	2L	SB	667	538	1,205
Akahele St to Lower Honoapiilani Hwy	7 - 8		NB	962	510	1,472
Lower Honoapiilani Hwy to Akahele St						
Puukolii Rd to Lower Honoapiilani Hwy	7 - 6	4LD	SB	1,223	500	1,723
Lower Honoapiilani Hwy to Puukolii Rd	6 - 7		NB	1,298	506	1,804
Puukolii Rd to Lower Honoapiilani Hwy						
Kaanapali Pkwy to Puukolii Rd	6 - 5	4LD	SB	1,223	602	1,825
Puukolii Rd to Kaanapali Pkwy	5 - 6		NB	1,298	399	1,697
Kaanapali Pkwy to Puukolii Rd						
Lealii Pkwy to Kaanapali Pkwy	5 - 4	4LD	SB	1,073	288	1,361
Kaanapali Pkwy to Lealii Pkwy	4 - 5		NB	1,384	254	1,638
Lealii Pkwy to Kaanapali Pkwy						
Kapunakea Rd to Lealii Pkwy	4 - 3	4LD	SB	1,073	317	1,390
Lealii Pkwy to Kapunakea Rd	3 - 4		NB	1,384	241	1,625
Kapunakea Rd to Lealii Pkwy						
Dickenson St to Kapunakea Rd	3 - 2	4LD	SB	1,073	330	1,403
Kapunakea Rd to Dickenson St	2 - 3		NB	1,384	237	1,621
Dickenson St to Kapunakea Rd						
Aholo Rd to Dickenson St	2 - 1	2L	SB	1,073	156	1,229
Dickenson St to Aholo Rd	1 - 2		NB	1,384	129	1,513
Aholo Rd to Dickenson St						
South Honoapiilani Hwy to Aholo Rd	1-S	2L	SB	1,073	122	1,195
Aholo Rd to South Honoapiilani Hwy	S-1		NB	1,384	142	1,526
South Honoapiilani Hwy to Aholo Rd						

SB = Peak direction

[1] Background traffic counts conducted May 14 - 17, 2004, by Phillip Rowell & Associates
[2]Total trips generated by West Maui Developments through 2011

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table A-2. AM Peak Hour Trips: Generation
WEST MAUI DEVELOPMENTS (continued)
December 2, 2004

MAUI PREPARATORY ACADEMY	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
See Maui Prep Traffic Impact Report Wilson Okamoto Corporation (April, 2004)							Entering						
							Exiting						
							Entering						
							Exiting						
	0	Total Dwelling Units					Entering		0		0		199
							Exiting		0		0		134
							Total		0		0		333

Notes:
Small discrepancies, if any, are due to rounding.
[1] Rates and equations are from *Trip Generation* (ITE, 7th Edition, 2003), on a weekday. Peak Hour of Adjacent Street Traffic, One Houe Between 7 and 9 a.m.
[2] For greatest accuracy, where an equation is available, equation-generated trips are typically utilized unless "Y" intercept is much higher than the number of units.
[3]Where available, pass-by capture rates are "average pass-by trip percentages" from *Trip Generation Handbook: An ITE Recommended Practice* (ITE, March, 2001)

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

VILLAS AT KAHANA RIDGE	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Apartment ITE Code 220	117 dwelling units	0.51 /unit	T=0.49(X) + 3.73	60	61	61	Entering	20%	12	0%	12	0%	12
							Exiting	80%	49	0%	49	0%	49
							Entering						
							Exiting						
	117	Total Dwelling Units					Entering		12		12		12
							Exiting		49		49		49
							Total		61		61		61

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

PULELEHUA	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
See Pulelehua Transportation Impact Report HPE (August 10, 2004)							Entering						
							Exiting						
							Entering						
							Exiting						
							Entering		0		0		259
							Exiting		0		0		486
							Total		0		0		745

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

Table A-3. AM Peak Hour Trips: Generation
WEST MAUI DEVELOPMENTS (continued)
December 2, 2004

MAUI BREAKERS	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Data from W. Maui Breakers Traffic Impact Analysis LSC Transportation Consultants, Inc. (November 8, 2004)													
							Entering						
							Exiting						
	0	Total Dwelling Units					Entering		0		0		7
							Exiting		0		0		33
							Total		0		0		40

Notes:
Small discrepancies, if any, are due to rounding.
[1] Rates and equations are from *Trip Generation* (ITE, 7th Edition, 2003), on a weekday. Peak Hour of Adjacent Street Traffic, One Houe Between 7 and 9 a.m.
[2] For greatest accuracy, where an equation is available, equation-generated trips are typically utilized unless "Y" intercept is much higher than the number of units.
[3]Where available, pass-by capture rates are "average pass-by trip percentages" from *Trip Generation Handbook: An ITE Recommended Practice* (ITE, March, 2001)

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

DHHL HONOKOWAI	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Single-Family Detached Housing ITE Code 210	0 dwelling units	0.75 /unit	T = 0.70(X) + 9.43	0		0	Entering	25%	0	2%		43%	0
							Exiting	75%	0	3%		43%	0
							Entering						
							Exiting						
	0	Total Dwelling Units					Enterng		0		0		0
							Exiting		0		0		0
							Total		0		0		0

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

MARIOTT EXPANSION	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Data from Maui Marriott Ocean Club Traffic Report Phillip Rowell & Associates (October 24, 2002)	457 units	0.52 /unit	Ln(T)=0.82 Ln(X) + 0.32	238	209	209	Entering	67%	140	2%	137	43%	78
							Exiting	33%	69	3%	67	43%	38
							Entering						
							Exiting						
							Entering		140		137		7
							Exiting		69		67		13
							Total		209		204		20

Internal Capture Summary
Entering 3
Exiting 2
Captured 5

Table A-4. AM Peak Hour Trips: Generation
WEST MAUI DEVELOPMENTS (continued)
December 2, 2004

HYATT EXPANSION	Units[4]	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Residential Condo/Townhouse ITE Code 230	196 units	0.44 /unit	Ln(T)=0.80 Ln(X) + 0.26	86	88	88	Entering	17%	15	25%	11	0%	11
							Exiting	83%	73	25%	55	0%	55
							Entering						
							Exiting						
	196	Total Dwelling Units					Entering		15		11		11
							Exiting		73		55		55
							Total		88		66		66

Notes:
Small discrepancies, if any, are due to rounding.
[1] Rates and equations are from *Trip Generation* (ITE, 7th Edition, 2003), on a weekday.
Peak Hour of Adjacent Street Traffic, One Houe Between 7 and 9 a.m.
[2] For greatest accuracy, where an equation is available, equation-generated trips are typically utilized unless "Y" intercept is much higher than the number of units.
[3]Where available, pass-by capture rates are "average pass-by trip percentages" from *Trip Generation Handbook: An ITE Recommended Practice* (ITE, March, 2001)
[4]Total dwelling units calculated based on 153 MF units + (173 lockout units X .25) = 196

Internal Capture Summary

Entering	4
Exiting	18
Captured	22

KIHUNE	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Apartment ITE Code 220	20 dwelling units	0.51 /unit	T=0.49(X) + 3.73	10	14	14	Entering	20%	3	0%	3	0%	3
							Exiting	80%	11	0%	11	0%	11
							Entering						
							Exiting						
	20	Total Dwelling Units					Entering		3		3		3
							Exiting		11		11		11
							Total		14		14		14

Internal Capture Summary

Entering	0
Exiting	0
Captured	0

INTRAWEST	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Apartment ITE Code 220	76 dwelling units	0.51 /unit	T=0.49(X) + 3.73	39	41	41	Entering	20%	8	25%	6	0%	6
							Exiting	80%	33	25%	25	0%	25
Hotel ITE Code 310	624 rooms	0.56 /rm	Ln(T)=1.24 Ln(X) - 2.00	349	396	396	Entering	53%	210	25%	157	0%	157
							Exiting	47%	186	25%	140	0%	140
							Entering		218		163		163
							Exiting		219		164		164
							Total		437		328		328

Internal Capture Summary

Entering	54
Exiting	55
Captured	109

Table A-5. AM Peak Hour Trips: Generation
WEST MAUI DEVELOPMENTS (continued)
December 2, 2004

KA'NAPALI 2020	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Single-Family Detached Housing ITE Code 210	200 dwelling units	0.75 /unit	T = 0.70(X) + 9.43	150	149	149	Entering	25%	37	25%	28	0%	28
							Exiting	75%	112	25%	84	0%	84
Apartment ITE Code 220	200 dwelling units	0.51 /unit	T=0.49(X) + 3.73	102	102	102	Entering	20%	20	25%	15	0%	15
							Exiting	80%	81	25%	61	0%	61
	400	Total Dwelling Units					Entering		58		43		43
							Exiting		193		145		145
							Total		251		188		188

Notes:
Small discrepancies, if any, are due to rounding.
[1] Rates and equations are from *Trip Generation* (ITE, 7th Edition, 2003), on a weekday.
Peak Hour of Adjacent Street Traffic, One Houe Between 7 and 9 a.m.
[2] For greatest accuracy, where an equation is available, equation-generated trips are typically utilized unless "Y" intercept is much higher than the number of units.
[3]Where available, pass-by capture rates are "average pass-by trip percentages" from *Trip Generation Handbook: An ITE Recommended Practice* (ITE, March, 2001)

Internal Capture Summary

Entering	14
Exiting	48
Captured	63

STARWOOD	Units[4]	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Apartment ITE Code 220	258 dwelling units	0.51 /unit	T=0.49(X) + 3.73	132	130	130	Entering	20%	26	25%	20	0%	20
							Exiting	80%	104	25%	78	0%	78
							Entering						
							Exiting						
							Entering						
							Exiting						
	258	Total Dwelling Units					Entering		26		20		20
							Exiting		104		78		78
							Total		130		98		98

[4]Total dwelling units calculated based on 258 MF units + (258 lockout units X .25) = 323

Internal Capture Summary

Entering	7
Exiting	26
Captured	33

PALISADES AT KAANAPALI	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
See Traffic Impact Assessment Report for Lanikeha Phil Rowell and Associates (July 22, 2004)							Entering						
							Exiting						
							Entering						
							Exiting						
							Entering		0		0		21
							Exiting		0		0		25
							Total		0		0		46

Internal Capture Summary

Entering	0
Exiting	0
Captured	0

Table A-6. AM Peak Hour Trips: Generation
WEST MAUI DEVELOPMENTS (continued)
December 2, 2004

LAND TECH	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Single-Family Detached Housing ITE Code 210	18 dwelling units	0.75 /unit	T = 0.70(X) + 9.43	14	22	22	Entering Exiting	25% 75%	6 17	25% 25%	4 12	0% 0%	4 12
							Entering Exiting						
	18	Total Dwelling Units					Entering Exiting Total		6 17 22		4 12 17		4 12 17

Notes:
Small discrepancies, if any, are due to rounding.
[1] Rates and equations are from *Trip Generation* (ITE, 7th Edition, 2003), on a weekday.
Peak Hour of Adjacent Street Traffic, One Houe Between 7 and 9 a.m.
[2] For greatest accuracy, where an equation is available, equation-generated trips are typically utilized unless "Y" intercept is much higher than the number of units.
[3] Where available, pass-by capture rates are "average pass-by trip percentages" from *Trip Generation Handbook: An ITE Recommended Practice* (ITE, March, 2001)

Internal Capture Summary
Entering 1
Exiting 4
Captured 6

VILLAGES AT LEIALII	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Single-Family Detached Housing ITE Code 210	104 dwelling units	0.75 /unit	T = 0.70(X) + 9.43	78	82	82	Entering Exiting	25% 75%	21 62	0% 0%	21 62	0% 0%	21 62
							Entering Exiting						
	104	Total Dwelling Units					Entering Exiting Total		21 62 82		21 62 82		21 62 82

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

WEST MAUI RESOURCE CTR PHASE II	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Single-Family Detached Housing ITE Code 210	26 dwelling units	0.75 /unit	T = 0.70(X) + 9.43	20	28	28	Entering Exiting	25% 75%	7 21	0% 0%	7 21	0% 0%	7 21
							Entering Exiting						
							Entering Exiting Total		7 21 28		7 21 28		7 21 28

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

Table A-7. AM Peak Hour Trips: Generation
WEST MAUI DEVELOPMENTS (continued)
December 2, 2004

LOKAHAI PACFIC	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Single-Family Detached Housing ITE Code 210	12 dwelling units	0.75 /unit	T = 0.70(X) + 9.43	9	18	18	Entering Exiting	25% 75%	4 13	0% 0%	4 13	0% 0%	4 13
							Entering Exiting						
	12	Total Dwelling Units					Entering Exiting Total		4 13 18		4 13 18		4 13 18

Notes:
Small discrepancies, if any, are due to rounding.
[1] Rates and equations are from *Trip Generation* (ITE, 7th Edition, 2003), on a weekday.
Peak Hour of Adjacent Street Traffic, One Houe Between 7 and 9 a.m.
[2] For greatest accuracy, where an equation is available, equation-generated trips are typically utilized unless "Y" intercept is much higher than the number of units.
[3] Where available, pass-by capture rates are "average pass-by trip percentages" from *Trip Generation Handbook: An ITE Recommended Practice* (ITE, March, 2001)

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

WAINEE VILLAGE	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Single-Family Detached Housing ITE Code 210	100 dwelling units	0.75 /unit	T = 0.70(X) + 9.43	75	79	79	Entering Exiting	25% 75%	20 60	15% 15%	17 51	0% 0%	17 51
Apartment ITE Code 220	60 dwelling units	0.51 /unit	T=0.49(X) + 3.73	31	33	33	Entering Exiting	20% 80%	7 27	15% 15%	6 23	0% 0%	6 23
	160	Total Dwelling Units					Entering Exiting Total		26 86 113		23 73 96		23 73 96

Internal Capture Summary
Entering 4
Exiting 13
Captured 17

PLANTATION INN	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
See Traffic Impact Assessment Report for Plantation Inn Phillip Rowell and Associates (May 8, 2002)							Entering Exiting						
							Entering Exiting						
							Entering Exiting Total		0 0 0		0 0 0		2 4 6

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

Table A-8. AM Peak Hour Trips: Generation
WEST MAUI DEVELOPMENTS (continued)
December 2, 2004

PUUNOA VILLAGE	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
See Traffic Impact Report for Pu'unoa Residential Subdivision Austin, Tsunami & Associates, Inc. (April, 2003)	0						Entering	63%	0	0%	0	0%	0
							Exiting	37%	0	0%	0	0%	0
							Entering						
							Exiting						
	0	Total Dwelling Units					Entering		0		0		0
							Exiting		0		0		0
							Total		0		0		0

Notes:
Small discrepancies, if any, are due to rounding.
[1] Rates and equations are from *Trip Generation* (ITE, 7th Edition, 2003), on a weekday.
Peak Hour of Adjacent Street Traffic, One Houe Between 7 and 9 a.m.
[2] For greatest accuracy, where an equation is available, equation-generated trips are typically utilized unless "Y" intercept is much higher than the number of units.
[3] Where available, pass-by capture rates are "average pass-by trip percentages" from *Trip Generation Handbook: An ITE Recommended Practice* (ITE, March, 2001)

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

MAKILA	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Single-Family Detached Housing ITE Code 210	40 dwelling units	0.75 /unit	T = 0.70(X) + 9.43	30	37	37	Entering	25%	9	0%	9	0%	9
							Exiting	75%	28	0%	28	0%	28
Apartment (Ohana Units) ITE Code 220	40 dwelling units	0.51 /unit	T=0.49(X) + 3.73	20	23	23	Entering	20%	5	0%	5	0%	5
							Exiting	80%	19	0%	19	0%	19
	80	Total Dwelling Units					Entering		14		14		14
							Exiting		47		47		47
							Total		61		61		61

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

OLOWALU	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Single-Family Detached Housing ITE Code 210	20 dwelling units	0.75 /unit	T = 0.70(X) + 9.43	15	23	23	Entering	25%	6	0%	6	0%	6
							Exiting	75%	18	0%	18	0%	18
Apartment (Ohana Units) ITE Code 220	20 dwelling units	0.51 /unit	T=0.49(X) + 3.73	10	14	14	Entering	20%	3	0%	3	0%	3
							Exiting	80%	11	0%	11	0%	11
							Entering		9		9		9
							Exiting		28		28		28
							Total		37		37		37

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

Table A-9. AM Peak Hour Trips: Generation
WEST MAUI DEVELOPMENTS (continued)
December 2, 2004

UKUMEHAME	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Single-Family Detached Housing ITE Code 210	46 dwelling units	0.75 /unit	T = 0.70(X) + 9.43	35	42	42	Entering	25%	10	0%	10	0%	10
							Exiting	75%	31	0%	31	0%	31
Apartment (Ohana Units) ITE Code 220	46 dwelling units	0.51 /unit	T=0.49(X) + 3.73	23	26	26	Entering	20%	5	0%	5	0%	5
							Exiting	80%	21	0%	21	0%	21
	92	Total Dwelling Units					Entering		16		16		16
							Exiting		52		52		52
							Total		68		68		68

Notes:
Small discrepancies, if any, are due to rounding.
[1] Rates and equations are from *Trip Generation* (ITE, 7th Edition, 2003), on a weekday.
Peak Hour of Adjacent Street Traffic, One Houe Between 7 and 9 a.m.
[2] For greatest accuracy, where an equation is available, equation-generated trips are typically utilized unless "Y" intercept is much higher than the number of units.
[3] Where available, pass-by capture rates are "average pass-by trip percentages" from *Trip Generation Handbook: An ITE Recommended Practice* (ITE, March, 2001)

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
							Entering						
							Exiting						
							Entering						
							Exiting						
	0	Total Dwelling Units					Entering		0		0		0
							Exiting		0		0		0
							Total		0		0		0

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

	Units	AM Pk Hr Trips Rate[1]	AM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
							Entering		0		0		0
							Exiting		0		0		0
							Total		0		0		0

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

Table B-1
AM Peak Hour Trip Distribution

HONOLUA RIDGE

December 2, 2004

Total Trips: 27
Entering: 7
Exiting: 20

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New AM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to site	N - 11	2L	**SB**	10%	0%	**1**
Site to North of Office Rd	11 - N		NB	0%	10%	2
Site to Office Rd	N - 11	2L	**SB**	0%	90%	**18**
Office Rd to Site	11 - N		NB	90%	0%	6
Office Rd to Napilihau St	11 - 10	2L	**SB**	0%	80%	**16**
Napilihau St to Office Rd	10 - 11		NB	80%	0%	5
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	0%	50%	**10**
Hoohui Rd to Napilihau St	9 - 10		NB	50%	0%	3
Hoohui Rd to Akahele St	9 - 8	2L	SB	0%	50%	**10**
Akahele St to Hoohui Rd	8 - 9		NB	50%	0%	3
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	0%	30%	**6**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	30%	0%	2
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	SB	0%	20%	**4**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	20%	0%	1
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	SB	0%	20%	**4**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	20%	0%	1
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	SB	0%	5%	**1**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	5%	0%	0
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	SB	0%	5%	**1**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	5%	0%	0
Kapunakea Rd to Dickenson St	3 - 2	4LD	SB	0%	5%	**1**
Dickenson St to Kapunakea Rd	2 - 3		NB	5%	0%	0
Dickenson St to Aholo Rd	2 - 1	2L	SB	0%	0%	**0**
Aholo Rd to Dickenson St	1 - 2		NB	0%	0%	0
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	0%	**0**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	0%	0%	0

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-2
AM Peak Hour Trip Distribution

KAPALUA MAUKA

December 2, 2004

Total Trips: 110
Entering: 25
Exiting: 85

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New AM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	5%	0%	**1**
Office Rd to North of Office Rd	11 - N		NB	0%	5%	4
Office Rd to Napilihau St	11 - 10	2L	**SB**	0%	80%	**68**
Napilihau St to Office Rd	10 - 11		NB	80%	0%	20
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	0%	50%	**42**
Hoohui Rd to Napilihau St	9 - 10		NB	50%	0%	13
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	0%	50%	**42**
Akahele St to Hoohui Rd	8 - 9		NB	50%	0%	13
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	0%	30%	**25**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	30%	0%	8
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	**SB**	0%	20%	**17**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	20%	0%	5
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	0%	20%	**17**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	20%	0%	5
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	0%	5%	**4**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	5%	0%	1
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	0%	5%	**4**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	5%	0%	1
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	0%	5%	**4**
Dickenson St to Kapunakea Rd	2 - 3		NB	5%	0%	1
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	0%	**0**
Aholo Rd to Dickenson St	1 - 2		NB	0%	0%	0
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	0%	**0**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	0%	0%	0

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	**1 - 2**
Dickenson Street to Kapunakea Road	**2 - 3**
Kapunakea Road to Lealii Parkway	**3 - 4**
Lealii Parkway to Kaanapali Parkway	**4 - 5**
Kaanapali Parkway to Puukolii Road	**5 - 6**
Puukolii Road to Lower Honoapiilani Highway	**6 - 7**
Lower Honoapiilani Highway to Akahele Street	**7 - 8**
Akahele Street to Hoohui Road	**8 - 9**
Hoohui Road to Napilihau Street	**9 - 10**
Napilihau STreet to Office Rd	**10 - 11**

Table B-3
AM Peak Hour Trip Distribution

PU'U KAHANA

December 2, 2004

Total Trips: 23
Entering: 6
Exiting: 17

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New AM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	10%	0%	**1**
Office Rd to North of Office Rd	11 - N		NB	0%	10%	2
Office Rd to Napiilihau St	11 - 10	2L	**SB**	20%	0%	**1**
Napilihau St to Office Rd	10 - 11		NB	0%	20%	3
Napilihau St to Site	10 - 9	2L	**SB**	40%	0%	**2**
Site to Napilihau St	9 - 10		NB	0%	40%	7
Site to Hoohui Rd	10 - 9	2L	**SB**	0%	60%	**10**
Hoohui Rd to Site	9 - 10		NB	60%	0%	3
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	0%	60%	**10**
Akahele St to Hoohui Rd	8 - 9		NB	60%	0%	3
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	0%	40%	**7**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	40%	0%	2
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	**SB**	0%	30%	**5**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	30%	0%	2
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	0%	30%	**5**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	30%	0%	2
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	0%	5%	**1**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	5%	0%	0
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	0%	5%	**1**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	5%	0%	0
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	0%	5%	**1**
Dickenson St to Kapunakea Rd	2 - 3		NB	5%	0%	0
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	0%	**0**
Aholo Rd to Dickenson St	1 - 2		NB	0%	0%	0
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	0%	**0**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	0%	0%	0

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-4
AM Peak Hour Trip Distribution

MAUI PREPARATORY ACADEMY

December 2, 2004

Total Trips: 333
Entering: 199
Exiting: 134

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New AM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	10%	0%	**20**
Office Rd to North of Office Rd	11 - N		NB	0%	10%	13
Office Rd to Napilihau St	11 - 10	2L	**SB**	20%	0%	**40**
Napilihau St to Office Rd	10 - 11		NB	0%	20%	27
Napilihau St to Site	10 - 9	2L	**SB**	30%	0%	**60**
Site to Napilihau St	9 - 10		NB	0%	30%	40
Site to Hoohui Rd	10 - 9	2L	**SB**	0%	70%	**94**
Hoohui Rd to Site	9 - 10		NB	70%	0%	139
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	0%	70%	**94**
Akahele St to Hoohui Rd	8 - 9		NB	70%	0%	139
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	0%	50%	**67**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	50%	0%	100
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	**SB**	0%	40%	**54**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	40%	0%	80
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	0%	40%	**54**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	40%	0%	80
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	0%	15%	**20**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	15%	0%	30
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	0%	15%	**20**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	15%	0%	30
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	0%	15%	**20**
Dickenson St to Kapunakea Rd	2 - 3		NB	15%	0%	30
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	5%	**7**
Aholo Rd to Dickenson St	1 - 2		NB	5%	0%	10
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	5%	**7**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	5%	0%	10

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-5
AM Peak Hour Trip Distribution
VILLAS AT KAHANA RIDGE

December 2, 2004

Total Trips: 61
Entering: 12
Exiting: 49

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New AM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	10%	0%	**1**
Office Rd to North of Office Rd	11 - N		NB	0%	10%	5
Office Rd to Napilihau St	11 - 10	2L	**SB**	20%	0%	**2**
Napilihau St to Office Rd	10 - 11		NB	0%	20%	10
Napilihau St to Site	10 - 9	2L	**SB**	40%	0%	**5**
Site to Napilihau St	9 - 10		NB	0%	40%	20
Site to Hoohui Rd	10 - 9	2L	**SB**	0%	60%	**29**
Hoohui Rd to Site	9 - 10		NB	60%	0%	7
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	0%	60%	**29**
Akahele St to Hoohui Rd	8 - 9		NB	60%	0%	7
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	0%	40%	**20**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	40%	0%	5
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	**SB**	0%	30%	**15**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	30%	0%	4
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	0%	30%	**15**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	30%	0%	4
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	0%	5%	**2**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	5%	0%	1
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	0%	5%	**2**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	5%	0%	1
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	0%	5%	**2**
Dickenson St to Kapunakea Rd	2 - 3		NB	5%	0%	1
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	0%	**0**
Aholo Rd to Dickenson St	1 - 2		NB	0%	0%	0
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	0%	**0**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	0%	0%	0

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	**1 - 2**
Dickenson Street to Kapunakea Road	**2 - 3**
Kapunakea Road to Lealii Parkway	**3 - 4**
Lealii Parkway to Kaanapali Parkway	**4 - 5**
Kaanapali Parkway to Puukolii Road	**5 - 6**
Puukolii Road to Lower Honoapiilani Highway	**6 - 7**
Lower Honoapiilani Highway to Akahele Street	**7 - 8**
Akahele Street to Hoohui Road	**8 - 9**
Hoohui Road to Napilihau Street	**9 - 10**
Napilihau Street to Office Road	**10 - 11**

Table B-6
AM Peak Hour Trip Distribution
PULELEHUA [Refer to the Pulelehua Report]

December 2, 2004

Total Trips: 745
Entering: 259
Exiting: 486

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New AM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**			
Office Rd to North of Office Rd	11 - N		NB			
Office Rd to Napilihau St	11 - 10	2L	**SB**			
Napilihau St to Office Rd	10 - 11		NB			
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**			
Hoohui Rd to Napilihau St	9 - 10		NB			
Hoohui Rd to Site	9 - 8	2L	**SB**			
Site to Hoohui Rd	8 - 9		NB			
Site to Akahele St	8 - 7	2L	**SB**			
Akahele St to Site	7 - 8		NB			
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**			
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB			
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	**SB**			
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB			
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**			
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB			
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**			
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB			
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**			
Kapunakea Rd to Lealii Pkwy	3 - 4		NB			
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**			
Dickenson St to Kapunakea Rd	2 - 3		NB			
Dickenson St to Aholo Rd	2 - 1	2L	**SB**			
Aholo Rd to Dickenson St	1 - 2		NB			
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**			
South Honoapiilani Hwy to Aholo Rd	S-1		NB			

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	**1 - 2**
Dickenson Street to Kapunakea Road	**2 - 3**
Kapunakea Road to Lealii Parkway	**3 - 4**
Lealii Parkway to Kaanapali Parkway	**4 - 5**
Kaanapali Parkway to Puukolii Road	**5 - 6**
Puukolii Road to Lower Honoapiilani Highway	**6 - 7**
Lower Honoapiilani Highway to Akahele Street	**7 - 8**
Akahele Street to Hoohui Road	**8 - 9**
Hoohui Road to Napilihau Street	**9 - 10**
Napilihau Street to Office Road	**10 - 11**

Table B-7
AM Peak Hour Trip Distribution
MAUI BREAKERS

December 2, 2004

Total Trips: 40
Entering: 7
Exiting: 33

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New AM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	10%	0%	**1**
Office Rd to North of Office Rd	11 - N		NB	0%	10%	3
Office Rd to Napilihau St	11 - 10	2L	**SB**	20%	0%	**1**
Napilihau St to Office Rd	10 - 11		NB	0%	20%	7
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	30%	0%	**2**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	30%	10
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	30%	0%	**2**
Akahele St to Hoohui Rd	8 - 9		NB	0%	30%	10
Akahele St to Site	8 - 7	2L	**SB**	50%	0%	**4**
Site to Akahele St	7 - 8		NB	0%	50%	17
Site to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	0%	50%	**17**
Lower Honoapiilani Hwy to Site	7 - 8		NB	50%	0%	4
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	**SB**	0%	40%	**13**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	40%	0%	3
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	0%	25%	**8**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	25%	0%	2
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	0%	15%	**5**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	15%	0%	1
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	0%	15%	**5**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	15%	0%	1
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	0%	15%	**5**
Dickenson St to Kapunakea Rd	2 - 3		NB	15%	0%	1
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	5%	**2**
Aholo Rd to Dickenson St	1 - 2		NB	5%	0%	0
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	5%	**2**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	5%	0%	0

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-8
AM Peak Hour Trip Distribution
DHHL HONOKOWAI

December 2, 2004

Total Trips: 0
Entering: 0
Exiting: 0

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New AM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**			**0**
Office Rd to North of Office Rd	11 - N		NB			0
Office Rd to Napilihau St	11 - 10	2L	**SB**			**0**
Napilihau St to Office Rd	10 - 11		NB			0
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**			**0**
Hoohui Rd to Napilihau St	9 - 10		NB			0
Hoohui Rd to Akahele St	9 - 8	2L	**SB**			**0**
Akahele St to Hoohui Rd	8 - 9		NB			0
Akahele St to Site	8 - 7	2L	**SB**			**0**
Site to Akahele St	7 - 8		NB			0
Site to Lower Honoapiilani Hwy	8 - 7	2L	**SB**			**0**
Lower Honoapiilani Hwy to Site	7 - 8		NB			0
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	**SB**			**0**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB			0
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**			**0**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB			0
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**			**0**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB			0
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**			**0**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB			0
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**			**0**
Dickenson St to Kapunakea Rd	2 - 3		NB			0
Dickenson St to Aholo Rd	2 - 1	2L	**SB**			**0**
Aholo Rd to Dickenson St	1 - 2		NB			0
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**			**0**
South Honoapiilani Hwy to Aholo Rd	S-1		NB			0

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-9
AM Peak Hour Trip Distribution
MARRIOTT EXPANSION

December 2, 2004

Total Trips: 20
Entering: 7
Exiting: 13

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New AM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	5%	0%	**0**
Office Rd to North of Office Rd	11 - N		NB	0%	5%	1
Office Rd to Napilihau St	11 - 10	2L	**SB**	10%	0%	**1**
Napilihau St to Office Rd	10 - 11		NB	0%	10%	1
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	20%	0%	**1**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	20%	3
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	20%	0%	**1**
Akahele St to Hoohui Rd	8 - 9		NB	0%	20%	3
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	40%	0%	**3**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	40%	5
Lower Honoapiilani Hwy to Site	7 - 6	2L	**SB**	50%	0%	**4**
Site to Lower Honoapiilani Hwy	6 - 7		NB	0%	50%	7
Site to Puukolii Rd	7 - 6	4LD	**SB**	0%	50%	**7**
Puukolii Rd to Site	6 - 7		NB	50%	0%	4
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	0%	50%	**7**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	50%	0%	4
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	0%	25%	**3**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	25%	0%	2
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	0%	25%	**3**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	25%	0%	2
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	0%	25%	**3**
Dickenson St to Kapunakea Rd	2 - 3		NB	25%	0%	2
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	5%	**1**
Aholo Rd to Dickenson St	1 - 2		NB	5%	0%	0
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	5%	**1**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	5%	0%	0

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-10
AM Peak Hour Trip Distribution
HYATT EXPANSION

December 2, 2004

Total Trips: 66
Entering: 11
Exiting: 55

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New AM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	5%	0%	**1**
Office Rd to North of Office Rd	11 - N		NB	0%	5%	3
Office Rd to Napilihau St	11 - 10	2L	**SB**	10%	0%	**1**
Napilihau St to Office Rd	10 - 11		NB	0%	10%	6
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	20%	0%	**2**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	20%	11
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	20%	0%	**2**
Akahele St to Hoohui Rd	8 - 9		NB	0%	20%	11
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	40%	0%	**5**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	40%	22
Lower Honoapiilani Hwy to Site	7 - 6	2L	**SB**	50%	0%	**6**
Site to Lower Honoapiilani Hwy	6 - 7		NB	0%	50%	28
Site to Puukolii Rd	7 - 6	4LD	**SB**	0%	50%	**28**
Puukolii Rd to Site	6 - 7		NB	50%	0%	6
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	0%	50%	**28**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	50%	0%	6
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	0%	25%	**14**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	25%	0%	3
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	0%	25%	**14**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	25%	0%	3
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	0%	25%	**14**
Dickenson St to Kapunakea Rd	2 - 3		NB	25%	0%	3
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	5%	**3**
Aholo Rd to Dickenson St	1 - 2		NB	5%	0%	1
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	5%	**3**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	5%	0%	1

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-11
AM Peak Hour Trip Distribution

KIHUNE

December 2, 2004

Total Trips: 14
Entering: 3
Exiting: 11

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New AM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	5%	0%	**0**
Office Rd to North of Office Rd	11 - N		NB	0%	5%	1
Office Rd to Napilihau St	11 - 10	2L	**SB**	10%	0%	**0**
Napilihau St to Office Rd	10 - 11		NB	0%	10%	1
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	20%	0%	**1**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	20%	2
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	20%	0%	**1**
Akahele St to Hoohui Rd	8 - 9		NB	0%	20%	2
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	40%	0%	**1**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	40%	4
Lower Honoapiilani Hwy to Site	7 - 6	2L	**SB**	50%	0%	**1**
Site to Lower Honoapiilani Hwy	6 - 7		NB	0%	50%	5
Site to Puukolii Rd	7 - 6	4LD	**SB**	0%	50%	**5**
Puukolii Rd to Site	6 - 7		NB	50%	0%	1
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	0%	50%	**5**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	50%	0%	1
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	0%	25%	**3**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	25%	0%	1
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	0%	25%	**3**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	25%	0%	1
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	0%	25%	**3**
Dickenson St to Kapunakea Rd	2 - 3		NB	25%	0%	1
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	5%	**1**
Aholo Rd to Dickenson St	1 - 2		NB	5%	0%	0
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	5%	**1**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	5%	0%	0

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-12
AM Peak Hour Trip Distribution

INTRAWEST

December 2, 2004

Total Trips: 328
Entering: 163
Exiting: 164

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New AM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	5%	0%	**8**
Office Rd to North of Office Rd	11 - N		NB	0%	5%	8
Office Rd to Napilihau St	11 - 10	2L	**SB**	10%	0%	**16**
Napilihau St to Office Rd	10 - 11		NB	0%	10%	16
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	20%	0%	**33**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	20%	33
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	20%	0%	**33**
Akahele St to Hoohui Rd	8 - 9		NB	0%	20%	33
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	40%	0%	**65**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	40%	66
Lower Honoapiilani Hwy to Site	7 - 6	2L	**SB**	50%	0%	**82**
Site to Lower Honoapiilani Hwy	6 - 7		NB	0%	50%	82
Site to Puukolii Rd	7 - 6	4LD	**SB**	0%	50%	**82**
Puukolii Rd to Site	6 - 7		NB	50%	0%	82
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	0%	50%	**82**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	50%	0%	82
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	0%	25%	**41**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	25%	0%	41
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	SB	0%	25%	**41**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	25%	0%	41
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	0%	25%	**41**
Dickenson St to Kapunakea Rd	2 - 3		NB	25%	0%	41
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	5%	**8**
Aholo Rd to Dickenson St	1 - 2		NB	5%	0%	8
Aholo Rd to South Honoapiilani Hwy	1-S	2L	SB	0%	5%	**8**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	5%	0%	8

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-13
AM Peak Hour Trip Distribution
KA'NAPALI 2020

December 2, 2004

Total Trips: 188
Entering: 43
Exiting: 145

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New AM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	5%	0%	**2**
Office Rd to North of Office Rd	11 - N		NB	0%	5%	7
Office Rd to Napilihau St	11 - 10	2L	**SB**	10%	0%	**4**
Napilihau St to Office Rd	10 - 11		NB	0%	10%	15
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	20%	0%	**9**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	20%	29
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	20%	0%	**9**
Akahele St to Hoohui Rd	8 - 9		NB	0%	20%	29
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	40%	0%	**17**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	40%	58
Lower Honoapiilani Hwy to Site	7 - 6	2L	**SB**	50%	0%	**22**
Site to Lower Honoapiilani Hwy	6 - 7		NB	0%	50%	73
Site to Puukolii Rd	7 - 6	4LD	**SB**	0%	50%	**73**
Puukolii Rd to Site	6 - 7		NB	50%	0%	22
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	0%	50%	**73**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	50%	0%	22
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	0%	25%	**36**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	25%	0%	11
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	0%	25%	**36**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	25%	0%	11
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	0%	25%	**36**
Dickenson St to Kapunakea Rd	2 - 3		NB	25%	0%	11
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	5%	**7**
Aholo Rd to Dickenson St	1 - 2		NB	5%	0%	2
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	5%	**7**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	5%	0%	2

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	**1 - 2**
Dickenson Street to Kapunakea Road	**2 - 3**
Kapunakea Road to Lealii Parkway	**3 - 4**
Lealii Parkway to Kaanapali Parkway	**4 - 5**
Kaanapali Parkway to Puukolii Road	**5 - 6**
Puukolii Road to Lower Honoapiilani Highway	**6 - 7**
Lower Honoapiilani Highway to Akahele Street	**7 - 8**
Akahele Street to Hoohui Road	**8 - 9**
Hoohui Road to Napilihau Street	**9 - 10**
Napilihau Street to Office Road	**10 - 11**

Table B-14
AM Peak Hour Trip Distribution
STARWOOD

December 2, 2004

Total Trips: 98
Entering: 20
Exiting: 78

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New AM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	5%	0%	**1**
Office Rd to North of Office Rd	11 - N		NB	0%	5%	4
Office Rd to Napilihau St	11 - 10	2L	**SB**	10%	0%	**2**
Napilihau St to Office Rd	10 - 11		NB	0%	10%	8
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	20%	0%	**4**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	20%	16
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	20%	0%	**4**
Akahele St to Hoohui Rd	8 - 9		NB	0%	20%	16
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	40%	0%	**8**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	40%	31
Lower Honoapiilani Hwy to Site	7 - 6	2L	**SB**	50%	0%	**10**
Site to Lower Honoapiilani Hwy	6 - 7		NB	0%	50%	39
Site to Puukolii Rd	7 - 6	4LD	**SB**	0%	50%	**39**
Puukolii Rd to Site	6 - 7		NB	50%	0%	10
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	0%	50%	**39**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	50%	0%	10
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	0%	25%	**20**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	25%	0%	5
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	0%	25%	**20**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	25%	0%	5
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	0%	25%	**20**
Dickenson St to Kapunakea Rd	2 - 3		NB	25%	0%	5
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	5%	**4**
Aholo Rd to Dickenson St	1 - 2		NB	5%	0%	1
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	5%	**4**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	5%	0%	1

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	**1 - 2**
Dickenson Street to Kapunakea Road	**2 - 3**
Kapunakea Road to Lealii Parkway	**3 - 4**
Lealii Parkway to Kaanapali Parkway	**4 - 5**
Kaanapali Parkway to Puukolii Road	**5 - 6**
Puukolii Road to Lower Honoapiilani Highway	**6 - 7**
Lower Honoapiilani Highway to Akahele Street	**7 - 8**
Akahele Street to Hoohui Road	**8 - 9**
Hoohui Road to Napilihau Street	**9 - 10**
Napilihau Street to Office Road	**10 - 11**

Table B-15
AM Peak Hour Trip Distribution
PALISADES AT KAANAPALI

December 2, 2004

Total Trips: 46
Entering: 21
Exiting: 25

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New AM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	5%	0%	**1**
Office Rd to North of Office Rd	11 - N		NB	0%	5%	1
Office Rd to Napilihau St	11 - 10	2L	**SB**	10%	0%	**2**
Napilihau St to Office Rd	10 - 11		NB	0%	10%	3
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	20%	0%	**4**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	20%	5
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	20%	0%	**4**
Akahele St to Hoohui Rd	8 - 9		NB	0%	20%	5
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	40%	0%	**8**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	40%	10
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	2L	**SB**	50%	0%	**11**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	0%	50%	13
Puukolii Rd to Site	6 - 5	4LD	**SB**	50%	0%	**11**
Site to Puukolii Rd	5 - 6		NB	0%	50%	13
Site to Kaanapali Pkwy	5 - 4	4LD	**SB**	0%	25%	**6**
Kaanapali Pkwy to Site	4 - 5		NB	25%	0%	5
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	0%	25%	**6**
Lealii Pkwy to Kaasnapali Pkwy	4 - 5		NB	25%	0%	5
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	0%	25%	**6**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	25%	0%	5
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	0%	25%	**6**
Dickenson St to Kapunakea Rd	2 - 3		NB	25%	0%	5
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	5%	**1**
Aholo Rd to Dickenson St	1 - 2		NB	5%	0%	1
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	5%	**1**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	5%	0%	1

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-16
AM Peak Hour Trip Distribution
LAND TECH

December 2, 2004

Total Trips: 17
Entering: 4
Exiting: 12

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New AM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	5%	0%	**0**
Office Rd to North of Office Rd	11 - N		NB	0%	5%	1
Office Rd to Napilihau St	11 - 10	2L	**SB**	10%	0%	**0**
Napilihau St to Office Rd	10 - 11		NB	0%	10%	1
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	20%	0%	**1**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	20%	2
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	20%	0%	**1**
Akahele St to Hoohui Rd	8 - 9		NB	0%	20%	2
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	40%	0%	**2**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	40%	5
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	2L	**SB**	50%	0%	**2**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	0%	50%	6
Puukolii Rd to Site	6 - 5	4LD	**SB**	50%	0%	**2**
Site to Puukolii Rd	5 - 6		NB	0%	50%	6
Site to Kaanapali Pkwy	5 - 4	4LD	**SB**	0%	25%	**3**
Kaanapali Pkwy to Site	4 - 5		NB	25%	0%	1
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	0%	25%	**3**
Lealii Pkwy to Kaasnapali Pkwy	4 - 5		NB	25%	0%	1
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	0%	25%	**3**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	25%	0%	1
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	0%	25%	**3**
Dickenson St to Kapunakea Rd	2 - 3		NB	25%	0%	1
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	5%	**1**
Aholo Rd to Dickenson St	1 - 2		NB	5%	0%	0
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	5%	**1**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	5%	0%	0

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-17
AM Peak Hour Trip Distribution
VILLAGES AT LEIALII

December 2, 2004

Total Trips: 82
Entering: 21
Exiting: 62

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New AM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	3%	0%	**1**
Office Rd to North of Office Rd	11 - N		NB	0%	3%	2
Office Rd to Napilihau St	11 - 10	2L	**SB**	5%	0%	**1**
Napilihau St to Office Rd	10 - 11		NB	0%	5%	3
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	10%	0%	**2**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	10%	6
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	10%	0%	**2**
Akahele St to Hoohui Rd	8 - 9		NB	0%	10%	6
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	15%	0%	**3**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	15%	9
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	2L	**SB**	15%	0%	**3**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	0%	15%	9
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	15%	0%	**3**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	0%	15%	9
Kaanapali Pkwy to Site	5 - 4	4LD	**SB**	40%	0%	**8**
Site to Kaanapali Pkwy	4 - 5		NB	0%	40%	25
Site to Lealii Pkwy	5 - 4	4LD	**SB**	0%	60%	**37**
Lealii Pkwy to Site	4 - 5		NB	60%	0%	12
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	0%	60%	**37**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	60%	0%	12
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	0%	60%	**37**
Dickenson St to Kapunakea Rd	2 - 3		NB	60%	0%	12
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	20%	**12**
Aholo Rd to Dickenson St	1 - 2		NB	20%	0%	4
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	20%	**12**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	20%	0%	4

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-18
AM Peak Hour Trip Distribution
WEST MAUI RESOURCE CENTER PHASE II

December 2, 2004

Total Trips: 28
Entering: 7
Exiting: 21

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New AM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	0%	0%	**0**
Office Rd to North of Office Rd	11 - N		NB	0%	0%	0
Office Rd to Napilihau St	11 - 10	2L	**SB**	0%	0%	**0**
Napilihau St to Office Rd	10 - 11		NB	0%	0%	0
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	0%	0%	**0**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	0%	0
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	0%	0%	**0**
Akahele St to Hoohui Rd	8 - 9		NB	0%	0%	0
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	5%	0%	**0**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	5%	1
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	2L	**SB**	10%	0%	**1**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	0%	10%	2
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	10%	0%	**1**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	0%	10%	2
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	30%	0%	**2**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	0%	30%	6
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	30%	0%	**2**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	0%	30%	6
Kapunakea Rd to Site	3 - 2	4LD	**SB**	30%	0%	**2**
Site to Kapunakea Rd	2 - 3		NB	0%	30%	6
Site to Dickenson	3 - 2	2L	**SB**	0%	80%	**17**
Dickenson St to Site	2 - 3		NB	80%	0%	6
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	20%	**4**
Aholo Rd to Dickenson St	1 - 2		NB	20%	0%	1
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	20%	**4**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	20%	0%	1

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-19
AM Peak Hour Trip Distribution
LOKAHAI PACIFIC

December 2, 2004

Total Trips: 18
Entering: 4
Exiting: 13

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New AM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	0%	0%	**0**
Office Rd to North of Office Rd	11 - N		NB	0%	0%	0
Office Rd to Napilihau St	11 - 10	2L	**SB**	0%	0%	**0**
Napilihau St to Office Rd	10 - 11		NB	0%	0%	0
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	0%	0%	**0**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	0%	0
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	0%	0%	**0**
Akahele St to Hoohui Rd	8 - 9		NB	0%	0%	0
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	5%	0%	**0**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	5%	1
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	2L	**SB**	10%	0%	**0**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	0%	10%	1
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	10%	0%	**0**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	0%	10%	1
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	60%	0%	**3**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	0%	60%	8
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	60%	0%	**3**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	0%	60%	8
Kapunakea Rd to Site	3 - 2	4LD	**SB**	30%	0%	**1**
Site to Kapunakea Rd	2 - 3		NB	0%	30%	4
Site to Dickenson	3 - 2	2L	**SB**	0%	20%	**3**
Dickenson St to Site	2 - 3		NB	20%	0%	1
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	20%	**3**
Aholo Rd to Dickenson St	1 - 2		NB	20%	0%	1
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	20%	**3**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	20%	0%	1

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-20
AM Peak Hour Trip Distribution
WAINEE VILLAGE

December 2, 2004

Total Trips: 96
Entering: 23
Exiting: 73

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New AM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	0%	0%	**0**
Office Rd to North of Office Rd	11 - N		NB	0%	0%	0
Office Rd to Napilihau St	11 - 10	2L	**SB**	0%	0%	**0**
Napilihau St to Office Rd	10 - 11		NB	0%	0%	0
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	0%	0%	**0**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	0%	0
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	0%	0%	**0**
Akahele St to Hoohui Rd	8 - 9		NB	0%	0%	0
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	5%	0%	**1**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	5%	4
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	**SB**	10%	0%	**2**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	0%	10%	7
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	10%	0%	**2**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	0%	10%	7
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	30%	0%	**7**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	0%	30%	22
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	30%	0%	**7**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	0%	30%	22
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	30%	0%	**7**
Dickenson St to Kapunakea Rd	2 - 3		NB	0%	30%	22
Dickenson to Site	2 - 1	2L	**SB**	0%	80%	**59**
Site to Dickenson	1 - 2		NB	80%	0%	18
Site to Aholo Rd	2 - 1	2L	**SB**	0%	20%	**15**
Aholo Rd to Site	1 - 2		NB	20%	0%	5
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	20%	**15**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	20%	0%	5

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-21
AM Peak Hour Trip Distribution
PLANTATION INN

December 2, 2004

Total Trips: 6
Entering: 2
Exiting: 4

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New AM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	0%	0%	**0**
Office Rd to North of Office Rd	11 - N		NB	0%	0%	0
Office Rd to Napilihau St	11 - 10	2L	**SB**	0%	0%	**0**
Napilihau St to Office Rd	10 - 11		NB	0%	0%	0
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	0%	0%	**0**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	0%	0
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	0%	0%	**0**
Akahele St to Hoohui Rd	8 - 9		NB	0%	0%	0
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	5%	0%	**0**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	5%	0
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	**SB**	10%	0%	**0**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	0%	10%	0
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	10%	0%	**0**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	0%	10%	0
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	30%	0%	**1**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	0%	30%	1
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	30%	0%	**1**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	0%	30%	1
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	30%	0%	**1**
Dickenson St to Kapunakea Rd	2 - 3		NB	0%	30%	1
Dickenson to Site	2 - 1	2L	**SB**	95%	0%	**2**
Site to Dickenson	1 - 2		NB	0%	95%	4
Site to Aholo Rd	2 - 1	2L	SB	0%	5%	**0**
Aholo Rd to Site	1 - 2		NB	5%	0%	0
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	5%	**0**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	5%	0%	0

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	**1 - 2**
Dickenson Street to Kapunakea Road	**2 - 3**
Kapunakea Road to Lealii Parkway	**3 - 4**
Lealii Parkway to Kaanapali Parkway	**4 - 5**
Kaanapali Parkway to Puukolii Road	**5 - 6**
Puukolii Road to Lower Honoapiilani Highway	**6 - 7**
Lower Honoapiilani Highway to Akahele Street	**7 - 8**
Akahele Street to Hoohui Road	**8 - 9**
Hoohui Road to Napilihau Street	**9 - 10**
Napilihau Street to Office Road	**10 - 11**

Table B-22
AM Peak Hour Trip Distribution
PUUNOA VILLAGE

December 2, 2004

Total Trips: 0
Entering: 0
Exiting: 0

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New AM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**			**0**
Office Rd to North of Office Rd	11 - N		NB			0
Office Rd to Napilihau St	11 - 10	2L	**SB**			**0**
Napilihau St to Office Rd	10 - 11		NB			0
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**			**0**
Hoohui Rd to Napilihau St	9 - 10		NB			0
Hoohui Rd to Akahele St	9 - 8	2L	**SB**			**0**
Akahele St to Hoohui Rd	8 - 9		NB			0
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**			**0**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB			0
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	**SB**			**0**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB			0
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**			**0**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB			0
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**			**0**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB			0
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**			**0**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB			0
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**			**0**
Dickenson St to Kapunakea Rd	2 - 3		NB			0
Dickenson to Site	2 - 1	2L	**SB**			**0**
Site to Dickenson	1 - 2		NB			0
Site to Aholo Rd	2 - 1	2L	**SB**			**0**
Aholo Rd to Site	1 - 2		NB			0
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**			**0**
South Honoapiilani Hwy to Aholo Rd	S-1		NB			0

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	**1 - 2**
Dickenson Street to Kapunakea Road	**2 - 3**
Kapunakea Road to Lealii Parkway	**3 - 4**
Lealii Parkway to Kaanapali Parkway	**4 - 5**
Kaanapali Parkway to Puukolii Road	**5 - 6**
Puukolii Road to Lower Honoapiilani Highway	**6 - 7**
Lower Honoapiilani Highway to Akahele Street	**7 - 8**
Akahele Street to Hoohui Road	**8 - 9**
Hoohui Road to Napilihau Street	**9 - 10**
Napilihau Street to Office Road	**10 - 11**

Table B-23
AM Peak Hour Trip Distribution

MAKILA

December 2, 2004

Total Trips: 61
Entering: 14
Exiting: 47

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New AM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	0%	0%	**0**
Office Rd to North of Office Rd	11 - N		NB	0%	0%	0
Office Rd to Napilihau St	11 - 10	2L	**SB**	0%	0%	**0**
Napilihau St to Office Rd	10 - 11		NB	0%	0%	0
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	0%	0%	**0**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	0%	0
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	0%	0%	**0**
Akahele St to Hoohui Rd	8 - 9		NB	0%	0%	0
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	5%	0%	**1**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	5%	2
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	**SB**	10%	0%	**1**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	0%	10%	5
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	10%	0%	**1**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	0%	10%	5
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	30%	0%	**4**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	0%	30%	14
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	30%	0%	**4**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	0%	30%	14
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	30%	0%	**4**
Dickenson St to Kapunakea Rd	2 - 3		NB	0%	30%	14
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	30%	0%	**4**
Aholo Rd to Dickenson St	1 - 2		NB	0%	30%	14
Aholo Rd to Site	S-1	2L	**SB**	80%	0%	**11**
Site to Aholo Rd	1-S		NB	0%	80%	37
Site to South Honoapiilani Hwy	1-S	2L	**SB**	0%	20%	**9**
South Honoapiilani Hwy to Site	S-1		NB	20%	0%	3

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Stree	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-24
AM Peak Hour Trip Distribution

OLOWALU

December 2, 2004

Total Trips: 37
Entering: 9
Exiting: 28

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New AM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	0%	0%	**0**
Office Rd to North of Office Rd	11 - N		NB	0%	0%	0
Office Rd to Napilihau St	11 - 10	2L	**SB**	0%	0%	**0**
Napilihau St to Office Rd	10 - 11		NB	0%	0%	0
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	0%	0%	**0**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	0%	0
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	0%	0%	**0**
Akahele St to Hoohui Rd	8 - 9		NB	0%	0%	0
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	5%	0%	**0**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	5%	1
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	**SB**	10%	0%	**1**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	0%	10%	3
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	10%	0%	**1**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	0%	10%	3
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	30%	0%	**3**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	0%	30%	9
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	30%	0%	**3**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	0%	30%	9
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	30%	0%	**3**
Dickenson St to Kapunakea Rd	2 - 3		NB	0%	30%	9
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	30%	0%	**3**
Aholo Rd to Dickenson St	1 - 2		NB	0%	30%	9
Aholo Rd to Site	1-S	2L	**SB**	80%	0%	**7**
Site to Aholo Rd	S-1		NB	0%	80%	23
Site to South Honoapiilani Hwy	1-S	2L	**SB**	0%	20%	**6**
South Honoapiilani Hwy to Site	S-1		NB	20%	0%	2

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

West Maui Developments - Summary
PM Peak Hour Trip Generation

Development	Entering	Exiting	Total
Honolua Ridge	19	11	31
Kapalua Mauka	88	50	139
Puu Kahana	16	10	26
Maui Preperatory Academy	27	45	72
Villas at Kahana Ridge	53	29	82
Pulelehua	564	423	987
Maui Breakers	33	16	49
DHHL Honokowai	0	0	0
Mariott Expansion	-2	3	1
Hyatt Expansion	52	26	78
Khuna	8	4	12
Intrawest	196	106	302
Kaanapali 2020	157	89	246
Starwood	95	51	146
Palisades at Kaanapali	24	26	50
Land Tech	11	6	17
Villages at Leialii	70	41	111
W. Maui Resource Ctr Ph II	20	12	32
Lokahai Pacific	10	6	16
Wainee Village	78	45	123
Plantation Inn	6	6	12
Puunoa Village	0	0	0
Makila	46	26	72
Olowalu	24	14	38
Ukumehame	52	30	82
Total Trips	1,649	1,074	2,723

WEST MAUI DEVELOPMENTS

PM PEAK HOUR TRIP GENERATION AND DISTRIBUTION

West Maui Developments

PM Peak Hour Trip Distribution

Development	Segment North-11		Segment 11-10		Segment 10-9		Segment 9-8		Segment 8-7		Segment 7-6		Segment 6-5		Segment 5-4		Segment 4-3		Segment 3-2		Segment 2-1		Segment 1-South	
	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB
Honolua Ridge	10	17	9	16	6	10	6	10	3	6	2	4	2	4	1	1	1	1	1	1	0	0	0	0
Kapalua Mauka	4	3	40	71	25	44	25	44	15	27	10	18	10	18	3	4	3	4	3	4	0	0	0	0
Puu Kahana	2	1	3	2	6	10	6	10	4	7	3	5	3	5	0	1	0	1	0	1	0	0	0	0
Maui Preperatory Academy	3	5	5	9	32	19	32	19	23	14	18	11	18	11	7	4	7	4	7	4	2	1	2	1
Villas at Kahana Ridge	5	3	11	6	17	32	17	32	11	21	9	16	9	16	1	3	1	3	1	3	0	0	0	0
Pulelehua	85	148	169	148	190	170	106	155	148	218	148	253	148	253	127	225	106	197	84	169	42	113	42	113
Maui Breakers	3	2	7	3	10	5	10	5	17	8	6	13	4	8	2	5	2	5	2	5	1	2	1	2
DHHL Honokowai	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mariott Expansion	0	0	0	0	0	1	0	1	-1	1	2	-1	2	-1	1	-1	1	-1	1	-1	0	0	0	0
Hyatt Expansion	3	1	5	3	10	5	10	5	21	10	26	13	13	26	6	13	6	13	6	13	1	3	1	3
Khuna	0	0	1	0	2	1	2	1	3	2	4	2	2	4	1	2	1	2	1	2	0	0	0	0
Intrawest	10	5	20	11	39	21	39	21	79	42	98	53	53	98	26	49	26	49	26	49	5	10	10	0
Kaanapali 2020	8	4	16	9	31	18	31	18	63	36	78	45	45	78	22	39	22	39	22	39	4	8	4	8
Starwood	5	3	10	5	19	10	19	10	38	21	48	26	26	48	13	24	13	24	13	24	3	5	3	5
Palisades at Kaanapali	1	1	2	3	5	5	5	5	10	10	12	13	12	13	7	6	7	6	7	6	1	1	1	1
Land Tech	1	0	1	1	2	1	2	1	4	3	5	3	5	3	2	3	2	3	2	3	0	1	0	1
Villages at Leialii	2	1	3	2	7	4	7	4	10	6	10	6	10	6	28	16	25	42	25	42	8	14	8	14
W.Maui Resource Ctr Ph II	0	0	0	0	0	0	0	0	1	1	2	1	2	1	6	4	6	4	9	16	2	4	2	4
Lokahai Pacific	0	0	0	0	0	0	0	0	1	0	1	1	1	1	6	4	6	4	3	2	1	2	1	2
Wainee Village	0	0	0	0	0	0	0	0	4	2	8	4	8	4	23	13	23	13	23	13	36	62	9	16
Plantation Inn	0	0	0	0	0	0	0	0	0	0	1	1	1	1	2	2	2	2	2	2	6	6	0	0
Puunoa Village	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Makila	0	0	0	0	0	0	0	0	1	1	5	3	5	3	14	8	14	8	14	8	14	8	37	21
Olowalu	0	0	0	0	0	0	0	0	1	1	2	1	2	1	7	4	7	4	7	4	7	4	19	11
Ukumehame	0	0	0	0	0	0	0	0	3	1	5	3	5	3	16	9	16	9	16	9	42	24	42	24
Total Trips	**142**	**195**	**302**	**287**	**401**	**356**	**317**	**341**	**459**	**437**	**504**	**493**	**385**	**604**	**321**	**438**	**296**	**435**	**275**	**418**	**176**	**267**	**184**	**225**
Trips without Pulelehua	**57**	**47**	**133**	**139**	**211**	**186**	**211**	**186**	**311**	**219**	**356**	**240**	**237**	**351**	**194**	**213**	**190**	**238**	**191**	**249**	**134**	**154**	**142**	**112**

Table B-25
AM Peak Hour Trip Distribution

UKUMEHAME

December 2, 2004

Total Trips: 68
Entering: 16
Exiting: 52

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New AM Peak Hour Project Trips
Honoapiilani Highway	N - 11	2L	**SB**	0%	0%	**0**
North of Office Rd to Office Rd	11 - N		NB	0%	0%	0
Office Rd to North of Office Rd						
	11 - 10	2L	**SB**	0%	0%	**0**
Office Rd to Napilihau St	10 - 11		NB	0%	0%	0
Napilihau St to Office Rd						
	10 - 9	2L	**SB**	0%	0%	**0**
Napilihau St to Hoohui Rd	9 - 10		NB	0%	0%	0
Hoohui Rd to Napilihau St						
	9 - 8	2L	**SB**	0%	0%	**0**
Hoohui Rd to Akahele St	8 - 9		NB	0%	0%	0
Akahele St to Hoohui Rd						
	8 - 7	2L	**SB**	5%	0%	**1**
Akahele St to Lower Honoapiilani Hwy	7 - 8		NB	0%	5%	3
Lower Honoapiilani Hwy to Akahele St						
	7 - 6	4LD	**SB**	10%	0%	**2**
Lower Honoapiilani Hwy to Puukolii Rd	6 - 7		NB	0%	10%	5
Puukolii Rd to Lower Honoapiilani Hwy						
	6 - 5	4LD	**SB**	10%	0%	**2**
Puukolii Rd to Kaanapali Pkwy	5 - 6		NB	0%	10%	5
Kaanapali Pkwy to Puukolii Rd						
	5 - 4	4LD	**SB**	30%	0%	**5**
Kaanapali Pkwy to Lealii Pkwy	4 - 5		NB	0%	30%	16
Lealii Pkwy to Kaanapali Pkwy						
	4 - 3	4LD	**SB**	30%	0%	**5**
Lealii Pkwy to Kapunakea Rd	3 - 4		NB	0%	30%	16
Kapunakea Rd to Lealii Pkwy						
	3 - 2	4LD	**SB**	30%	0%	**5**
Kapunakea Rd to Dickenson St	2 - 3		NB	0%	30%	16
Dickenson St to Kapunakea Rd						
	2 - 1	2L	**SB**	80%	0%	**13**
Dickenson St to Aholo Rd	1 - 2		NB	0%	80%	42
Aholo Rd to Dickenson St						
	1-S	2L	**SB**	80%	0%	**13**
Aholo Rd to Site	S-1		NB	0%	80%	42
Site to Aholo Rd						
	1-S	2L	**SB**	0%	20%	**10**
Site to South Honoapiilani Hwy	S-1		NB	20%	0%	3
South Honoapiilani Hwy to Site						

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table A-2. PM Peak Hour Trips: Generation
WEST MAUI DEVELOPMENTS (continued)

MAUI PREPARATORY ACADEMY	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
See Maui Prep Traffic Impact Report Wilson Okamoto Corporation (April, 2004)							Entering						
							Exiting						
							Entering						
							Exiting						
	0	Total Dwelling Units					Entering		0		0		27
							Exiting		0		0		45
							Total		0		0		72

Notes:
Small discrepancies, if any, are due to rounding.
[1] Rates and equations are from *Trip Generation* (ITE, 7th Edition, 2003), on a weekday.
Peak Hour of Adjacent Street Traffic, One Houe Between 4 and 6 p.m.
[2] For greatest accuracy, where an equation is available, equation-generated trips are typically utilized unless "Y" intercept is much higher than the number of units.
[3] Where available, pass-by capture rates are "average pass-by trip percentages" from *Trip Generation Handbook: An ITE Recommended Practice* (ITE, March, 2001)

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

VILLAS AT KAHANA RIDGE	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Apartment ITE Code 220	117 dwelling units	0.62 /unit	T=0.55(X) + 17.65	73	82	82	Entering	65%	53	0%	53	0%	53
							Exiting	35%	29	0%	29	0%	29
							Entering						
							Exiting						
	117	Total Dwelling Units					Entering		53		53		53
							Exiting		29		29		29
							Total		82		82		82

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

PULELEHUA	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[3]	Net NewTrips
See Pulelehua Transportation Impact Report HPE (August 10, 2004)							Entering						
							Exiting						
							Entering						
							Exiting						
							Entering		0		0		564
							Exiting		0		0		423
							Total		0		0		987

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

PM Peak Hour Trip: Synchro Distribution
West Maui Developments

December 2, 2004

Roadway Segment	Link	No. Lanes	Dir	2004 PM Peak Hour Background Traffic[1]	2011 West Maui Development Trips[2]	Total 2011 PM Peak Hour Trips
HONOAPIILANI HIGHWAY						
Office Rd to North of Office Rd	N - 11	2L	SB	435	142	577
North of Office Rd to Office Rd	11 - N		NB	335	195	530
Office Rd to North of Office Rd						
Napilihau St to Office Rd	11 - 10	2L	SB	380	302	682
Office Rd to Napilihau St	10 - 11		NB	278	287	565
Napilihau St to Office Rd						
Hoohui Rd to Napilihau St	10 - 9	2L	SB	679	401	1,080
Napilihau St to Hoohui Rd	9 - 10		NB	690	356	1,046
Hoohui Rd to Napilihau St						
Akahele St to Hoohui Rd	9 - 8	2L	SB	759	317	1,076
Hoohui Rd to Akahele St	8 - 9		NB	871	341	1,212
Akahele St to Hoohui Rd						
Lower Honoapiilani Hwy to Akahele St	8 - 7	2L	SB	780	459	1,239
Akahele St to Lower Honoapiilani Hwy	7 - 8		NB	1,258	437	1,695
Lower Honoapiilani Hwy to Akahele St						
Puukolii Rd to Lower Honoapiilani Hwy	7 - 6	4LD	SB	780	504	1,284
Lower Honoapiilani Hwy to Puukolii Rd	6 - 7		NB	1,258	493	1,751
Puukolii Rd to Lower Honoapiilani Hwy						
Kaanapali Pkwy to Puukolii Rd	6 - 5	4LD	SB	1,810	385	2,195
Puukolii Rd to Kaanapali Pkwy	5 - 6		NB	1,708	604	2,312
Kaanapali Pkwy to Puukolii Rd						
Lealii Pkwy to Kaanapali Pkwy	5 - 4	4LD	SB	1,756	321	2,077
Kaanapali Pkwy to Lealii Pkwy	4 - 5		NB	1,630	438	2,068
Kaanapali Pkwy to Lealii Pkwy						
Kapunakea Rd to Lealii Pkwy	4 - 3	4LD	SB	1,756	296	2,052
Lealii Pkwy to Kapunakea Rd	3 - 4		NB	1,630	435	2,065
Kapunakea Rd to Lealii Pkwy						
Dickenson St to Kapunakea Rd	3 - 2	4LD	SB	1,756	275	2,031
Kapunakea Rd to Dickenson St	2 - 3		NB	1,630	418	2,048
Dickenson St to Kapunakea Rd						
Aholo Rd to Dickenson St	2 - 1	2L	SB	1,756	176	1,932
Dickenson St to Aholo Rd	1 - 2		NB	1,630	267	1,897
Aholo Rd to Dickenson St						
South Honoapiilani Hwy to Aholo Rd	1-S	2L	SB	1,756	184	1,940
Aholo Rd to South Honoapiilani Hwy	S-1		NB	1,630	225	1,855
South Honoapiilani Hwy to Aholo Rd						

SB = Peak direction

[1] Background traffic counts conducted May 14 - 17, 2004, by Phillip Rowell & Associates
[2] Total trips generated by West Maui Developments through 2011

Analysis Segments	
Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table A-4. PM Peak Hour Trips: Generation
WEST MAUI DEVELOPMENTS (continued)
December 2, 2004

HYATT EXPANSION[4]	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Residential Condo/Townhouse	196	0.52	Ln(T)=0.82 Ln(X) + 0.32	102	104	104	Entering	67%	70	25%	52	0%	52
ITE Code 230	units	/unit					Exiting	33%	34	25%	26	0%	26
							Entering						
							Exiting						
	196	Total Dwelling Units					Entering		70		52		52
							Exiting		34		26		26
							Total		104		78		78

Notes:
Small discrepancies, if any, are due to rounding.
[1] Rates and equations are from *Trip Generation* (ITE, 7th Edition, 2003), on a weekday.
Peak Hour of Adjacent Street Traffic, One Houe Between 4 and 6 p.m.
[2] For greatest accuracy, where an equation is available, equation-generated trips are typically utilized unless "Y" intercept is much higher than the number of units.
[3]Where available, pass-by capture rates are "average pass-by trip percentages" from *Trip Generation Handbook: An ITE Recommended Practice* (ITE, March, 2001)
[4]Total dwelling units calculated based on 153 MF units + (173 lockout units X .25) = 196

Internal Capture Summary
Entering 17
Exiting 9
Captured 26

KIHUNE	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[3]	Net NewTrips
Apartment	20	0.62	T=0.55(X) + 17.65	12	N/A	12	Entering	65%	8	0%		0%	8
ITE Code 220	dwelling units	/unit					Exiting	35%	4	0%		0%	4
							Entering						
							Exiting						
	20	Total Dwelling Units					Entering		8		8		8
							Exiting		4		4		4
							Total		12		12		12

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

INTRAWEST	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Apartment	700	0.62	T=0.55(X) + 17.65	434	403	403	Entering	65%	262	25%	196	0%	196
ITE Code 220	dwelling units	/unit					Exiting	35%	141	25%	106	0%	106
							Entering		0		0		0
							Exiting		0		0		0
							Entering		262		196		196
							Exiting		141		106		106
							Total		403		302		302

Internal Capture Summary
Entering 65
Exiting 35
Captured 101

Table A - 1. PM Peak Hour Trips: Generation
WEST MAUI DEVELOPMENTS
December 2, 2004

HONOLUA RIDGE	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Single-Family Detached Housing	25	1.01	Ln(T)=0.90 Ln(X) + 0.53	25	31	31	Entering	63%	19	0%	19	0%	19
ITE Code 210	dwelling units	/unit					Exiting	37%	11	0%	11	0%	11
							Entering						
							Exiting						
	25	Total Dwelling Units					Entering		19		19		19
							Exiting		11		11		11
							Total		31		31		31

Notes:
Small discrepancies, if any, are due to rounding.
[1] Rates and equations are from *Trip Generation* (ITE, 7th Edition, 2003), on a weekday.
Peak Hour of Adjacent Street Traffic, One Houe Between 4 and 6 p.m.
[2] For greatest accuracy, where an equation is available, equation-generated trips are typically utilized unless "Y" intercept is much higher than the number of units.
[3]Where available, pass-by capture rates are "average pass-by trip percentages" from *Trip Generation Handbook: An ITE Recommended Practice* (ITE, March, 2001)

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

KAPALUA MAUKA	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Single-Family Detached Housing	75	1.01	Ln(T)=0.90 Ln(X) + 0.53	76	83	83	Entering	63%	52	0%	52	0%	52
ITE Code 210	dwelling units	/unit					Exiting	37%	31	0%	31	0%	31
Apartment	90	0.62	T=0.55(X) + 17.65	56	N/A	56	Entering	65%	36	0%	36	0%	36
ITE Code 220	dwelling units	/unit					Exiting	35%	20	0%	20	0%	20
	165	Total Dwelling Units					Entering		88		88		88
							Exiting		50		50		50
							Total		139		139		139

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

PU'U KAHANA	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[3]	Net NewTrips
Single-Family Detached Housing	25	1.01	Ln(T)=0.90 Ln(X) + 0.53	25	31	31	Entering	63%	19	15%	16	0%	16
ITE Code 210	dwelling units	/unit					Exiting	37%	11	15%	10	0%	10
							Entering						
							Exiting						
							Entering		19		16		16
							Exiting		11		10		10
							Total		31		26		26

Internal Capture Summary
Entering 3
Exiting 2
Captured 5

Table A-6. PM Peak Hour Trips: Generation
WEST MAUI DEVELOPMENTS (continued)
December 2, 2004

LAND TECH	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Single-Family Detached Housing ITE Code 210	18 dwelling units	1.01 /unit	Ln(T)=0.90 Ln(X) + 0.53	18	23	23	Entering	63%	14	25%	11	0%	11
							Exiting	37%	8	25%	6	0%	6
							Entering						
							Exiting						
	18	Total Dwelling Units					Entering		14		11		11
							Exiting		8		6		6
							Total		23		17		17

Notes:
Small discrepancies, if any, are due to rounding.
[1] Rates and equations are from *Trip Generation* (ITE, 7th Edition, 2003), on a weekday.
Peak Hour of Adjacent Street Traffic, One Houe Between 4 and 6 p.m.
[2] For greatest accuracy, where an equation is available, equation-generated trips are typically utilized unless "Y" intercept is much higher than the number of units.
[3]Where available, pass-by capture rates are "average pass-by trip percentages" from *Trip Generation Handbook: An ITE Recommended Practice* (ITE, March, 2001)

Internal Capture Summary
Entering 4
Exiting 2
Captured 6

VILLAGES AT LEIALII	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Single-Family Detached Housing ITE Code 210	104 dwelling units	1.01 /unit	Ln(T)=0.90 Ln(X) + 0.53	105	111	111	Entering	63%	70	0%	70	0%	70
							Exiting	37%	41	0%	41	0%	41
							Entering						
							Exiting						
	104	Total Dwelling Units					Entering		70		70		70
							Exiting		41		41		41
							Total		111		111		111

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

WEST MAUI RESOURCE CTR PHASE II	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[3]	Net NewTrips
Single-Family Detached Housing ITE Code 210	26 dwelling units	1.01 /unit	Ln(T)=0.90 Ln(X) + 0.53	26	32	32	Entering	63%	20	0%	20	0%	20
							Exiting	37%	12	0%	12	0%	12
							Entering						
							Exiting						
							Entering		20		20		20
							Exiting		12		12		12
							Total		32		32		32

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

Table A-3. PM Peak Hour Trips: Generation
WEST MAUI DEVELOPMENTS (continued)
December 2, 2004

MAUI BREAKERS	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Data from W. Maui Breakers Traffic Impact Analysis LSC Transportation Consultants, Inc. (November 8, 2004)													
							Entering						
							Exiting						
	0	Total Dwelling Units					Entering		0		0		33
							Exiting		0		0		16
							Total		0		0		49

Notes:
Small discrepancies, if any, are due to rounding.
[1] Rates and equations are from *Trip Generation* (ITE, 7th Edition, 2003), on a weekday.
Peak Hour of Adjacent Street Traffic, One Houe Between 4 and 6 p.m.
[2] For greatest accuracy, where an equation is available, equation-generated trips are typically utilized unless "Y" intercept is much higher than the number of units.
[3]Where available, pass-by capture rates are "average pass-by trip percentages" from *Trip Generation Handbook: An ITE Recommended Practice* (ITE, March, 2001)

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

DHHL HONOKOWAI	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[3]	Net NewTrips
Single-Family Detached Housing ITE Code 210	0 dwelling units	1.01 /unit	Ln(T)=0.90 Ln(X) + 0.53	0	0	0	Entering	63%	0	0%		0%	0
							Exiting	37%	0	0%		0%	0
							Entering						
							Exiting						
	0	Total Dwelling Units					Entering		0		0		0
							Exiting		0		0		0
							Total		0		0		0

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

MARIOTT EXPANSION	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[3]	Net NewTrips
Data from Maui Marriott Ocean Club Traffic Report Phillip Rowell & Associates (October 24, 2002)													
							Entering						
							Exiting						
							Entering						
							Exiting						
							Entering		0		0		-2
							Exiting		0		0		3
							Total		0		0		1

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

Table A-8. PM Peak Hour Trips: Generation
WEST MAUI DEVELOPMENTS (continued)

PUUNOA VILLAGE	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
See Traffic Impact Report for Pu'unoa Residential Subdivision Austin, Tsunami & Associates, Inc. (April, 2003)	0						Entering	63%	0	0%	0	0%	0
							Exiting	37%	0	0%	0	0%	0
							Entering						
							Exiting						
	0	Total Dwelling Units					Entering		0		0		0
							Exiting		0		0		0
							Total		0		0		0

Notes:
Small discrepancies, if any, are due to rounding.
[1] Rates and equations are from *Trip Generation* (ITE, 7th Edition, 2003), on a weekday.
Peak Hour of Adjacent Street Traffic, One Houe Between 4 and 6 p.m.
[2] For greatest accuracy, where an equation is available, equation-generated trips are typically utilized unless "Y" intercept is much higher than the number of units.
[3]Where available, pass-by capture rates are "average pass-by trip percentages" from *Trip Generation Handbook: An ITE Recommended Practice* (ITE, March, 2001)

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

MAKILA	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Single-Family Detached Housing ITE Code 210	40 dwelling units	1.01 /unit	Ln(T)=0.90 Ln(X) + 0.53	40	47	47	Entering	63%	30	0%	30	0%	30
							Exiting	37%	17	0%	17	0%	17
Apartment (Ohana Units) ITE Code 220	40 dwelling units	0.62 /unit	T=0.55(X) + 17.65	25	N/A	25	Entering	65%	16	0%	16	0%	16
							Exiting	35%	9	0%	9	0%	9
	80	Total Dwelling Units					Entering		46		46		46
							Exiting		26		26		26
							Total		72		72		72

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

OLOWALU	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[3]	Net NewTrips
Single-Family Detached Housing ITE Code 210	20 dwelling units	1.01 /unit	Ln(T)=0.90 Ln(X) + 0.53	20	25	25	Entering	63%	16	0%	16	0%	16
							Exiting	37%	9	0%	9	0%	9
Apartment (Ohana Units) ITE Code 220	20 dwelling units	0.62 /unit	T=0.55(X) + 17.65	12	N/A	12	Entering	65%	8	0%	8	0%	8
							Exiting	35%	4	0%	4	0%	4
							Entering		24		24		24
							Exiting		14		14		14
							Total		38		38		38

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

Table A-5. PM Peak Hour Trips: Generation
WEST MAUI DEVELOPMENTS (continued)
December 2, 2004

KA'NAPALI 2020	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Single-Family Detached Housing ITE Code 210	200 dwelling units	1.01 /unit	Ln(T)=0.90 Ln(X) + 0.53	202	200	200	Entering	63%	126	25%	95	0%	95
							Exiting	37%	74	25%	56	0%	56
Apartment ITE Code 220	200 dwelling units	0.62 /unit	T=0.55(X) + 17.65	124	128	128	Entering	65%	83	25%	62	0%	62
							Exiting	35%	45	25%	34	0%	34
	400	Total Dwelling Units					Entering		209		157		157
							Exiting		119		89		89
							Total		328		246		246

Notes:
Small discrepancies, if any, are due to rounding.
[1] Rates and equations are from *Trip Generation* (ITE, 7th Edition, 2003), on a weekday.
Peak Hour of Adjacent Street Traffic, One Houe Between 4 and 6 p.m.
[2] For greatest accuracy, where an equation is available, equation-generated trips are typically utilized unless "Y" intercept is much higher than the number of units.
[3]Where available, pass-by capture rates are "average pass-by trip percentages" from *Trip Generation Handbook: An ITE Recommended Practice* (ITE, March, 2001)

Internal Capture Summary
Entering 52
Exiting 30
Captured 82

STARWOOD	Units[4]	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[3]	Net NewTrips
Apartment ITE Code 220	323 dwelling units	0.62 /unit	T=0.55(X) + 17.65	200	195	195	Entering	65%	127	25%	95	0%	95
							Exiting	35%	68	25%	51	0%	51
							Entering						
							Exiting						
							Entering						
							Exiting						
	323	Total Dwelling Units					Entering		127		95		95
							Exiting		68		51		51
							Total		195		146		146

[4]Total dwelling units calculated based on 258 MF units + (258 lockout units X .25) = 323

Internal Capture Summary
Entering 32
Exiting 17
Captured 49

PALISADES AT KAANAPALI	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
See Traffic Impact Assessment Report for Lanikeha Phillip Rowell and Associates (July 22, 2004)							Entering						
							Exiting						
							Entering						
							Exiting						
							Entering		0		0		24
							Exiting		0		0		26
							Total		0		0		50

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

Table A-9. PM Peak Hour Trips: Generation
WEST MAUI DEVELOPMENTS (continued)
December 2, 2004

UKUMEHAME	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Single-Family Detached Housing ITE Code 210	46 dwelling units	1.01 /unit	Ln(T)=0.90 Ln(X) + 0.53	46	53	53	Entering	63%	34	0%	34	0%	34
							Exiting	37%	20	0%	20	0%	20
Apartment (Ohana Units)	46 dwelling units	0.62 /unit	T=0.55(X) + 17.65	29	N/A	29	Entering	65%	19	0%	19	0%	19
							Exiting	35%	10	0%	10	0%	10
	92	Total Dwelling Units					Entering		52		52		52
							Exiting		30		30		30
							Total		82		82		82

Notes:
Small discrepancies, if any, are due to rounding.
[1] Rates and equations are from *Trip Generation* (ITE, 7th Edition, 2003), on a weekday.
Peak Hour of Adjacent Street Traffic, One Houe Between 4 and 6 p.m.
[2] For greatest accuracy, where an equation is available, equation-generated trips are typically utilized unless "Y" intercept is much higher than the number of units.
[3]Where available, pass-by capture rates are "average pass-by trip percentages" from *Trip Generation Handbook: An ITE Recommended Practice* (ITE, March, 2001)

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
							Entering						
							Exiting						
							Entering						
							Exiting						
	0	Total Dwelling Units					Entering		0		0		0
							Exiting		0		0		0
							Total		0		0		0

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[3]	Net NewTrips
							Entering		0		0		0
							Exiting		0		0		0
							Total		0		0		0

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

Table A-7. PM Peak Hour Trips: Generation
WEST MAUI DEVELOPMENTS (continued)
December 2, 2004

LOKAHAI PACFIC	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[4]	Net NewTrips
Single-Family Detached Housing ITE Code 210	12 dwelling units	1.01 /unit	Ln(T)=0.90 Ln(X) + 0.53	12	16	16	Entering	63%	10	0%	10	0%	10
							Exiting	37%	6	0%	6	0%	6
							Entering						
							Exiting						
	12	Total Dwelling Units					Entering		10		10		10
							Exiting		6		6		6
							Total		16		16		16

Notes:
Small discrepancies, if any, are due to rounding.
[1] Rates and equations are from *Trip Generation* (ITE, 7th Edition, 2003), on a weekday.
Peak Hour of Adjacent Street Traffic, One Houe Between 4 and 6 p.m.
[2] For greatest accuracy, where an equation is available, equation-generated trips are typically utilized unless "Y" intercept is much higher than the number of units.
[3]Where available, pass-by capture rates are "average pass-by trip percentages" from *Trip Generation Handbook: An ITE Recommended Practice* (ITE, March, 2001)

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

WAINEE VILLAGE	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[3]	Net NewTrips
Single-Family Detached Housing ITE Code 210	100 dwelling units	1.01 /unit	Ln(T)=0.90 Ln(X) + 0.53	101	107	107	Entering	63%	68	15%	57	0%	57
							Exiting	37%	40	15%	34	0%	34
Apartment ITE Code 220	60 dwelling units	0.62 /unit	T=0.55(X) + 17.65	37	N/A	37	Entering	65%	24	15%	21	0%	21
							Exiting	35%	13	15%	11	0%	11
	160	Total Dwelling Units					Entering		92		78		78
							Exiting		53		45		45
							Total		144		123		123

Internal Capture Summary
Entering 14
Exiting 8
Captured 22

PLANTATION INN	Units	PM Pk Hr Trips Rate[1]	PM Pk Hr Trips Equation[1]	Calculated Trips by Rate	Calculated Trips by Equation	Trips Used in Analysis[2]	Base Trip Generation			Internal Capture	Adjusted Trips	Pass-by Capture[3]	Net NewTrips
See Traffic Impact Assessment Report for Plantation Inn Phillip Rowell and Associates (May 8, 2002)							Entering						
							Exiting						
							Entering						
							Exiting						
							Entering						6
							Exiting						6
							Total		0		0		12

Internal Capture Summary
Entering 0
Exiting 0
Captured 0

Table B-1
PM Peak Hour Trip Distribution
HONOLUA RIDGE

December 2, 2004

Total Trips: 31
Entering: 19
Exiting: 11

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New PM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to site	N - 11	2L	**SB**	10%	0%	**2**
Site to North of Office Rd	11 - N		NB	0%	10%	1
Site to Office Rd	N - 11	2L	**SB**	0%	90%	**10**
Office Rd to Site	11 - N		NB	90%	0%	17
Office Rd to Napilihau St	11 - 10	2L	**SB**	0%	80%	**9**
Napilihau St to Office Rd	10 - 11		NB	80%	0%	16
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	0%	50%	**6**
Hoohui Rd to Napilihau St	9 - 10		NB	50%	0%	10
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	0%	50%	**6**
Akahele St to Hoohui Rd	8 - 9		NB	50%	0%	10
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	0%	30%	**3**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	30%	0%	6
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	**SB**	0%	20%	**2**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	20%	0%	4
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	0%	20%	**2**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	20%	0%	4
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	0%	5%	**1**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	5%	0%	1
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	0%	5%	**1**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	5%	0%	1
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	0%	5%	**1**
Dickenson St to Kapunakea Rd	2 - 3		NB	5%	0%	1
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	0%	**0**
Aholo Rd to Dickenson St	1 - 2		NB	0%	0%	0
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	0%	**0**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	0%	0%	0

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	**1 - 2**
Dickenson Street to Kapunakea Road	**2 - 3**
Kapunakea Road to Lealii Parkway	**3 - 4**
Lealii Parkway to Kaanapali Parkway	**4 - 5**
Kaanapali Parkway to Puukolii Road	**5 - 6**
Puukolii Road to Lower Honoapiilani Highway	**6 - 7**
Lower Honoapiilani Highway to Akahele Street	**7 - 8**
Akahele Street to Hoohui Road	**8 - 9**
Hoohui Road to Napilihau Street	**9 - 10**
Napilihau Street to Office Road	**10 - 11**

Table B-2
PM Peak Hour Trip Distribution
KAPALUA MAUKA

December 2, 2004

Total Trips: 139
Entering: 88
Exiting: 50

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New PM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	5%	0%	**4**
Office Rd to North of Office Rd	11 - N		NB	0%	5%	3
Office Rd to Napilihau St	11 - 10	2L	**SB**	0%	80%	**40**
Napilihau St to Office Rd	10 - 11		NB	80%	0%	**71**
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	0%	50%	**25**
Hoohui Rd to Napilihau St	9 - 10		NB	50%	0%	44
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	0%	50%	**25**
Akahele St to Hoohui Rd	8 - 9		NB	50%	0%	44
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	0%	30%	**15**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	30%	0%	**27**
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	**SB**	0%	20%	**10**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	20%	0%	18
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	0%	20%	**10**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	20%	0%	18
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	0%	5%	**3**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	5%	0%	4
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	0%	5%	**3**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	5%	0%	4
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	0%	5%	**3**
Dickenson St to Kapunakea Rd	2 - 3		NB	5%	0%	4
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	0%	**0**
Aholo Rd to Dickenson St	1 - 2		NB	0%	0%	0
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	0%	**0**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	0%	0%	0

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	**1 - 2**
Dickenson Street to Kapunakea Road	**2 - 3**
Kapunakea Road to Lealii Parkway	**3 - 4**
Lealii Parkway to Kaanapali Parkway	**4 - 5**
Kaanapali Parkway to Puukolii Road	**5 - 6**
Puukolii Road to Lower Honoapiilani Highway	**6 - 7**
Lower Honoapiilani Highway to Akahele Street	**7 - 8**
Akahele Street to Hoohui Road	**8 - 9**
Hoohui Road to Napilihau Street	**9 - 10**
Napilihau Street to Office Road	**10 - 11**

Table B-3
PM Peak Hour Trip Distribution
PU'U KAHANA

December 2, 2004

Total Trips: 26
Entering: 16
Exiting: 10

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New PM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	10%	0%	**2**
Office Rd to North of Office Rd	11 - N		NB	0%	10%	1
Office Rd to Napilihau St	11 - 10	2L	**SB**	20%	0%	**3**
Napilihau St to Office Rd	10 - 11		NB	0%	20%	2
Napilihau St to Site	10 - 9	2L	**SB**	40%	0%	**7**
Site to Napilihau St	9 - 10		NB	0%	40%	4
Site to Hoohui Rd	10 - 9	2L	**SB**	0%	60%	**6**
Hoohui Rd to Site	9 - 10		NB	60%	0%	10
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	0%	60%	**6**
Akahele St to Hoohui Rd	8 - 9		NB	60%	0%	10
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	0%	40%	**4**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	40%	0%	7
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	**SB**	0%	30%	**3**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	30%	0%	5
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	0%	30%	**3**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	30%	0%	5
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	0%	5%	**0**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	5%	0%	1
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	0%	5%	**0**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	5%	0%	1
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	0%	5%	**0**
Dickenson St to Kapunakea Rd	2 - 3		NB	5%	0%	1
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	0%	**0**
Aholo Rd to Dickenson St	1 - 2		NB	0%	0%	0
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	0%	**0**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	0%	0%	0

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-4
PM Peak Hour Trip Distribution
MAUI PREPARATORY ACADEMY

December 2, 2004

Total Trips: 72
Entering: 27
Exiting: 45

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New PM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	10%	0%	**3**
Office Rd to North of Office Rd	11 - N		NB	0%	10%	5
Office Rd to Napilihau St	11 - 10	2L	**SB**	20%	0%	**5**
Napilihau St to Office Rd	10 - 11		NB	0%	20%	9
Napilihau St to Site	10 - 9	2L	**SB**	30%	0%	**8**
Site to Napilihau St	9 - 10		NB	0%	30%	14
Site to Hoohui Rd	10 - 9	2L	**SB**	0%	70%	**32**
Hoohui Rd to Site	9 - 10		NB	70%	0%	19
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	0%	70%	**32**
Akahele St to Hoohui Rd	8 - 9		NB	70%	0%	19
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	0%	50%	**23**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	50%	0%	14
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	**SB**	0%	40%	**18**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	40%	0%	11
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	0%	40%	**18**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	40%	0%	11
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	0%	15%	**7**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	15%	0%	4
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	0%	15%	**7**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	15%	0%	4
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	0%	15%	**7**
Dickenson St to Kapunakea Rd	2 - 3		NB	15%	0%	4
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	5%	**2**
Aholo Rd to Dickenson St	1 - 2		NB	5%	0%	1
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	5%	**2**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	5%	0%	1

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-5
PM Peak Hour Trip Distribution
VILLAS AT KAHANA RIDGE

December 2, 2004

Total Trips: 82
Entering: 53
Exiting: 29

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New PM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	10%	0%	**5**
Office Rd to North of Office Rd	11 - N		NB	0%	10%	3
Office Rd to Napilihau St	11 - 10	2L	**SB**	20%	0%	**11**
Napilihau St to Office Rd	10 - 11		NB	0%	20%	6
Napilihau St to Site	10 - 9	2L	**SB**	40%	0%	**21**
Site to Napilihau St	9 - 10		NB	0%	40%	11
Site to Hoohui Rd	10 - 9	2L	**SB**	0%	60%	**17**
Hoohui Rd to Site	9 - 10		NB	60%	0%	32
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	0%	60%	**17**
Akahele St to Hoohui Rd	8 - 9		NB	60%	0%	32
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	0%	40%	**11**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	40%	0%	21
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	**SB**	0%	30%	**9**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	30%	0%	16
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	0%	30%	**9**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	30%	0%	16
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	0%	5%	**1**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	5%	0%	3
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	0%	5%	**1**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	5%	0%	3
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	0%	5%	**1**
Dickenson St to Kapunakea Rd	2 - 3		NB	5%	0%	3
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	0%	**0**
Aholo Rd to Dickenson St	1 - 2		NB	0%	0%	0
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	0%	**0**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	0%	0%	0

SB = Peak direction

Analysis Segments	
Aholo Road to Dickenson Street	**1 - 2**
Dickenson Street to Kapunakea Road	**2 - 3**
Kapunakea Road to Lealii Parkway	**3 - 4**
Lealii Parkway to Kaanapali Parkway	**4 - 5**
Kaanapali Parkway to Puukolii Road	**5 - 6**
Puukolii Road to Lower Honoapiilani Highway	**6 - 7**
Lower Honoapiilani Highway to Akahele Street	**7 - 8**
Akahele Street to Hoohui Road	**8 - 9**
Hoohui Road to Napilihau Street	**9 - 10**
Napilihau Street to Office Road	**10 - 11**

Table B-6
PM Peak Hour Trip Distribution
PULELEHUA [Refer to Pulelehua Report]

December 2, 2004

Total Trips: 987
Entering: 564
Exiting: 423

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New PM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**			
Office Rd to North of Office Rd	11 - N		NB			
Office Rd to Napilihau St	11 - 10	2L	**SB**			
Napilihau St to Office Rd	10 - 11		NB			
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**			
Hoohui Rd to Napilihau St	9 - 10		NB			
Hoohui Rd to Site	9 - 8	2L	**SB**			
Site to Hoohui Rd	8 - 9		NB			
Site to Akahele St	8 - 7	2L	**SB**			
Akahele St to Site	7 - 8		NB			
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**			
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB			
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	**SB**			
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB			
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**			
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB			
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**			
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB			
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**			
Kapunakea Rd to Lealii Pkwy	3 - 4		NB			
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**			
Dickenson St to Kapunakea Rd	2 - 3		NB			
Dickenson St to Aholo Rd	2 - 1	2L	**SB**			
Aholo Rd to Dickenson St	1 - 2		NB			
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**			
South Honoapiilani Hwy to Aholo Rd	S-1		NB			

SB = Peak direction

Analysis Segments	
Aholo Road to Dickenson Street	**1 - 2**
Dickenson Street to Kapunakea Road	**2 - 3**
Kapunakea Road to Lealii Parkway	**3 - 4**
Lealii Parkway to Kaanapali Parkway	**4 - 5**
Kaanapali Parkway to Puukolii Road	**5 - 6**
Puukolii Road to Lower Honoapiilani Highway	**6 - 7**
Lower Honoapiilani Highway to Akahele Street	**7 - 8**
Akahele Street to Hoohui Road	**8 - 9**
Hoohui Road to Napilihau Street	**9 - 10**
Napilihau Street to Office Road	**10 - 11**

Table B-7
PM Peak Hour Trip Distribution
MAUI BREAKERS

December 2, 2004

Total Trips: 49
Entering: 33
Exiting: 16

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New PM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	10%	0%	**3**
Office Rd to North of Office Rd	11 - N		NB	0%	10%	2
Office Rd to Napilihau St	11 - 10	2L	**SB**	20%	0%	**7**
Napilihau St to Office Rd	10 - 11		NB	0%	20%	3
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	30%	0%	**10**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	30%	5
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	30%	0%	**10**
Akahele St to Hoohui Rd	8 - 9		NB	0%	30%	5
Akahele St to Site	8 - 7	2L	**SB**	50%	0%	**17**
Site to Akahele St	7 - 8		NB	0%	50%	8
Site to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	0%	50%	**8**
Lower Honoapiilani Hwy to Site	7 - 8		NB	50%	0%	17
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	**SB**	0%	40%	**6**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	40%	0%	13
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	0%	25%	**4**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	25%	0%	8
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	0%	15%	**2**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	15%	0%	5
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	0%	15%	**2**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	15%	0%	5
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	0%	15%	**2**
Dickenson St to Kapunakea Rd	2 - 3		NB	15%	0%	5
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	5%	**1**
Aholo Rd to Dickenson St	1 - 2		NB	5%	0%	2
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	5%	**1**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	5%	0%	2

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-8
PM Peak Hour Trip Distribution
DHHL HONOKOWAI

December 2, 2004

Total Trips: 0
Entering: 0
Exiting: 0

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New PM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**			**0**
Office Rd to North of Office Rd	11 - N		NB			0
Office Rd to Napilihau St	11 - 10	2L	**SB**			**0**
Napilihau St to Office Rd	10 - 11		NB			0
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**			**0**
Hoohui Rd to Napilihau St	9 - 10		NB			0
Hoohui Rd to Akahele St	9 - 8	2L	**SB**			**0**
Akahele St to Hoohui Rd	8 - 9		NB			0
Akahele St to Site	8 - 7	2L	**SB**			**0**
Site to Akahele St	7 - 8		NB			0
Site to Lower Honoapiilani Hwy	8 - 7	2L	**SB**			**0**
Lower Honoapiilani Hwy to Site	7 - 8		NB			0
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	**SB**			**0**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB			0
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**			**0**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB			0
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**			**0**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB			0
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**			**0**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB			0
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**			**0**
Dickenson St to Kapunakea Rd	2 - 3		NB			0
Dickenson St to Aholo Rd	2 - 1	2L	**SB**			**0**
Aholo Rd to Dickenson St	1 - 2		NB			0
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**			**0**
South Honoapiilani Hwy to Aholo Rd	S-1		NB			0

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-9
PM Peak Hour Trip Distribution
MARRIOTT EXPANSION

December 2, 2004

Total Trips: 1
Entering: -2
Exiting: 3

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New PM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	5%	0%	**0**
Office Rd to North of Office Rd	11 - N		NB	0%	5%	0
Office Rd to Napilihau St	11 - 10	2L	**SB**	10%	0%	**0**
Napilihau St to Office Rd	10 - 11		NB	0%	10%	0
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	20%	0%	**0**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	20%	1
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	20%	0%	**0**
Akahele St to Hoohui Rd	8 - 9		NB	0%	20%	1
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	40%	0%	**-1**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	40%	1
Lower Honoapiilani Hwy to Site	7 - 6	2L	**SB**	50%	0%	**-1**
Site to Lower Honoapiilani Hwy	6 - 7		NB	0%	50%	2
Site to Puukolii Rd	7 - 6	4LD	**SB**	0%	50%	**2**
Puukolii Rd to Site	6 - 7		NB	50%	0%	-1
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	0%	50%	**2**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	50%	0%	-1
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	0%	25%	**1**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	25%	0%	-1
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	0%	25%	**1**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	25%	0%	-1
Kapunakea Rd to Dickenson St	3 - 2	4LD	SB	0%	25%	**1**
Dickenson St to Kapunakea Rd	2 - 3		NB	25%	0%	-1
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	5%	**0**
Aholo Rd to Dickenson St	1 - 2		NB	5%	0%	0
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	5%	**0**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	5%	0%	0

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	**1 - 2**
Dickenson Street to Kapunakea Road	**2 - 3**
Kapunakea Road to Lealii Parkway	**3 - 4**
Lealii Parkway to Kaanapali Parkway	**4 - 5**
Kaanapali Parkway to Puukolii Road	**5 - 6**
Puukolii Road to Lower Honoapiilani Highway	**6 - 7**
Lower Honoapiilani Highway to Akahele Street	**7 - 8**
Akahele Street to Hoohui Road	**8 - 9**
Hoohui Road to Napilihau Street	**9 - 10**
Napilihau Street to Office Road	**10 - 11**

Table B-10
PM Peak Hour Trip Distribution
HYATT EXPANSION

December 2, 2004

Total Trips: 78
Entering: 52
Exiting: 26

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New PM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	5%	0%	**3**
Office Rd to North of Office Rd	11 - N		NB	0%	5%	1
Office Rd to Napilihau St	11 - 10	2L	**SB**	10%	0%	**5**
Napilihau St to Office Rd	10 - 11		NB	0%	10%	3
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	20%	0%	**10**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	20%	5
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	20%	0%	**10**
Akahele St to Hoohui Rd	8 - 9		NB	0%	20%	5
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	40%	0%	**21**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	40%	10
Lower Honoapiilani Hwy to Site	7 - 6	2L	**SB**	50%	0%	**26**
Site to Lower Honoapiilani Hwy	6 - 7		NB	0%	50%	13
Site to Puukolii Rd	7 - 6	4LD	**SB**	0%	50%	**13**
Puukolii Rd to Site	6 - 7		NB	50%	0%	26
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	0%	50%	**13**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	50%	0%	26
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	0%	25%	**6**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	25%	0%	13
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	0%	25%	**6**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	25%	0%	13
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	0%	25%	**6**
Dickenson St to Kapunakea Rd	2 - 3		NB	25%	0%	13
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	5%	**1**
Aholo Rd to Dickenson St	1 - 2		NB	5%	0%	3
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	5%	**1**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	5%	0%	3

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	**1 - 2**
Dickenson Street to Kapunakea Road	**2 - 3**
Kapunakea Road to Lealii Parkway	**3 - 4**
Lealii Parkway to Kaanapali Parkway	**4 - 5**
Kaanapali Parkway to Puukolii Road	**5 - 6**
Puukolii Road to Lower Honoapiilani Highway	**6 - 7**
Lower Honoapiilani Highway to Akahele Street	**7 - 8**
Akahele Street to Hoohui Road	**8 - 9**
Hoohui Road to Napilihau Street	**9 - 10**
Napilihau Street to Office Road	**10 - 11**

Table B-11
PM Peak Hour Trip Distribution

KIHUNE

December 2, 2004

Total Trips: 12
Entering: 8
Exiting: 4

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New PM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	SB	5%	0%	**0**
Office Rd to North of Office Rd	11 - N		NB	0%	5%	0
Office Rd to Napilihau St	11 - 10	2L	SB	10%	0%	**1**
Napilihau St to Office Rd	10 - 11		NB	0%	10%	0
Napilihau St to Hoohui Rd	10 - 9	2L	SB	20%	0%	**2**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	20%	1
Hoohui Rd to Akahele St	9 - 8	2L	SB	20%	0%	**2**
Akahele St to Hoohui Rd	8 - 9		NB	0%	20%	1
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	SB	40%	0%	**3**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	40%	2
Lower Honoapiilani Hwy to Site	7 - 6	2L	SB	50%	0%	**4**
Site to Lower Honoapiilani Hwy	6 - 7		NB	0%	50%	2
Site to Puukolii Rd	7 - 6	4LD	SB	0%	50%	**2**
Puukolii Rd to Site	6 - 7		NB	50%	0%	4
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	SB	0%	50%	**2**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	50%	0%	4
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	SB	0%	25%	**1**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	25%	0%	2
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	SB	0%	25%	**1**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	25%	0%	2
Kapunakea Rd to Dickenson St	3 - 2	4LD	SB	0%	25%	**1**
Dickenson St to Kapunakea Rd	2 - 3		NB	25%	0%	2
Dickenson St to Aholo Rd	2 - 1	2L	SB	0%	5%	**0**
Aholo Rd to Dickenson St	1 - 2		NB	5%	0%	0
Aholo Rd to South Honoapiilani Hwy	1-S	2L	SB	0%	5%	**0**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	5%	0%	0

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-12
PM Peak Hour Trip Distribution

INTRAWEST

December 2, 2004

Total Trips: 302
Entering: 196
Exiting: 106

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New PM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	SB	5%	0%	**10**
Office Rd to North of Office Rd	11 - N		NB	0%	5%	5
Office Rd to Napilihau St	11 - 10	2L	SB	10%	0%	**20**
Napilihau St to Office Rd	10 - 11		NB	0%	10%	11
Napilihau St to Hoohui Rd	10 - 9	2L	SB	20%	0%	**39**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	20%	21
Hoohui Rd to Akahele St	9 - 8	2L	SB	20%	0%	**39**
Akahele St to Hoohui Rd	8 - 9		NB	0%	20%	21
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	SB	40%	0%	**79**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	40%	42
Lower Honoapiilani Hwy to Site	7 - 6	2L	SB	50%	0%	**98**
Site to Lower Honoapiilani Hwy	6 - 7		NB	0%	50%	53
Site to Puukolii Rd	7 - 6	4LD	SB	0%	50%	**53**
Puukolii Rd to Site	6 - 7		NB	50%	0%	98
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	SB	0%	50%	**53**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	50%	0%	98
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	SB	0%	25%	**26**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	25%	0%	49
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	SB	0%	25%	**26**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	25%	0%	49
Kapunakea Rd to Dickenson St	3 - 2	4LD	SB	0%	25%	**26**
Dickenson St to Kapunakea Rd	2 - 3		NB	25%	0%	49
Dickenson St to Aholo Rd	2 - 1	2L	SB	0%	5%	**5**
Aholo Rd to Dickenson St	1 - 2		NB	5%	0%	10
Aholo Rd to South Honoapiilani Hwy	1-S	2L	SB	0%	5%	**5**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	5%	0%	10

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-13
PM Peak Hour Trip Distribution
KA'NAPALI 2020

December 2, 2004

Total Trips: 246
Entering: 157
Exiting: 89

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New PM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	5%	0%	**8**
Office Rd to North of Office Rd	11 - N		NB	0%	5%	4
Office Rd to Napilihau St	11 - 10	2L	**SB**	10%	0%	**16**
Napilihau St to Office Rd	10 - 11		NB	0%	10%	9
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	20%	0%	**31**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	20%	18
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	20%	0%	**31**
Akahele St to Hoohui Rd	8 - 9		NB	0%	20%	18
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	40%	0%	**63**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	40%	36
Lower Honoapiilani Hwy to Site	7 - 6	2L	**SB**	50%	0%	**78**
Site to Lower Honoapiilani Hwy	6 - 7		NB	0%	50%	45
Site to Puukolii Rd	7 - 6	4LD	**SB**	0%	50%	**45**
Puukolii Rd to Site	6 - 7		NB	50%	0%	78
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	0%	50%	**45**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	50%	0%	78
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	0%	25%	**22**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	25%	0%	39
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	0%	25%	**22**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	25%	0%	39
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	0%	25%	**22**
Dickenson St to Kapunakea Rd	2 - 3		NB	25%	0%	39
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	5%	**4**
Aholo Rd to Dickenson St	1 - 2		NB	5%	0%	8
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	5%	**4**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	5%	0%	8

SB = Peak direction

Analysis Segments	
Aholo Road to Dickenson Street	1 - 2
Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-14
PM Peak Hour Trip Distribution
STARWOOD

December 2, 2004

Total Trips: 146
Entering: 95
Exiting: 51

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New PM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	5%	0%	**5**
Office Rd to North of Office Rd	11 - N		NB	0%	5%	3
Office Rd to Napilihau St	11 - 10	2L	**SB**	10%	0%	**10**
Napilihau St to Office Rd	10 - 11		NB	0%	10%	5
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	20%	0%	**19**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	20%	10
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	20%	0%	**19**
Akahele St to Hoohui Rd	8 - 9		NB	0%	20%	10
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	40%	0%	**38**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	40%	21
Lower Honoapiilani Hwy to Site	7 - 6	2L	**SB**	50%	0%	**48**
Site to Lower Honoapiilani Hwy	6 - 7		NB	0%	50%	26
Site to Puukolii Rd	7 - 6	4LD	**SB**	0%	50%	**26**
Puukolii Rd to Site	6 - 7		NB	50%	0%	48
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	0%	50%	**26**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	50%	0%	48
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	0%	25%	**13**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	25%	0%	24
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	0%	25%	**13**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	25%	0%	24
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	0%	25%	**13**
Dickenson St to Kapunakea Rd	2 - 3		NB	25%	0%	24
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	5%	**3**
Aholo Rd to Dickenson St	1 - 2		NB	5%	0%	5
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	5%	**3**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	5%	0%	5

SB = Peak direction

Analysis Segments	
Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-15
PM Peak Hour Trip Distribution
PALISADES AT KAANAPALI

December 2, 2004

Total Trips: 50
Entering: 24
Exiting: 26

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New PM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	5%	0%	**1**
Office Rd to North of Office Rd	11 - N		NB	0%	5%	1
Office Rd to Napilihau St	11 - 10	2L	**SB**	10%	0%	**2**
Napilihau St to Office Rd	10 - 11		NB	0%	10%	3
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	20%	0%	**5**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	20%	5
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	20%	0%	**5**
Akahele St to Hoohui Rd	8 - 9		NB	0%	20%	5
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	40%	0%	**10**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	40%	10
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	2L	**SB**	50%	0%	**12**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	0%	50%	13
Puukolii Rd to Site	6 - 5	4LD	**SB**	50%	0%	**12**
Site to Puukolii Rd	5 - 6		NB	0%	50%	13
Site to Kaanapali Pkwy	5 - 4	4LD	**SB**	0%	25%	**7**
Kaanapali Pkwy to Site	4 - 5		NB	25%	0%	6
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	0%	25%	**7**
Lealii Pkwy to Kaasnapali Pkwy	4 - 5		NB	25%	0%	6
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	SB	0%	25%	**7**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	25%	0%	6
Kapunakea Rd to Dickenson St	3 - 2	4LD	SB	0%	25%	**7**
Dickenson St to Kapunakea Rd	2 - 3		NB	25%	0%	6
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	5%	**1**
Aholo Rd to Dickenson St	1 - 2		NB	5%	0%	1
Aholo Rd to South Honoapiilani Hwy	1-S	2L	SB	0%	5%	**1**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	5%	0%	1

SB = Peak direction

Analysis Segments	
Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-16
PM Peak Hour Trip Distribution
LAND TECH

December 2, 2004

Total Trips: 17
Entering: 11
Exiting: 6

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New PM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	5%	0%	**1**
Office Rd to North of Office Rd	11 - N		NB	0%	5%	0
Office Rd to Napilihau St	11 - 10	2L	**SB**	10%	0%	**1**
Napilihau St to Office Rd	10 - 11		NB	0%	10%	1
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	20%	0%	**2**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	20%	1
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	20%	0%	**2**
Akahele St to Hoohui Rd	8 - 9		NB	0%	20%	1
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	40%	0%	**4**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	40%	3
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	2L	**SB**	50%	0%	**5**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	0%	50%	3
Puukolii Rd to Site	6 - 5	4LD	**SB**	50%	0%	**5**
Site to Puukolii Rd	5 - 6		NB	0%	50%	3
Site to Kaanapali Pkwy	5 - 4	4LD	**SB**	0%	25%	**2**
Kaanapali Pkwy to Site	4 - 5		NB	25%	0%	3
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	0%	25%	**2**
Lealii Pkwy to Kaasnapali Pkwy	4 - 5		NB	25%	0%	3
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	SB	0%	25%	**2**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	25%	0%	3
Kapunakea Rd to Dickenson St	3 - 2	4LD	SB	0%	25%	**2**
Dickenson St to Kapunakea Rd	2 - 3		NB	25%	0%	3
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	5%	**0**
Aholo Rd to Dickenson St	1 - 2		NB	5%	0%	1
Aholo Rd to South Honoapiilani Hwy	1-S	2L	SB	0%	5%	**0**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	5%	0%	1

SB = Peak direction

Analysis Segments	
Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-17
PM Peak Hour Trip Distribution
VILLAGES AT LEIALII

December 2, 2004

Total Trips: 111
Entering: 70
Exiting: 41

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New PM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	3%	0%	**2**
Office Rd to North of Office Rd	11 - N		NB	0%	3%	1
Office Rd to Napilihau St	11 - 10	2L	**SB**	5%	0%	**3**
Napilihau St to Office Rd	10 - 11		NB	0%	5%	2
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	10%	0%	**7**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	10%	4
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	10%	0%	**7**
Akahele St to Hoohui Rd	8 - 9		NB	0%	10%	4
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	15%	0%	**10**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	15%	6
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	2L	**SB**	15%	0%	**10**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	0%	15%	**6**
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	15%	0%	**10**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	0%	15%	6
Kaanapali Pkwy to Site	5 - 4	4LD	**SB**	40%	0%	**28**
Site to Kaanapali Pkwy	4 - 5		NB	0%	40%	16
Site to Lealii Pkwy	5 - 4	4LD	**SB**	0%	60%	**25**
Lealii Pkwy to Site	4 - 5		NB	60%	0%	42
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	0%	60%	**25**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	60%	0%	42
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	0%	60%	**25**
Dickenson St to Kapunakea Rd	2 - 3		NB	60%	0%	42
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	20%	**8**
Aholo Rd to Dickenson St	1 - 2		NB	20%	0%	14
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	20%	**8**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	20%	0%	14

SB = Peak direction

Analysis Segments	
Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-18
PM Peak Hour Trip Distribution
WEST MAUI RESOURCE CENTER PHASE II

December 2, 2004

Total Trips: 32
Entering: 20
Exiting: 12

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New PM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	0%	0%	**0**
Office Rd to North of Office Rd	11 - N		NB	0%	0%	0
Office Rd to Napilihau St	11 - 10	2L	**SB**	0%	0%	**0**
Napilihau St to Office Rd	10 - 11		NB	0%	0%	0
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	0%	0%	**0**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	0%	0
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	0%	0%	**0**
Akahele St to Hoohui Rd	8 - 9		NB	0%	0%	0
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	5%	0%	**1**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	5%	**1**
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	2L	**SB**	10%	0%	**2**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	0%	10%	1
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	10%	0%	**2**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	0%	10%	1
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	30%	0%	**6**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	0%	30%	4
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	30%	0%	**6**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	0%	30%	4
Kapunakea Rd to Site	3 - 2	4LD	**SB**	30%	0%	**6**
Site to Kapunakea Rd	2 - 3		NB	0%	30%	4
Site to Dickenson	3 - 2	2L	**SB**	0%	80%	**9**
Dickenson St to Site	2 - 3		NB	80%	0%	16
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	20%	**2**
Aholo Rd to Dickenson St	1 - 2		NB	20%	0%	4
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	20%	**2**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	20%	0%	4

SB = Peak direction

Analysis Segments	
Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-19
PM Peak Hour Trip Distribution
LOKAHAI PACIFIC

December 2, 2004

Total Trips: 16
Entering: 10
Exiting: 6

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New PM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	0%	0%	**0**
Office Rd to North of Office Rd	11 - N		NB	0%	0%	0
Office Rd to Napilihau St	11 - 10	2L	**SB**	0%	0%	**0**
Napilihau St to Office Rd	10 - 11		NB	0%	0%	0
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	0%	0%	**0**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	0%	0
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	0%	0%	**0**
Akahele St to Hoohui Rd	8 - 9		NB	0%	0%	0
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	5%	0%	**1**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	5%	0
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	2L	**SB**	10%	0%	**1**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	0%	10%	1
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	10%	0%	**1**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	0%	10%	1
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	60%	0%	**6**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	0%	60%	4
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	60%	0%	**6**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	0%	60%	4
Kapunakea Rd to Site	3 - 2	4LD	**SB**	30%	0%	**3**
Site to Kapunakea Rd	2 - 3		NB	0%	30%	2
Site to Dickenson	3 - 2	2L	**SB**	0%	20%	**1**
Dickenson St to Site	2 - 3		NB	20%	0%	2
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	0%	20%	**1**
Aholo Rd to Dickenson St	1 - 2		NB	20%	0%	2
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	20%	**1**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	20%	0%	2

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-20
PM Peak Hour Trip Distribution
WAINEE VILLAGE

December 2, 2004

Total Trips: 123
Entering: 78
Exiting: 45

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New PM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	0%	0%	**0**
Office Rd to North of Office Rd	11 - N		NB	0%	0%	0
Office Rd to Napilihau St	11 - 10	2L	**SB**	0%	0%	**0**
Napilihau St to Office Rd	10 - 11		NB	0%	0%	0
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	0%	0%	**0**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	0%	0
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	0%	0%	**0**
Akahele St to Hoohui Rd	8 - 9		NB	0%	0%	0
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	5%	0%	**4**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	5%	2
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	**SB**	10%	0%	**8**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	0%	10%	4
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	10%	0%	**8**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	0%	10%	4
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	30%	0%	**23**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	0%	30%	13
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	30%	0%	**23**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	0%	30%	13
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	30%	0%	**23**
Dickenson St to Kapunakea Rd	2 - 3		NB	0%	30%	13
Dickenson to Site	2 - 1	2L	**SB**	0%	80%	**36**
Site to Dickenson	1 - 2		NB	80%	0%	62
Site to Aholo Rd	2 - 1	2L	**SB**	0%	20%	**9**
Aholo Rd to Site	1 - 2		NB	20%	0%	16
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	20%	**9**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	20%	0%	16

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-21
PM Peak Hour Trip Distribution
PLANTATION INN

December 2, 2004

Total Trips: 12
Entering: 6
Exiting: 6

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New PM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	0%	0%	**0**
Office Rd to North of Office Rd	11 - N		NB	0%	0%	0
Office Rd to Napilihau St	11 - 10	2L	**SB**	0%	0%	**0**
Napilihau St to Office Rd	10 - 11		NB	0%	0%	0
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	0%	0%	**0**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	0%	0
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	0%	0%	**0**
Akahele St to Hoohui Rd	8 - 9		NB	0%	0%	0
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	5%	0%	**0**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	5%	0
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	**SB**	10%	0%	**1**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	0%	10%	1
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	10%	0%	**1**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	0%	10%	1
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	30%	0%	**2**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	0%	30%	2
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	30%	0%	**2**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	0%	30%	2
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	30%	0%	**2**
Dickenson St to Kapunakea Rd	2 - 3		NB	0%	30%	2
Dickenson to Site	2 - 1	2L	**SB**	95%	0%	**6**
Site to Dickenson	1 - 2		NB	0%	95%	6
Site to Aholo Rd	2 - 1	2L	**SB**	0%	5%	**0**
Aholo Rd to Site	1 - 2		NB	5%	0%	0
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**	0%	5%	**0**
South Honoapiilani Hwy to Aholo Rd	S-1		NB	5%	0%	0

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-22
PM Peak Hour Trip Distribution
PUUNOA VILLAGE

December 2, 2004

Total Trips: 0
Entering: 0
Exiting: 0

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New PM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**			**0**
Office Rd to North of Office Rd	11 - N		NB			0
Office Rd to Napilihau St	11 - 10	2L	**SB**			**0**
Napilihau St to Office Rd	10 - 11		NB			0
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**			**0**
Hoohui Rd to Napilihau St	9 - 10		NB			0
Hoohui Rd to Akahele St	9 - 8	2L	**SB**			**0**
Akahele St to Hoohui Rd	8 - 9		NB			0
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**			**0**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB			0
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	**SB**			**0**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB			0
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**			**0**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB			0
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**			**0**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB			0
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**			**0**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB			0
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**			**0**
Dickenson St to Kapunakea Rd	2 - 3		NB			0
Dickenson to Site	2 - 1	2L	**SB**			**0**
Site to Dickenson	1 - 2		NB			0
Site to Aholo Rd	2 - 1	2L	**SB**			**0**
Aholo Rd to Site	1 - 2		NB			0
Aholo Rd to South Honoapiilani Hwy	1-S	2L	**SB**			**0**
South Honoapiilani Hwy to Aholo Rd	S-1		NB			0

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-23
PM Peak Hour Trip Distribution

MAKILA

December 2, 2004

Total Trips: 72
Entering: 46
Exiting: 26

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New PM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	0%	0%	**0**
Office Rd to North of Office Rd	11 - N		NB	0%	0%	0
Office Rd to Napilihau St	11 - 10	2L	**SB**	0%	0%	**0**
Napilihau St to Office Rd	10 - 11		NB	0%	0%	0
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	0%	0%	**0**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	0%	0
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	0%	0%	**0**
Akahele St to Hoohui Rd	8 - 9		NB	0%	0%	0
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	5%	0%	**2**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	5%	1
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	**SB**	10%	0%	**5**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	0%	10%	3
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	10%	0%	**5**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	0%	10%	3
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	30%	0%	**14**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	0%	30%	8
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	30%	0%	**14**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	0%	30%	8
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	30%	0%	**14**
Dickenson St to Kapunakea Rd	2 - 3		NB	0%	30%	8
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	30%	0%	**14**
Aholo Rd to Dickenson St	1 - 2		NB	0%	30%	8
Aholo Rd to Site	S-1	2L	**SB**	80%	0%	**37**
Site to Aholo Rd	1-S		NB	0%	80%	21
Site to South Honoapiilani Hwy	1-S	2L	**SB**	0%	20%	**5**
South Honoapiilani Hwy to Site	S-1		NB	20%	0%	9

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Stree	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-24
PM Peak Hour Trip Distribution

OLOWALU

December 2, 2004

Total Trips: 38
Entering: 24
Exiting: 14

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New PM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	**SB**	0%	0%	**0**
Office Rd to North of Office Rd	11 - N		NB	0%	0%	**0**
Office Rd to Napilihau St	11 - 10	2L	**SB**	0%	0%	**0**
Napilihau St to Office Rd	10 - 11		NB	0%	0%	**0**
Napilihau St to Hoohui Rd	10 - 9	2L	**SB**	0%	0%	**0**
Hoohui Rd to Napilihau St	9 - 10		NB	0%	0%	0
Hoohui Rd to Akahele St	9 - 8	2L	**SB**	0%	0%	**0**
Akahele St to Hoohui Rd	8 - 9		NB	0%	0%	0
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	**SB**	5%	0%	**1**
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	5%	**1**
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	**SB**	10%	0%	**2**
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	0%	10%	**1**
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	**SB**	10%	0%	**2**
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	0%	10%	1
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	**SB**	30%	0%	**7**
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	0%	30%	4
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	**SB**	30%	0%	**7**
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	0%	30%	4
Kapunakea Rd to Dickenson St	3 - 2	4LD	**SB**	30%	0%	**7**
Dickenson St to Kapunakea Rd	2 - 3		NB	0%	30%	4
Dickenson St to Aholo Rd	2 - 1	2L	**SB**	30%	0%	**7**
Aholo Rd to Dickenson St	1 - 2		NB	0%	30%	4
Aholo Rd to Site	1-S	2L	**SB**	80%	0%	**19**
Site to Aholo Rd	S-1		NB	0%	80%	**11**
Site to South Honoapiilani Hwy	1-S	2L	**SB**	0%	20%	**3**
South Honoapiilani Hwy to Site	S-1		NB	20%	0%	5

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11

Table B-25
PM Peak Hour Trip Distribution
UKUMEHAME

December 2, 2004

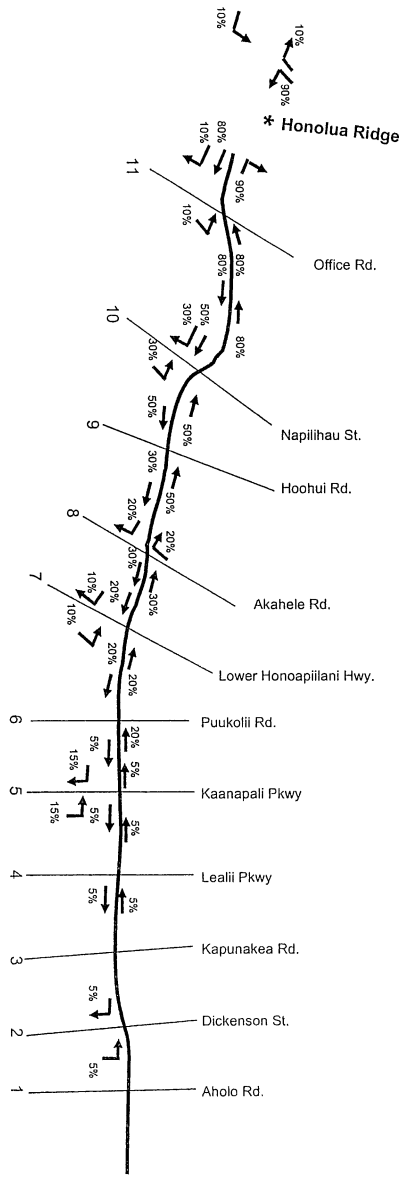
Total Trips: 82
Entering: 52
Exiting: 30

Roadway Segment	Segment	No. Lanes	Dir	% of New Entering Project Trips	% of New Exiting Project Trips	Net New PM Peak Hour Project Trips
Honoapiilani Highway						
North of Office Rd to Office Rd	N - 11	2L	SB	0%	0%	0
Office Rd to North of Office Rd	11 - N		NB	0%	0%	0
Office Rd to Napilihau St	11 - 10	2L	SB	0%	0%	0
Napilihau St to Office Rd	10 - 11		NB	0%	0%	0
Napilihau St to Hoohui Rd	10 - 9	2L	SB	0%	0%	0
Hoohui Rd to Napilihau St	9 - 10		NB	0%	0%	0
Hoohui Rd to Akahele St	9 - 8	2L	SB	0%	0%	0
Akahele St to Hoohui Rd	8 - 9		NB	0%	0%	0
Akahele St to Lower Honoapiilani Hwy	8 - 7	2L	SB	5%	0%	3
Lower Honoapiilani Hwy to Akahele St	7 - 8		NB	0%	5%	1
Lower Honoapiilani Hwy to Puukolii Rd	7 - 6	4LD	SB	10%	0%	5
Puukolii Rd to Lower Honoapiilani Hwy	6 - 7		NB	0%	10%	3
Puukolii Rd to Kaanapali Pkwy	6 - 5	4LD	SB	10%	0%	5
Kaanapali Pkwy to Puukolii Rd	5 - 6		NB	0%	10%	3
Kaanapali Pkwy to Lealii Pkwy	5 - 4	4LD	SB	30%	0%	16
Lealii Pkwy to Kaanapali Pkwy	4 - 5		NB	0%	30%	9
Lealii Pkwy to Kapunakea Rd	4 - 3	4LD	SB	30%	0%	16
Kapunakea Rd to Lealii Pkwy	3 - 4		NB	0%	30%	9
Kapunakea Rd to Dickenson St	3 - 2	4LD	SB	30%	0%	16
Dickenson St to Kapunakea Rd	2 - 3		NB	0%	30%	9
Dickenson St to Aholo Rd	2 - 1	2L	SB	80%	0%	42
Aholo Rd to Dickenson St	1 - 2		NB	0%	80%	24
Aholo Rd to Site	1-S	2L	SB	80%	0%	42
Site to Aholo Rd	S-1		NB	0%	80%	24
Site to South Honoapiilani Hwy	1-S	2L	SB	0%	20%	6
South Honoapiilani Hwy to Site	S-1		NB	20%	0%	10

SB = Peak direction

Analysis Segments

Aholo Road to Dickenson Street	1 - 2
Dickenson Street to Kapunakea Road	2 - 3
Kapunakea Road to Lealii Parkway	3 - 4
Lealii Parkway to Kaanapali Parkway	4 - 5
Kaanapali Parkway to Puukolii Road	5 - 6
Puukolii Road to Lower Honoapiilani Highway	6 - 7
Lower Honoapiilani Highway to Akahele Street	7 - 8
Akahele Street to Hoohui Road	8 - 9
Hoohui Road to Napilihau Street	9 - 10
Napilihau Street to Office Road	10 - 11



B-1

PM Peak Hour Distribution

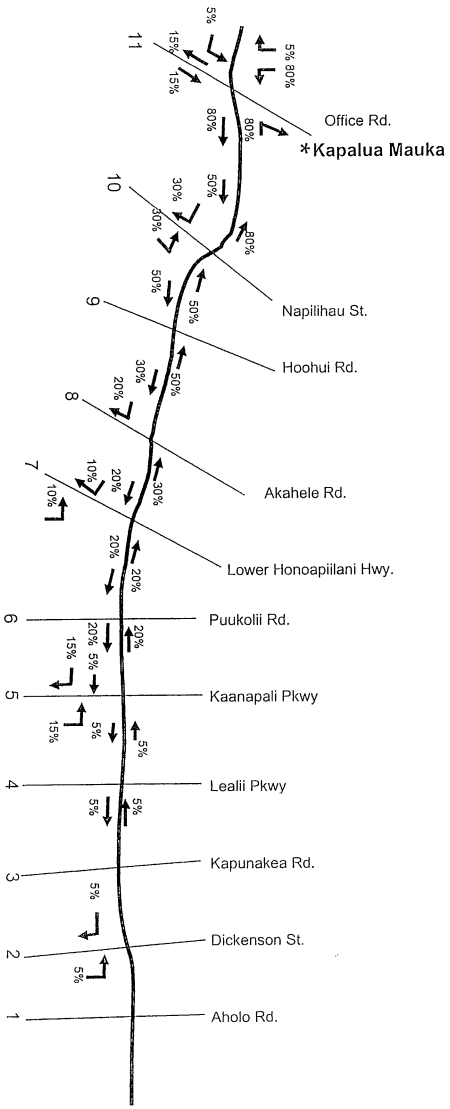
Honolua Ridge

14-Oct-04

B-2

PM Peak Hour Distribution

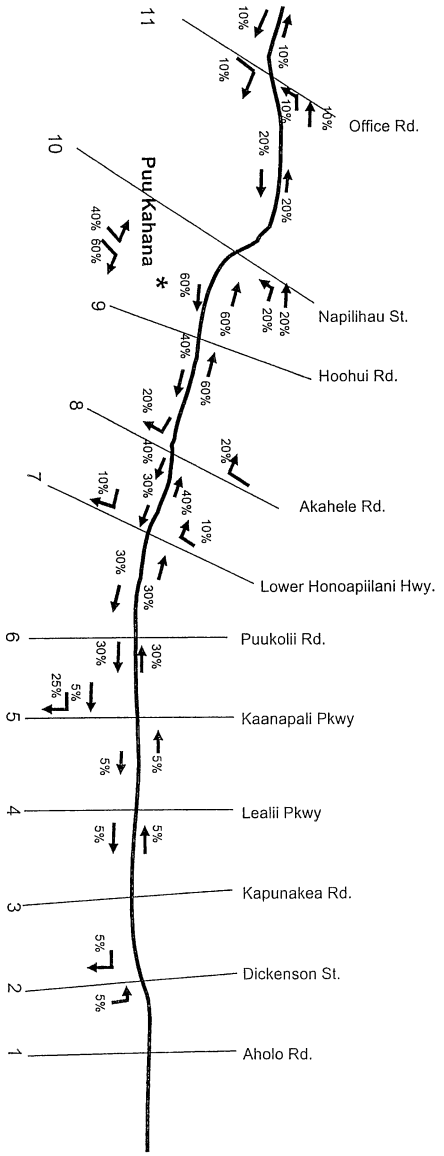
Kapalua Mauka



B-3

PM Peak Hour Distribution

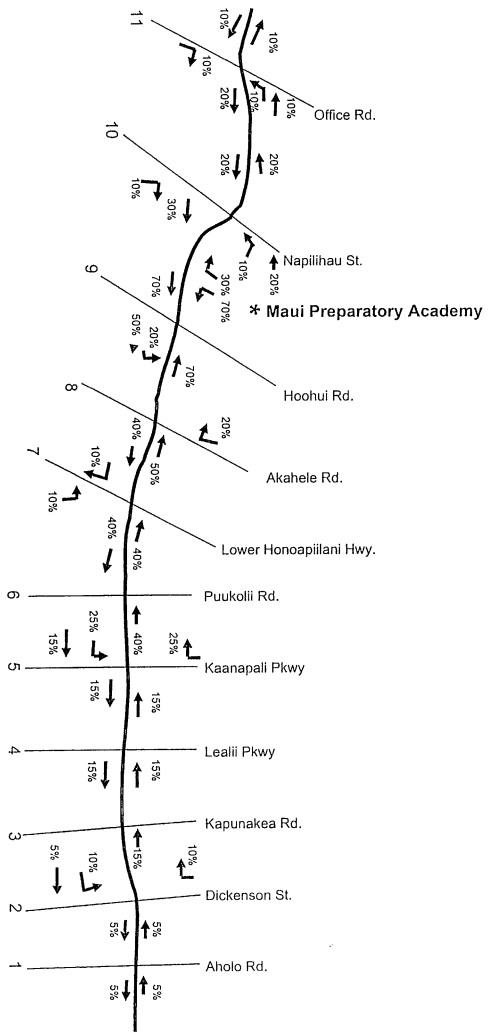
Puu Kahana



B-4

PM Peak Hour Distribution

Maui Preparatory Academy

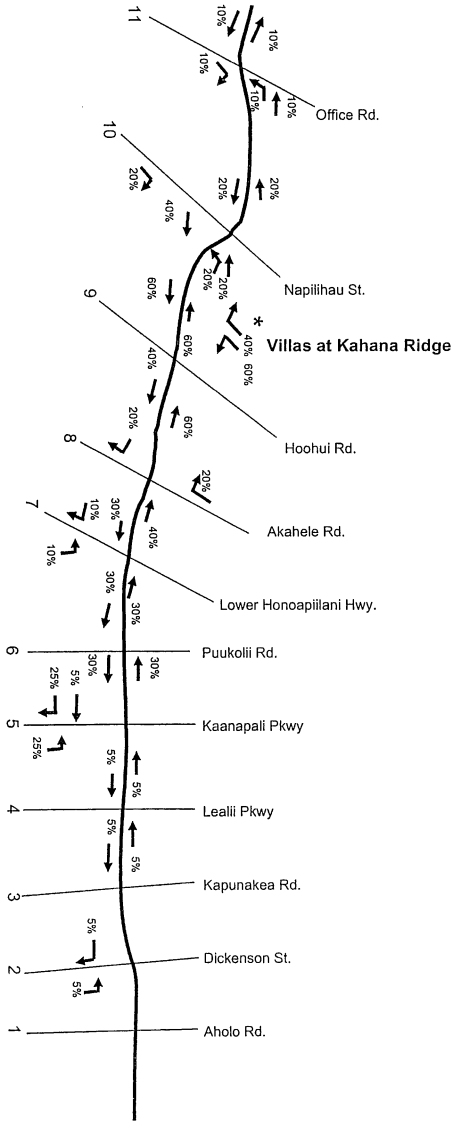


14-Oct-04

B-5

PM Peak Hour Distribution

Villas at Kahana Ridge

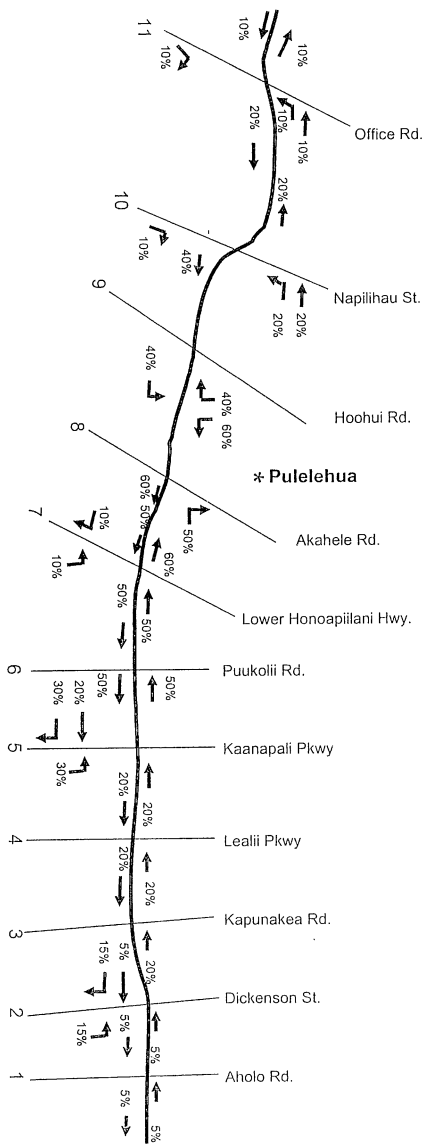


14-Oct-04

B-6

PM Peak Hour Distribution

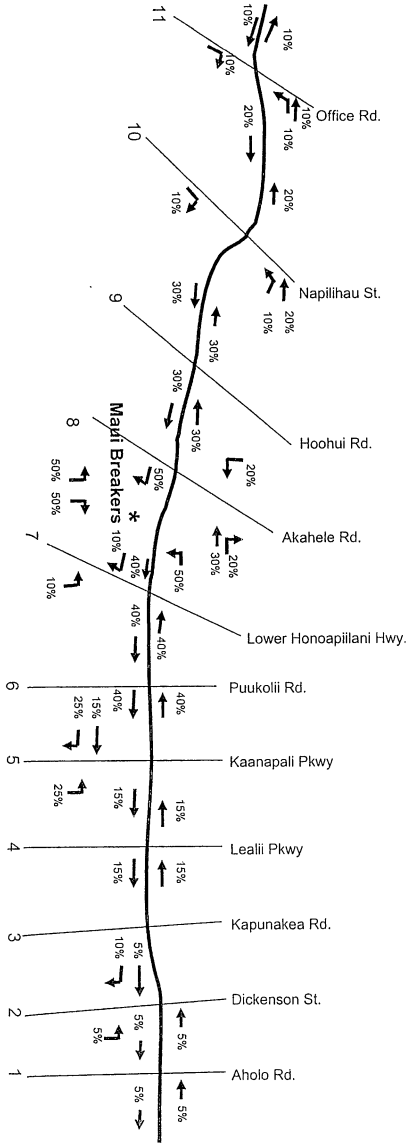
Pulelehua



B-7

PM Peak Hour Distribution

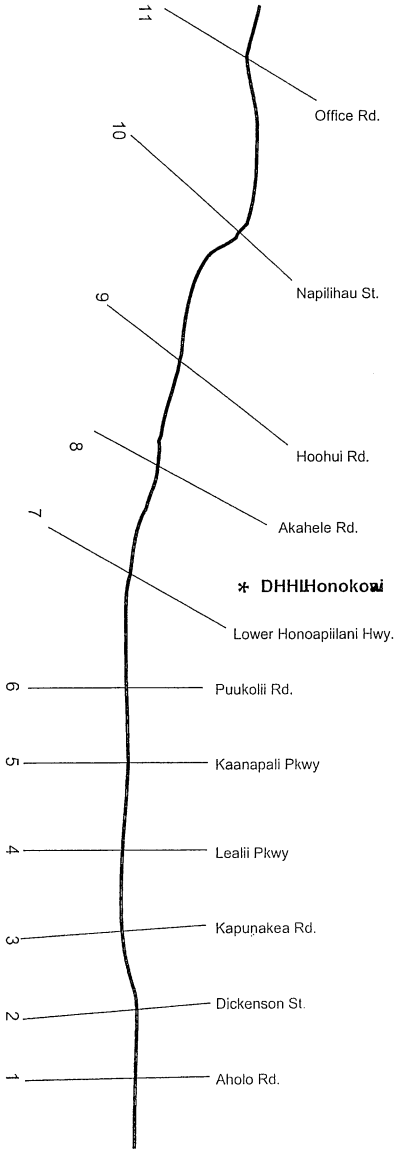
Maui Breakers



B-8

PM Peak Hour Distribution

DHHI Honokowai

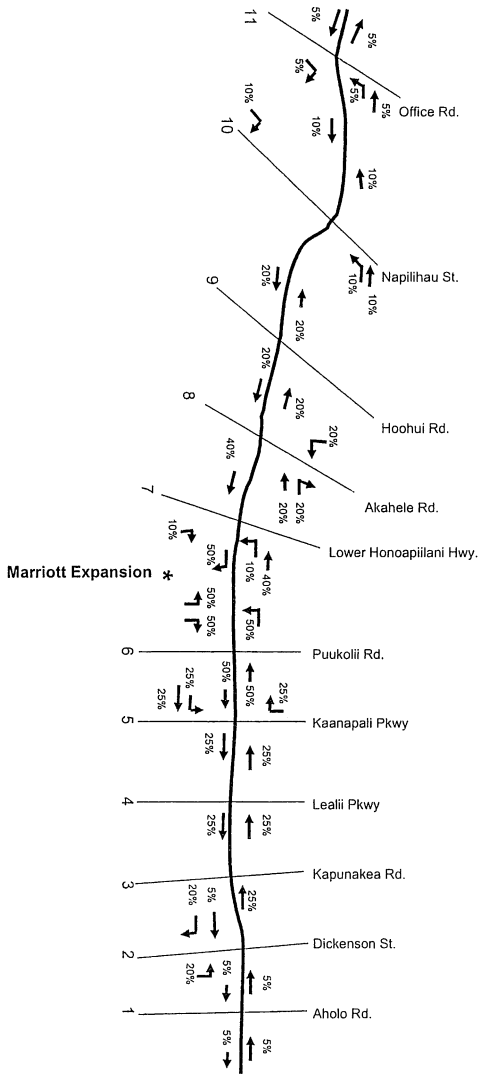


14-Oct-04

B-9

PM Peak Hour Distribution

Marriott Expansion

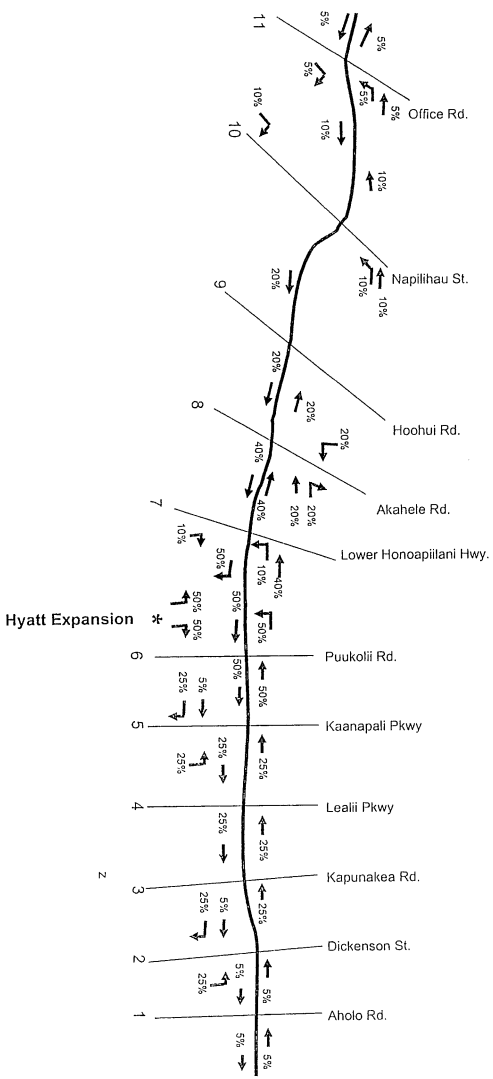


14-Oct-04

B-10

PM Peak Hour Distribution

Hyatt Expansion

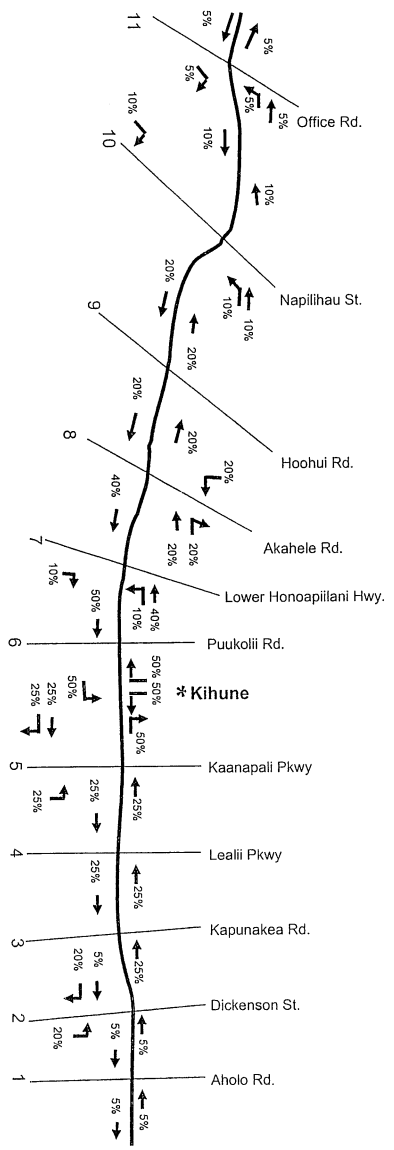


14-Oct-04

B-11

PM Peak Hour Distribution

Kihune

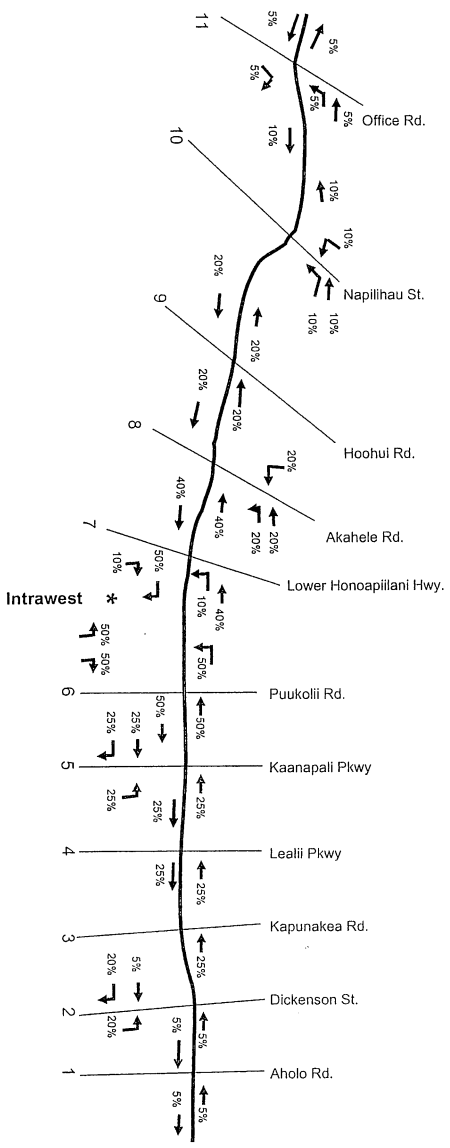


14-Oct-04

B-12

PM Peak Hour Distribution

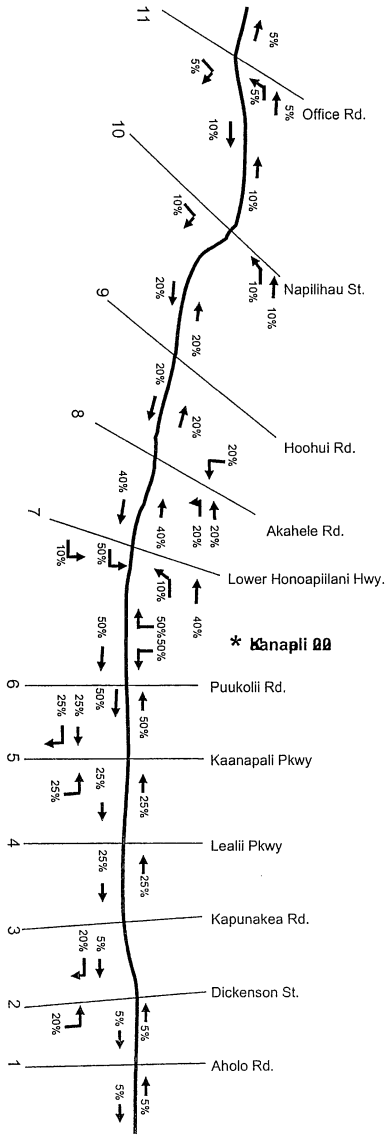
Intrawest



B-13

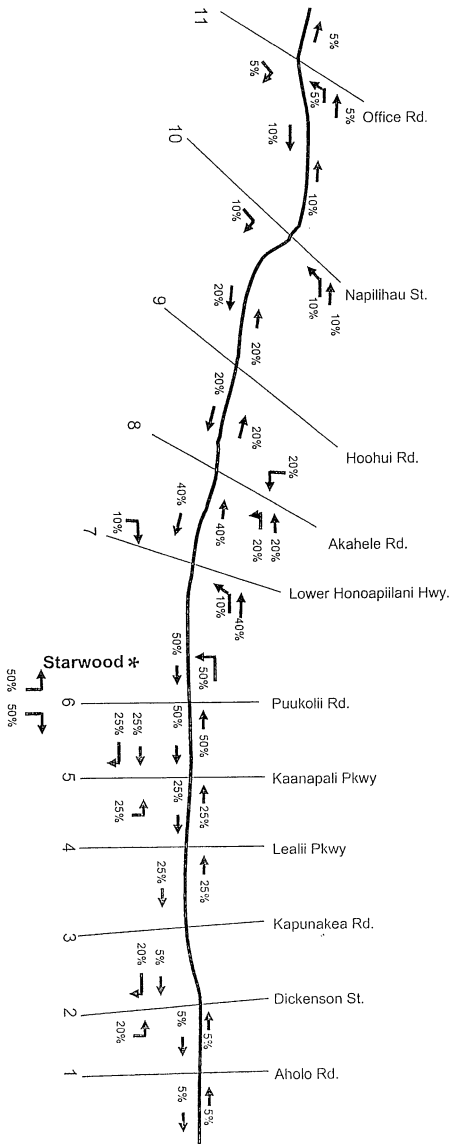
PM Peak Hour Distribution

Kanapali 2020



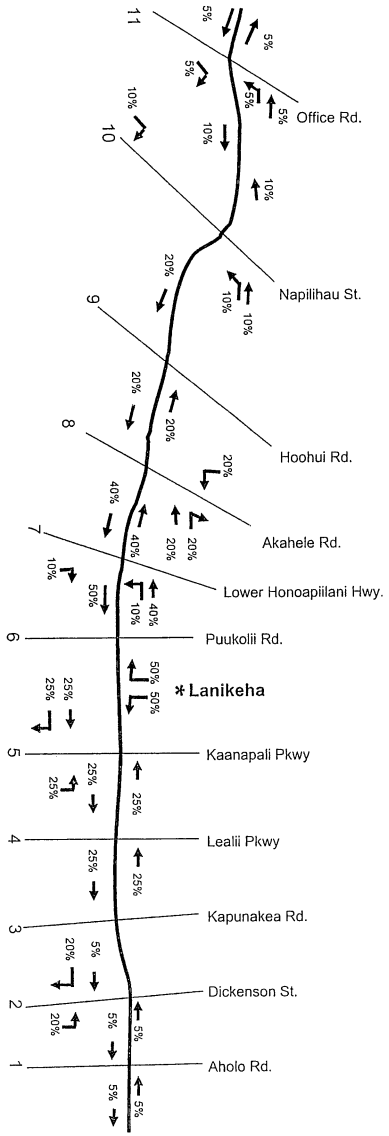
B-14

PM Peak Hour Distribution
Starwood



B-15

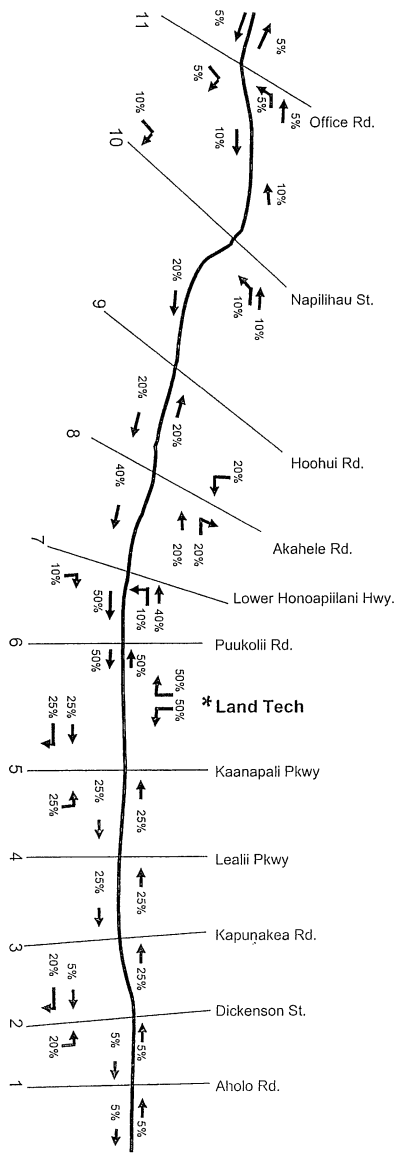
PM Peak Hour Distribution
Lanikeha



B-16

PM Peak Hour Distribution

Land Tech



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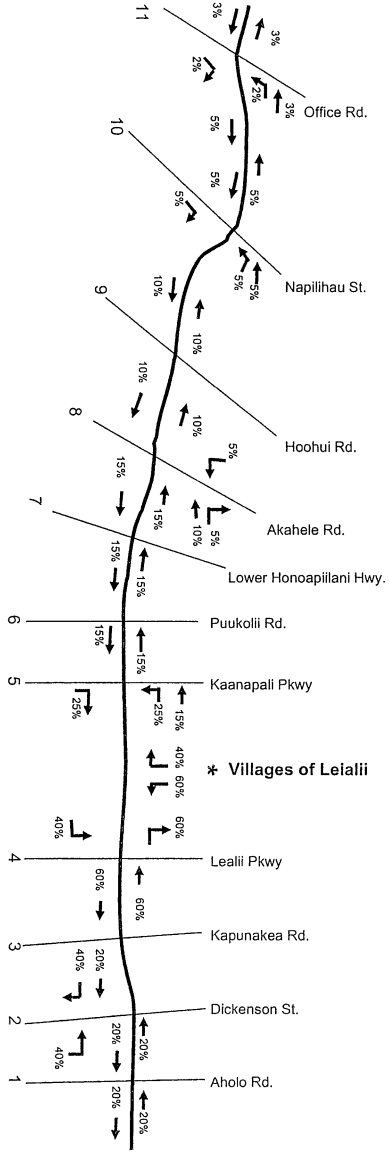
B-17

PM Peak Hour Distribution

Villages of Leialii



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B-18

PM Peak Hour Distribution

West Maui Resource

Center Phase II

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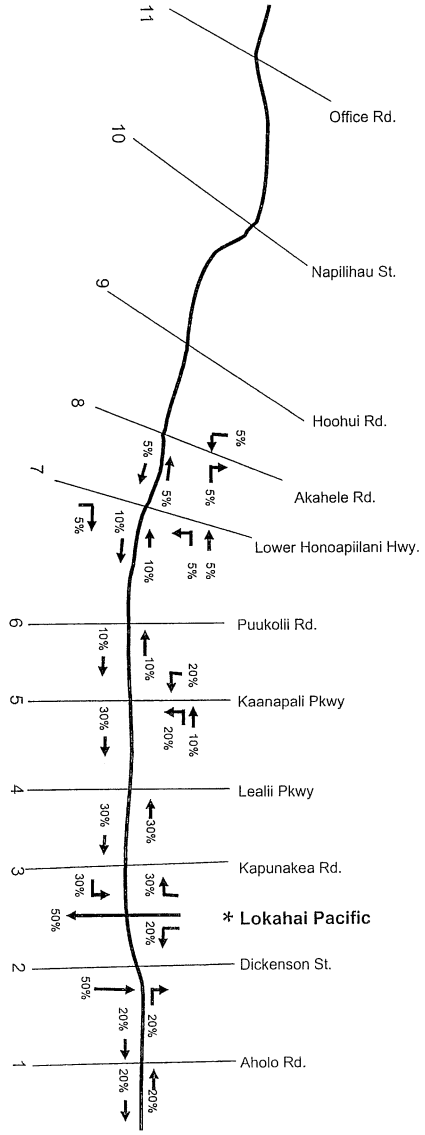
B-19



PM Peak Hour Distribution

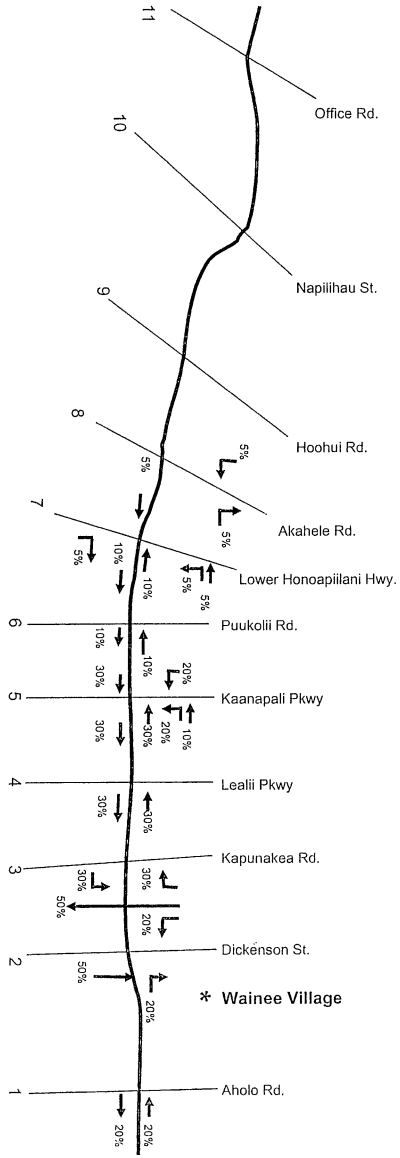
Lokahai Pacific

14-Oct-04

B-20

PM Peak Hour Distribution

Wainee Village



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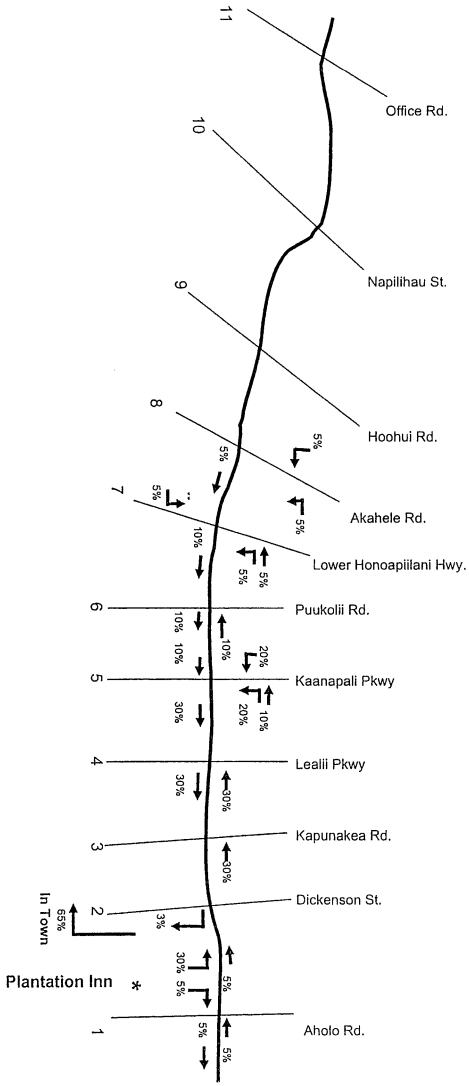
B-21

PM Peak Hour Distribution

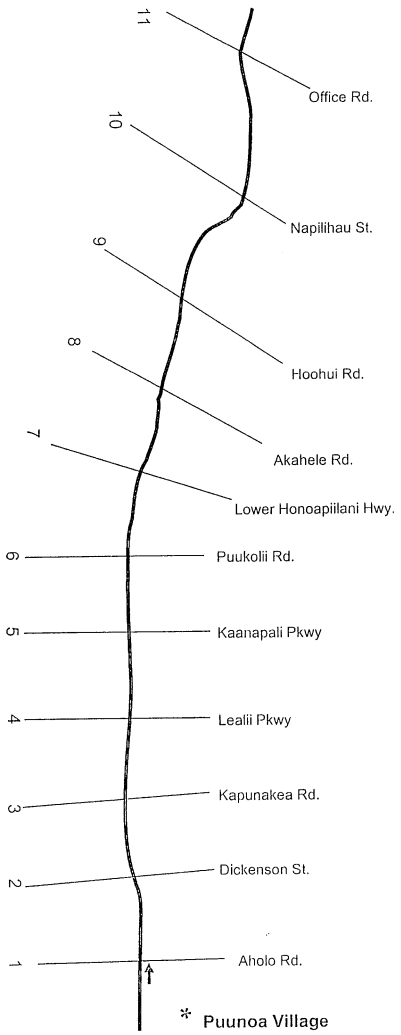
Plantation Inn



14-Oct-04

B-22

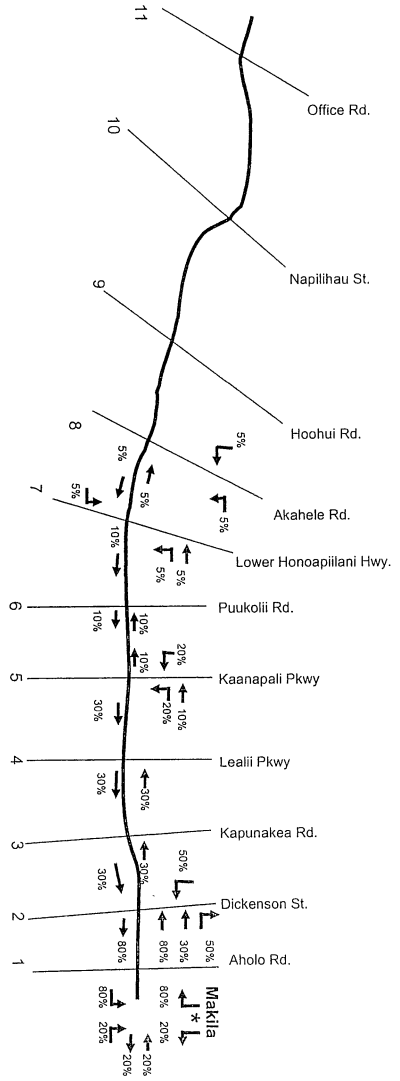
PM Peak Hour Distribution
Puunoa Village



14-Oct-04

B-23

PM Peak Hour Distribution
Makila

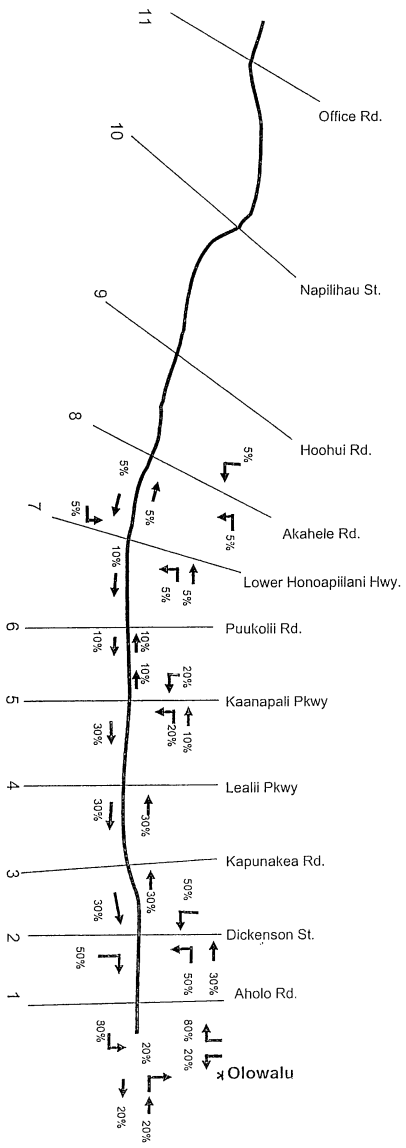


13-Oct-04

B-24

PM Peak Hour Distribution

Olowalu

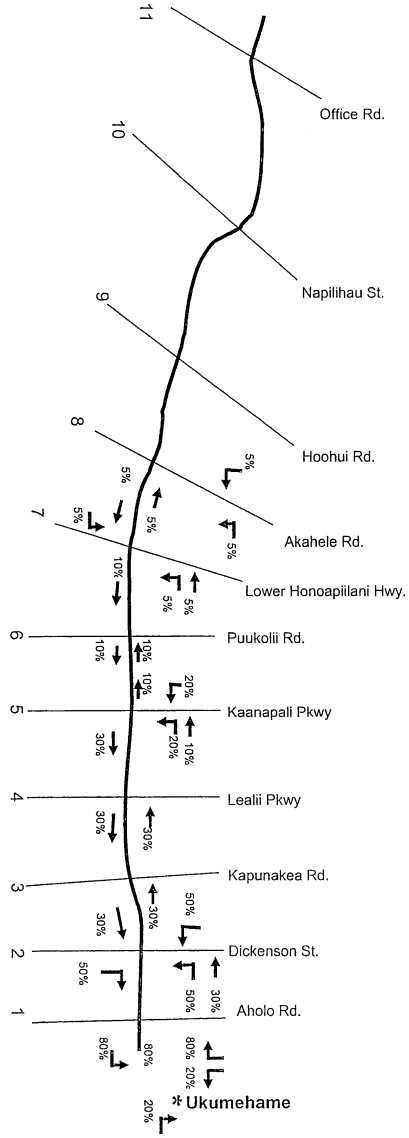


14-Oct-04

B-25

PM Peak Hour Distribution

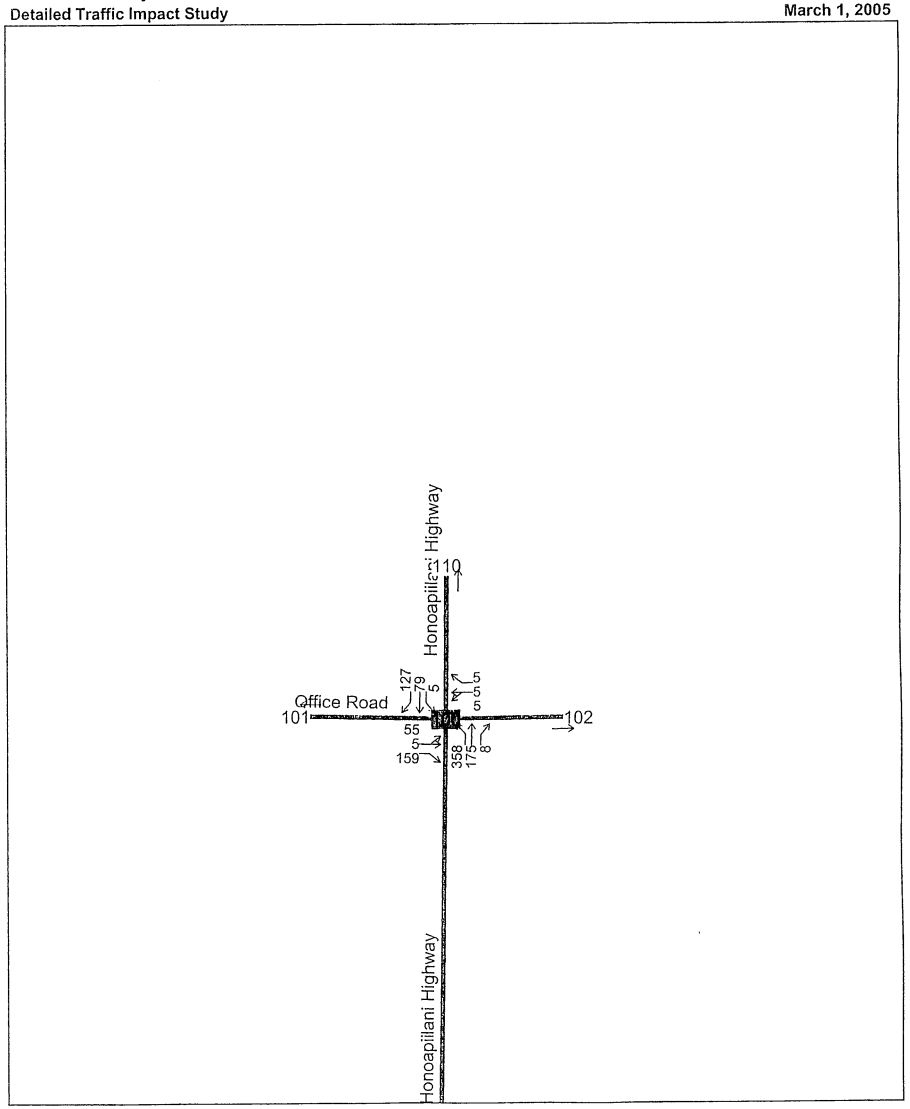
Ukumehame

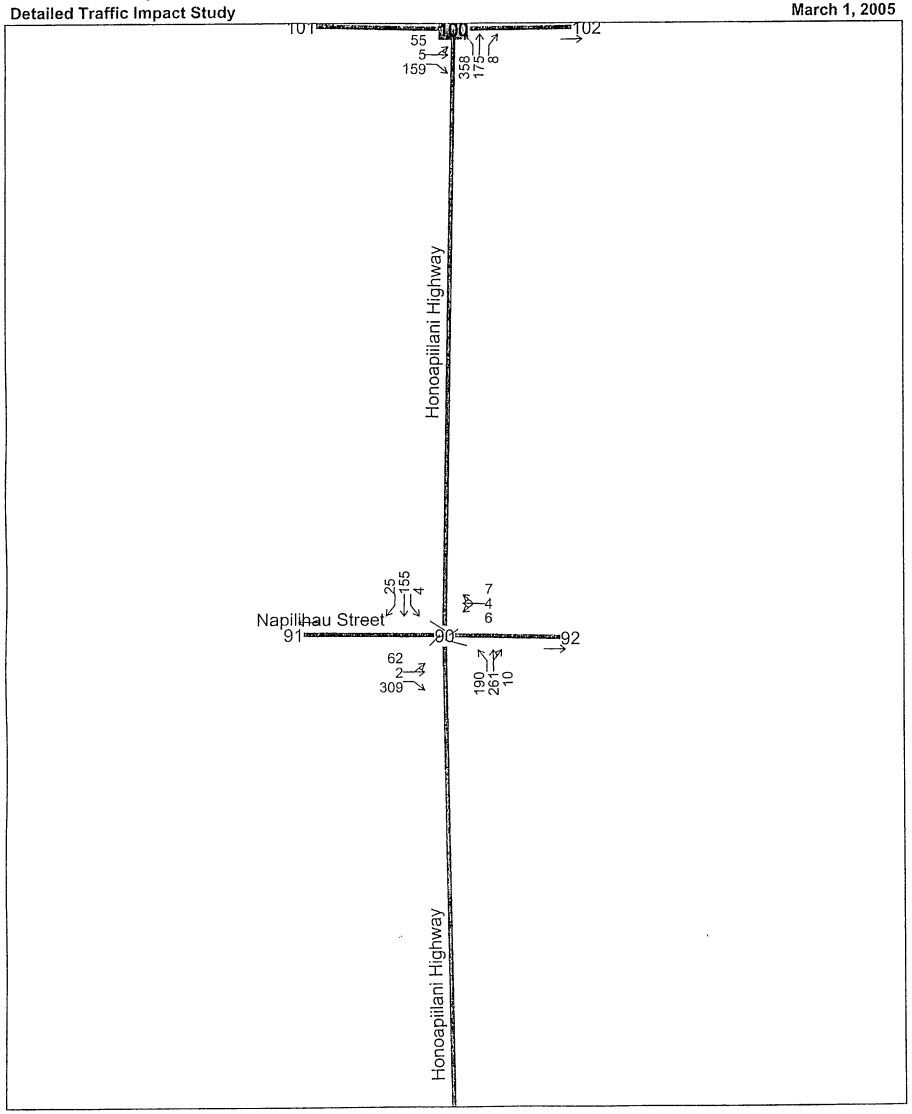


14-Oct-04

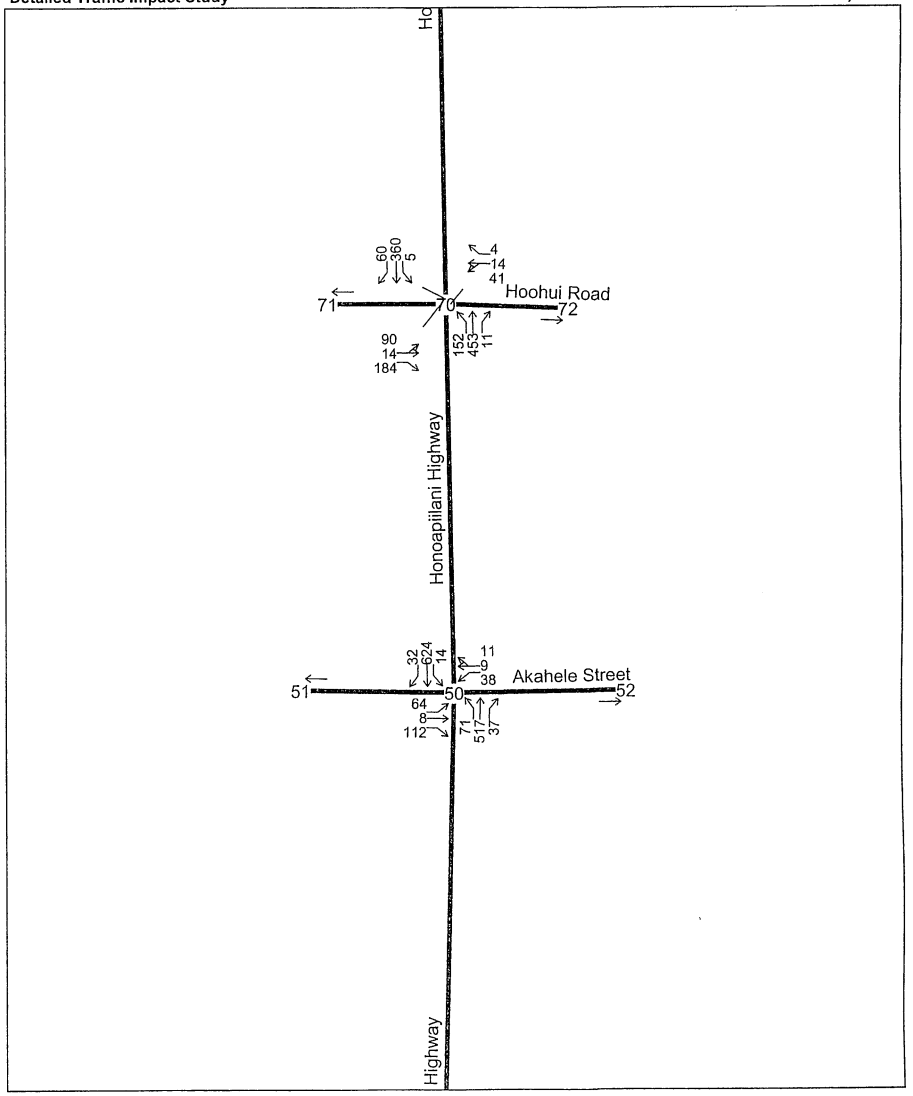
APPENDIX B

Honoapiilani Highway Arterial Level of Service Analysis 2004 AM Peak Hour without Project Trips (SYNCHRO)

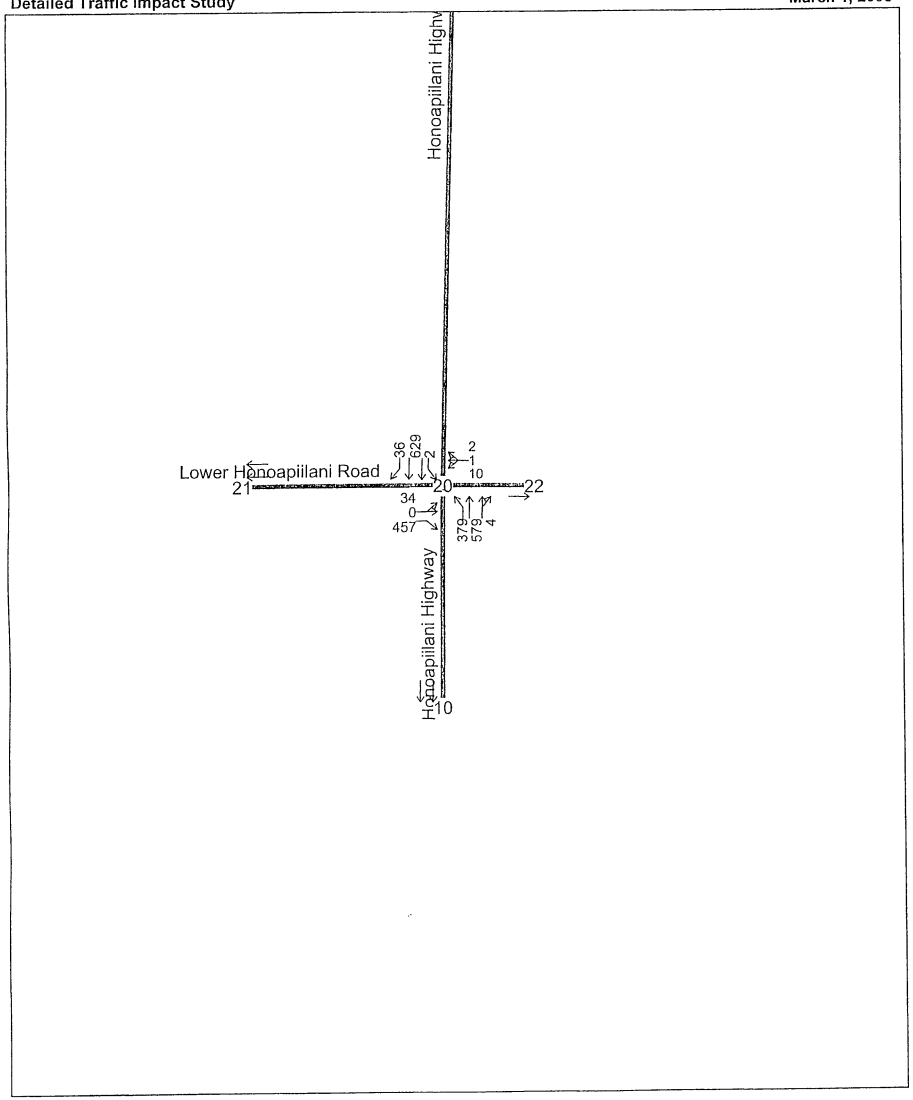




Arterial LOS Analysis
Detailed Traffic Impact Study
AM Pk Hr Existing Conditions 2004
March 1, 2005



Hall Planning & Engineering, Inc.



Pulelehua

Arterial Level of Service: NB Honoapiilani Highway

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Lower Honoapiilani R	II	45	33.6	8.6	42.2	0.35	29.9	B
Akahele Street	II	45	103.9	7.3	111.2	1.30	42.0	A
Hoohui Road	II	45	49.1	11.5	60.6	0.61	36.5	A
Napilihau Street	II	45	90.7	6.6	97.3	1.13	41.9	A
Total	II		277.3	34.0	311.3	3.40	39.3	A

Arterial Level of Service: SB Honoapiilani Highway

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Napilihau Street	II	45	95.7	12.9	108.6	1.20	39.7	A
Hoohui Road	II	45	90.7	9.3	100.0	1.13	40.8	A
Akahele Street	II	45	49.1	12.6	61.7	0.61	35.8	A
Lower Honoapiilani R	II	45	103.9	29.8	133.7	1.30	35.0	B
Total	II		339.4	64.6	404.0	4.24	37.8	A

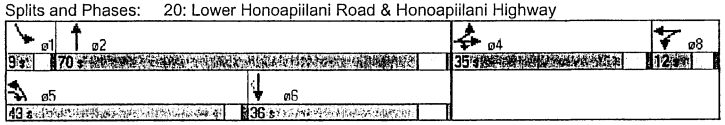
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		0	0		0	200		0	0		200
Storage Lanes	0		1	0		0	1		0	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	1.00
Frt			0.850		0.981			0.999				0.850
Flt Protected		0.950			0.962		0.950			0.950		
Satd. Flow (prot)	0	1770	1583	0	1758	0	1770	3536	0	1770	3539	1583
Flt Permitted		0.950			0.962		0.950			0.950		
Satd. Flow (perm)	0	1770	1583	0	1758	0	1770	3536	0	1770	3539	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			194		2			1				38
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		1680			766			1848			6856	
Travel Time (s)		57.3			26.1			28.0			103.9	
Volume (vph)	34	0	457	10	1	2	379	579	4	2	629	36
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	38	0	508	11	1	2	421	643	4	2	699	40
Lane Group Flow (vph)	0	38	508	0	14	0	421	647	0	2	699	40
Turn Type	Split		pt+ov	Split			Prot			Prot		Perm
Protected Phases	4	4	4 5	8	8		5	2		1	6	
Permitted Phases												6
Detector Phases	4	4	4 5	8	8		5	2		1	6	6
Minimum Initial (s)	5.0	5.0		5.0	5.0		3.0	15.0		3.0	15.0	15.0
Minimum Split (s)	35.0	35.0		12.0	12.0		9.0	36.0		9.0	36.0	36.0
Total Split (s)	35.0	35.0	78.0	12.0	12.0	0.0	43.0	70.0	0.0	9.0	36.0	36.0
Total Split (%)	27.8%	27.8%	61.9%	9.5%	9.5%	0.0%	34.1%	55.6%	0.0%	7.1%	28.6%	28.6%
Maximum Green (s)	30.0	30.0		7.0	7.0		39.0	64.0		5.0	30.0	30.0
Yellow Time (s)	4.0	4.0		4.0	4.0		3.0	5.0		3.0	5.0	5.0
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	1.0
Lead/Lag							Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		2.0	5.0		2.0	5.0	5.0
Recall Mode	None	None		None	None		None	Max		None	Max	Max
Walk Time (s)	7.0	7.0						7.0			7.0	7.0
Flash Dont Walk (s)	23.0	23.0						16.0			23.0	23.0
Pedestrian Calls (#/hr)	0	0						0			0	0
Act Effct Green (s)		20.3	50.8		8.2		28.5	69.5		5.7	39.4	39.4
Actuated g/C Ratio		0.20	0.50		0.08		0.28	0.68		0.05	0.39	0.39
v/c Ratio		0.11	0.57		0.10		0.85	0.27		0.02	0.51	0.06
Control Delay		35.5	9.2		47.3		40.3	8.6		55.5	29.8	11.2
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	0.0
Total Delay		35.5	9.2		47.3		40.3	8.6		55.5	29.8	11.2
LOS		D	A		D		D	A		E	C	B

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		11.0			47.3			21.1			28.9	
Approach LOS		B			D			C			C	
90th %ile Green (s)	27.4	27.4		7.0	7.0		39.0	64.0		5.0	30.0	30.0
90th %ile Term Code	Gap	Gap		Max	Max		Max	MaxR		Max	MaxR	MaxR
70th %ile Green (s)	21.1	21.1		6.9	6.9		36.5	70.5		0.0	30.0	30.0
70th %ile Term Code	Gap	Gap		Gap	Gap		Gap	Hold		Skip	MaxR	MaxR
50th %ile Green (s)	18.4	18.4		0.0	0.0		28.1	64.0		0.0	31.9	31.9
50th %ile Term Code	Gap	Gap		Skip	Skip		Gap	MaxR		Skip	Hold	Hold
30th %ile Green (s)	15.4	15.4		0.0	0.0		21.2	64.0		0.0	38.8	38.8
30th %ile Term Code	Gap	Gap		Skip	Skip		Gap	MaxR		Skip	Hold	Hold
10th %ile Green (s)	10.9	10.9		0.0	0.0		15.7	64.0		0.0	44.3	44.3
10th %ile Term Code	Gap	Gap		Skip	Skip		Gap	MaxR		Skip	Hold	Hold

Intersection Summary

Area Type: Other
Cycle Length: 126
Actuated Cycle Length: 101.5
Natural Cycle: 105
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.85
Intersection Signal Delay: 21.3 Intersection LOS: C
Intersection Capacity Utilization 59.9% ICU Level of Service B
Analysis Period (min) 15
90th %ile Actuated Cycle: 123.4
70th %ile Actuated Cycle: 114.5
50th %ile Actuated Cycle: 93.4
30th %ile Actuated Cycle: 90.4
10th %ile Actuated Cycle: 85.9

Splits and Phases: 20: Lower Honoapiilani Road & Honoapiilani Highway



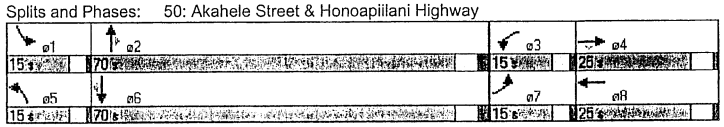
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		200	200		200
Storage Lanes	1		1	1		0	1		1	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50		50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0	0	0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850		0.918				0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1863	1583	1770	1710	0	1770	1863	1583	1770	1863	1583
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	1863	1583	1770	1710	0	1770	1863	1583	1770	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			118		12				41			29
Headway 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
Link Speed (mph)		30			30			45			45	
Link Distance (ft)		1291			1428			6856			3242	
Travel Time (s)		29.3			32.5			103.9			49.1	
Volume (vph)	64	8	112	38	9	11	71	517	37	14	624	32
Peak Hour Factor	0.95	0.95	0.95	0.90	0.90	0.90	0.95	0.95	0.90	0.90	0.95	0.95
Adj. Flow (vph)	67	8	118	42	10	12	75	544	41	16	657	34
Lane Group Flow (vph)	67	8	118	42	22	0	75	544	41	16	657	34
Turn Type	Prot		Perm	Prot			Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4						2			6
Detector Phases	7	4	4	3	8		5	2	2	1	6	6
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0		5.0	10.0	10.0	5.0	10.0	10.0
Minimum Split (s)	9.0	23.0	23.0	9.0	23.0		9.0	24.0	24.0	9.0	24.0	24.0
Total Split (s)	15.0	25.0	25.0	15.0	25.0	0.0	15.0	70.0	70.0	15.0	70.0	70.0
Total Split (%)	12.0%	20.0%	20.0%	12.0%	20.0%	0.0%	12.0%	56.0%	56.0%	12.0%	56.0%	56.0%
Maximum Green (s)	11.0	20.0	20.0	11.0	20.0		11.0	64.0	64.0	11.0	64.0	64.0
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0		3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0		1.0	2.0	2.0	1.0	2.0	2.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0		2.0	5.0	5.0	2.0	5.0	5.0
Recall Mode	None	None	None	None	None		None	Min	Min	None	Min	Min
Walk Time (s)		7.0	7.0		7.0			7.0	7.0		7.0	7.0
Flash Dont Walk (s)		11.0	11.0		11.0			11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)		0	0		0			0	0		0	0
Act Effct Green (s)	12.0	10.6	10.6	8.9	10.1		9.7	64.4	64.4	7.9	58.6	58.6
Actuated g/C Ratio	0.14	0.12	0.12	0.10	0.11		0.11	0.79	0.79	0.09	0.71	0.71
v/c Ratio	0.27	0.03	0.40	0.23	0.11		0.37	0.37	0.03	0.10	0.49	0.03
Control Delay	34.9	37.5	9.5	38.8	27.8		36.9	7.3	2.7	43.8	12.6	4.9
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	34.9	37.5	9.5	38.8	27.8		36.9	7.3	2.7	43.8	12.6	4.9
LOS	C	D	A	D	C		D	A	A	D	B	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		19.4			35.0			10.4			13.0	
Approach LOS		B			D			B			B	
90th %ile Green (s)	11.0	11.2	11.2	9.9	10.1		11.0	61.3	61.3	7.2	57.5	57.5
90th %ile Term Code	Max	Gap	Gap	Gap	Hold		Max	Hold	Hold	Gap	Gap	Gap
70th %ile Green (s)	9.0	8.2	8.2	7.5	6.7		9.4	55.0	55.0	0.0	41.6	41.6
70th %ile Term Code	Gap	Hold	Hold	Gap	Gap		Gap	Hold	Hold	Skip	Gap	Gap
50th %ile Green (s)	16.8	5.7	5.7	6.1	0.0		7.3	42.9	42.9	0.0	31.6	31.6
50th %ile Term Code	Hold	Gap	Gap	Gap	Skip		Gap	Hold	Hold	Skip	Gap	Gap
30th %ile Green (s)	0.0	0.0	0.0	0.0	0.0		0.0	19.9	19.9	0.0	19.9	19.9
30th %ile Term Code	Skip	Skip	Skip	Skip	Skip		Skip	Dwell	Dwell	Skip	Dwell	Dwell
10th %ile Green (s)	0.0	0.0	0.0	0.0	0.0		0.0	114.0	114.0	0.0	114.0	114.0
10th %ile Term Code	Skip	Skip	Skip	Skip	Skip		Skip	Dwell	Dwell	Skip	Dwell	Dwell

Intersection Summary

Area Type: Other
Cycle Length: 125
Actuated Cycle Length: 82
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.49
Intersection Signal Delay: 13.6 Intersection LOS: B
Intersection Capacity Utilization 57.2% ICU Level of Service B
Analysis Period (min) 15
90th %ile Actuated Cycle: 108.6
70th %ile Actuated Cycle: 85.7
50th %ile Actuated Cycle: 69.7
30th %ile Actuated Cycle: 25.9
10th %ile Actuated Cycle: 120

Splits and Phases: 50: Akahele Street & Honoapiilani Highway



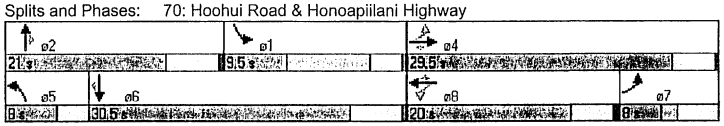
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		200	200		200
Storage Lanes	0		1	0		1	1		1	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50	50	50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850			0.850			0.850			0.850
Flt Protected		0.959			0.964		0.950			0.950		
Satd. Flow (prot)	0	1786	1583	0	1796	1583	1770	1863	1583	1770	1863	1583
Flt Permitted		0.771			0.778		0.950			0.950		
Satd. Flow (perm)	0	1436	1583	0	1449	1583	1770	1863	1583	1770	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			204			4			12			67
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		998			1017			3242			5984	
Travel Time (s)		34.0			34.7			49.1			90.7	
Volume (vph)	90	14	184	41	14	4	152	453	11	5	360	60
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	100	16	204	46	16	4	169	503	12	6	400	67
Lane Group Flow (vph)	0	116	204	0	62	4	169	503	12	6	400	67
Turn Type	pm+pt		Perm	Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Detector Phases	7	4	4	8	8	8	5	2	2	1	6	6
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	3.0	5.0	5.0	3.0	5.0	5.0
Minimum Split (s)	8.0	20.0	20.0	20.0	20.0	20.0	8.0	20.0	20.0	9.5	20.0	20.0
Total Split (s)	8.0	29.5	29.5	20.0	20.0	20.0	8.0	21.0	21.0	9.5	30.5	30.5
Total Split (%)	11.8%	43.4%	43.4%	29.4%	29.4%	29.4%	11.8%	30.9%	30.9%	14.0%	44.9%	44.9%
Maximum Green (s)	4.0	25.0	25.0	15.5	15.5	15.5	5.0	15.5	15.5	6.0	25.0	25.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	3.0	5.0	5.0	3.0	5.0	5.0
All-Red Time (s)	0.0	0.5	0.5	0.5	0.5	0.5	0.0	0.5	0.5	0.5	0.5	0.5
Lead/Lag	Lag			Lead	Lead	Lead	Lead	Lead	Lead	Lag	Lag	Lag
Lead-Lag Optimize?				Yes	Yes	Yes						
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	2.0	4.0	4.0	2.0	4.0	4.0
Recall Mode	None	None	None	None	None	None	None	Min	Min	None	Max	Max
Act Effct Green (s)		11.6	11.6		11.6	11.6	5.0	37.6	37.6	7.2	32.4	32.4
Actuated g/C Ratio		0.20	0.20		0.20	0.20	0.09	0.67	0.67	0.11	0.58	0.58
v/c Ratio		0.40	0.42		0.21	0.01	1.06	0.40	0.01	0.03	0.37	0.07
Control Delay		18.7	4.3		17.7	11.0	120.1	11.5	6.3	20.6	9.3	2.8
Queue Delay		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		18.7	4.3		17.7	11.0	120.1	11.5	6.3	20.6	9.3	2.8
LOS		B	A		B	B	F	B	A	C	A	A
Approach Delay		9.5			17.3			38.2			8.5	
Approach LOS		A			B			D			A	
90th %ile Green (s)	0.0	14.9	14.9	14.9	14.9	14.9	5.0	15.5	15.5	14.0	25.0	25.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
90th %ile Term Code	Skip	Gap	Gap	Hold	Hold	Hold	Max	Max	Max	Hold	MaxR	MaxR
70th %ile Green (s)	0.0	11.2	11.2	11.2	11.2	11.2	5.0	33.0	33.0	0.0	25.0	25.0
70th %ile Term Code	Skip	Gap	Gap	Hold	Hold	Hold	Max	Hold	Hold	Skip	MaxR	MaxR
50th %ile Green (s)	0.0	9.4	9.4	9.4	9.4	9.4	5.0	33.0	33.0	0.0	25.0	25.0
50th %ile Term Code	Skip	Gap	Gap	Hold	Hold	Hold	Max	Hold	Hold	Skip	MaxR	MaxR
30th %ile Green (s)	0.0	7.7	7.7	7.7	7.7	7.7	5.0	33.0	33.0	0.0	25.0	25.0
30th %ile Term Code	Skip	Gap	Gap	Hold	Hold	Hold	Max	Hold	Hold	Skip	MaxR	MaxR
10th %ile Green (s)	0.0	0.0	0.0	0.0	0.0	0.0	5.0	60.4	60.4	0.0	52.4	52.4
10th %ile Term Code	Skip	Skip	Skip	Skip	Skip	Skip	Max	Dwell	Dwell	Skip	Dwell	Dwell

Intersection Summary

Area Type: Other
Cycle Length: 68
Actuated Cycle Length: 56.2
Natural Cycle: 60
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 1.06
Intersection Signal Delay: 22.3 — Intersection LOS: C
Intersection Capacity Utilization 49.8% — ICU Level of Service A
Analysis Period (min) 15
90th %ile Actuated Cycle: 57.9
70th %ile Actuated Cycle: 54.2
50th %ile Actuated Cycle: 52.4
30th %ile Actuated Cycle: 50.7
10th %ile Actuated Cycle: 65.9

Splits and Phases: 70: Hoohui Road & Honoapiilani Highway



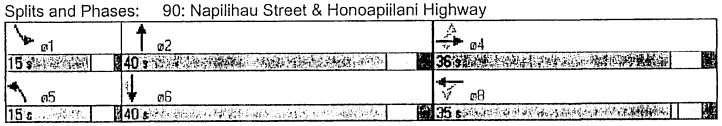
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		125	200		0
Storage Lanes	0		1	0		0	1		0	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850		0.943			0.994				0.850
Flt Protected		0.954			0.982		0.950			0.950		
Satd. Flow (prot)	0	1777	1583	0	1725	0	1770	1852	0	1770	1863	1583
Flt Permitted		0.768			0.941		0.950			0.950		
Satd. Flow (perm)	0	1431	1583	0	1653	0	1770	1852	0	1770	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			343		8			3				28
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		1254			1054			5984			5035	
Travel Time (s)		42.8			35.9			90.7			76.3	
Volume (vph)	62	2	309	6	4	7	190	261	10	4	155	25
Peak Hour Factor	0.90	0.91	0.90	0.92	0.93	0.90	0.95	0.95	0.93	0.90	0.95	0.90
Adj. Flow (vph)	69	2	343	7	4	8	200	275	11	4	163	28
Lane Group Flow (vph)	0	71	343	0	19	0	200	286	0	4	163	28
Turn Type	Perm		Perm	Perm			Prot			Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8								6
Detector Phases	4	4	4	8	8		5	2		1	6	6
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0		5.0	15.0		5.0	15.0	15.0
Minimum Split (s)	36.0	36.0	36.0	35.0	35.0		9.5	31.0		9.5	30.0	30.0
Total Split (s)	36.0	36.0	36.0	35.0	35.0	0.0	15.0	40.0	0.0	15.0	40.0	40.0
Total Split (%)	39.6%	39.6%	39.6%	38.5%	38.5%	0.0%	16.5%	44.0%	0.0%	16.5%	44.0%	44.0%
Maximum Green (s)	30.0	30.0	30.0	30.0	30.0		11.0	34.0		11.0	34.0	34.0
Yellow Time (s)	4.0	4.0	4.0	3.0	3.0		3.0	4.0		3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		1.0	2.0		1.0	2.0	2.0
Lead/Lag							Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		2.0	4.5		2.0	4.5	4.5
Recall Mode	None	None	None	None	None		None	None		None	None	None
Walk Time (s)	5.0	5.0	5.0					5.0			5.0	5.0
Flash Dont Walk (s)	19.0	19.0	19.0					20.0			19.0	19.0
Pedestrian Calls (#/hr)	0	0	0					0			0	0
Act Effct Green (s)		11.1	11.1		11.1		13.9	28.0		6.2	18.1	18.1
Actuated g/C Ratio		0.24	0.24		0.24		0.30	0.60		0.11	0.35	0.35
v/c Ratio		0.21	0.54		0.05		0.38	0.26		0.02	0.25	0.05
Control Delay		16.1	3.7		11.8		19.8	6.6		23.2	12.9	5.9
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	0.0
Total Delay		16.1	3.7		11.8		19.8	6.6		23.2	12.9	5.9
LOS		B	A		B		B	A		C	B	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		5.8			11.8			12.1			12.1	
Approach LOS		A			B			B			B	
90th %ile Green (s)	14.0	14.0	14.0	15.0	15.0		11.0	21.0		5.2	15.2	15.2
90th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Gap	Gap	Gap
70th %ile Green (s)	8.6	8.6	8.6	9.6	9.6		11.0	30.0		0.0	15.0	15.0
70th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	Min	Min
50th %ile Green (s)	7.3	7.3	7.3	8.3	8.3		11.0	30.0		0.0	15.0	15.0
50th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	Min	Min
30th %ile Green (s)	5.9	5.9	5.9	6.9	6.9		9.5	28.5		0.0	15.0	15.0
30th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Gap	Hold		Skip	Min	Min
10th %ile Green (s)	5.0	5.0	5.0	6.0	6.0		17.0	15.0		0.0	0.0	0.0
10th %ile Term Code	Min	Min	Min	Hold	Hold		Hold	Hold		Skip	Skip	Skip

Intersection Summary

Area Type: Other
Cycle Length: 91
Actuated Cycle Length: 46.9
Natural Cycle: 80
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.54
Intersection Signal Delay: 9.7 — Intersection LOS: A
Intersection Capacity Utilization 45.8% — ICU Level of Service A
Analysis Period (min) 15
90th %ile Actuated Cycle: 56.2
70th %ile Actuated Cycle: 50.6
50th %ile Actuated Cycle: 49.3
30th %ile Actuated Cycle: 46.4
10th %ile Actuated Cycle: 32

Splits and Phases: 90: Napilihau Street & Honoapiilani Highway



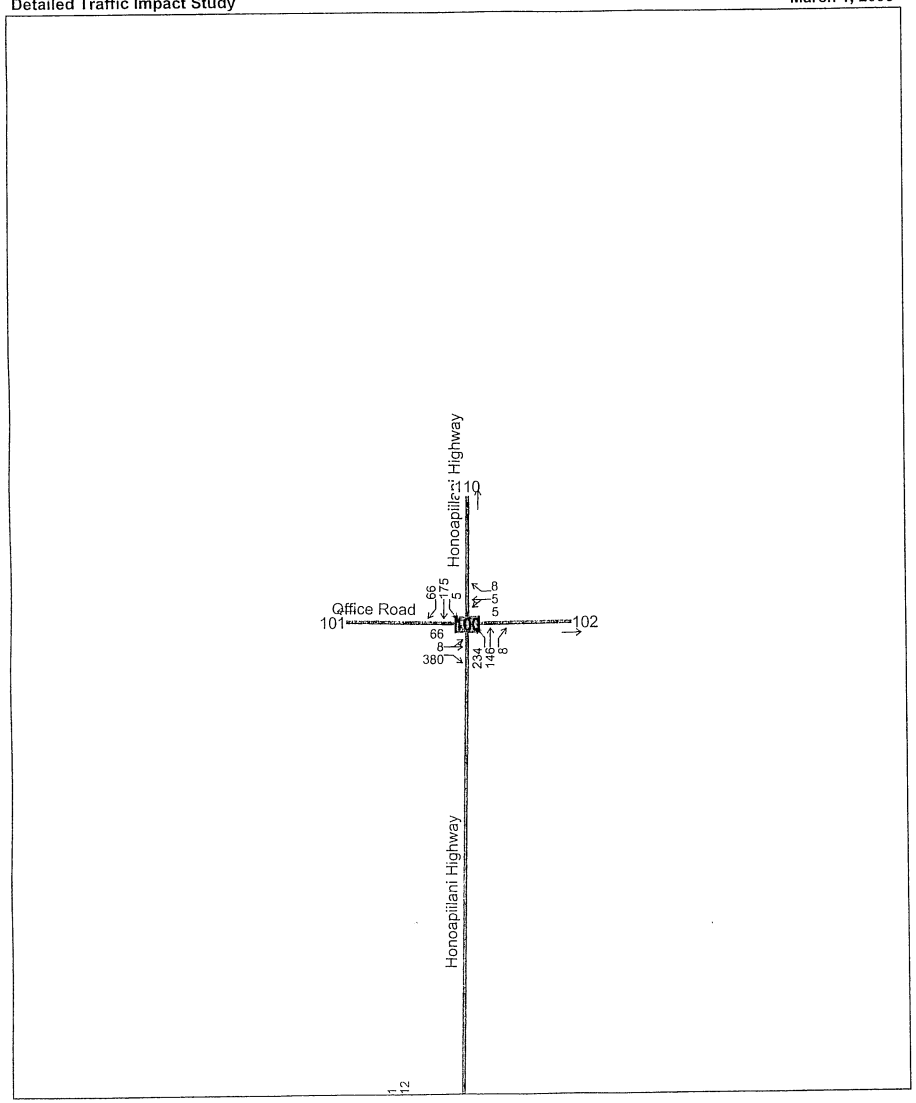
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		200	200		200
Storage Lanes	0		1	0		1	1		1	1		1
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850			0.850			0.850			0.850
Flt Protected		0.956			0.976		0.950			0.950		
Satd. Flow (prot)	0	1781	1583	0	1818	1583	1770	1863	1583	1770	1863	1583
Flt Permitted		0.956			0.976		0.950			0.950		
Satd. Flow (perm)	0	1781	1583	0	1818	1583	1770	1863	1583	1770	1863	1583
Headway 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
Link Speed (mph)		25			25			45			45	
Link Distance (ft)		1268			1116			5035			1283	
Travel Time (s)		34.6			30.4			76.3			19.4	
Volume (vph)	55	5	159	5	5	5	358	175	8	5	79	127
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	61	6	177	6	6	6	398	194	9	6	88	141
Lane Group Flow (vph)	0	67	177	0	12	6	398	194	9	6	88	141
Sign Control		Stop			Stop			Free			Free	

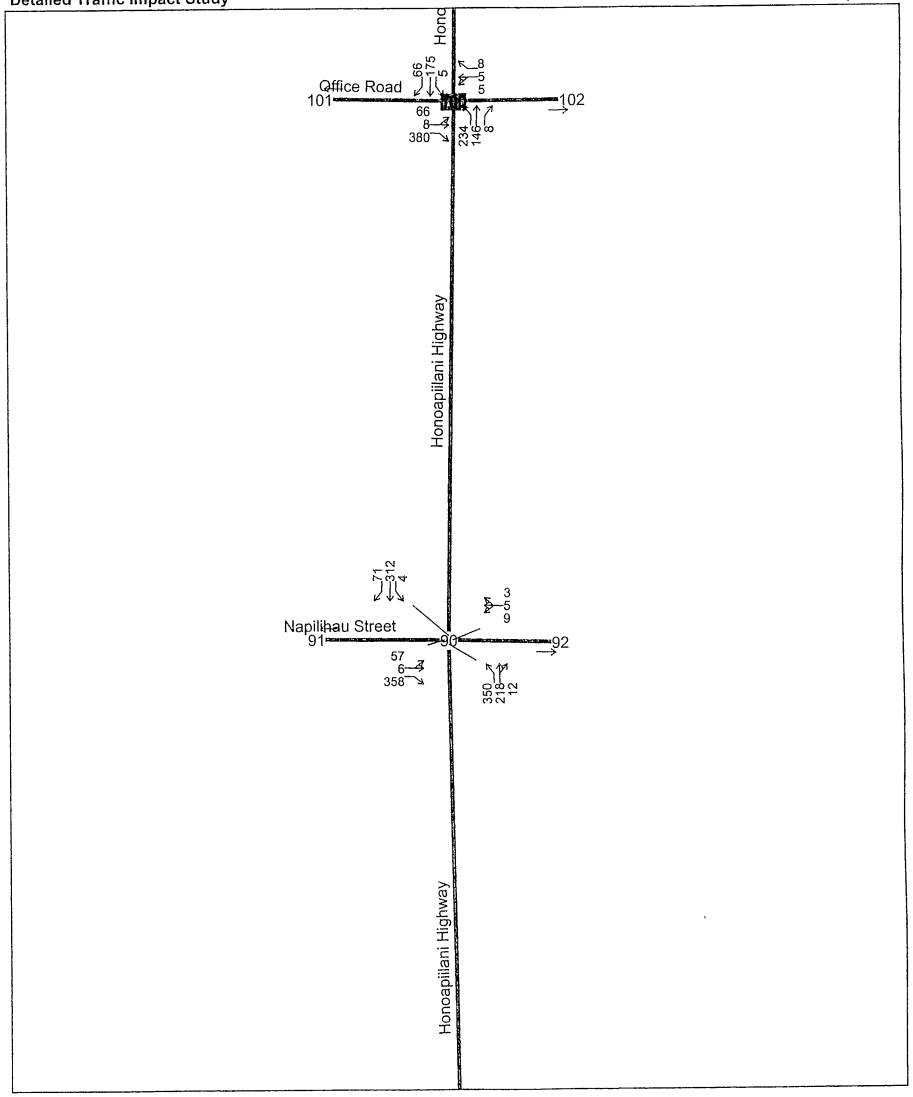
Intersection Summary

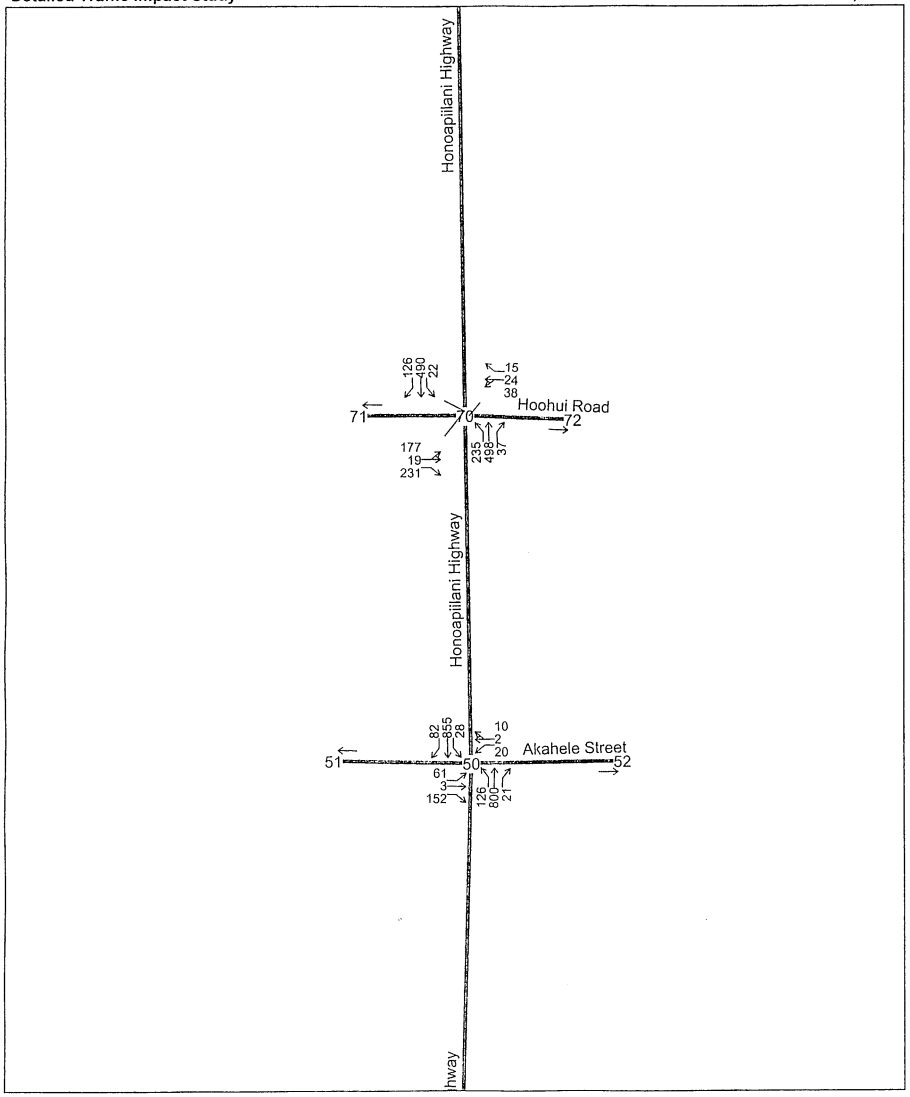
Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 43.1% ICU Level of Service A
Analysis Period (min) 15

APPENDIX C

Honoapiilani Highway Arterial Level of Service Analysis 2004 PM Peak Hour without Project Trips (SYNCHRO)

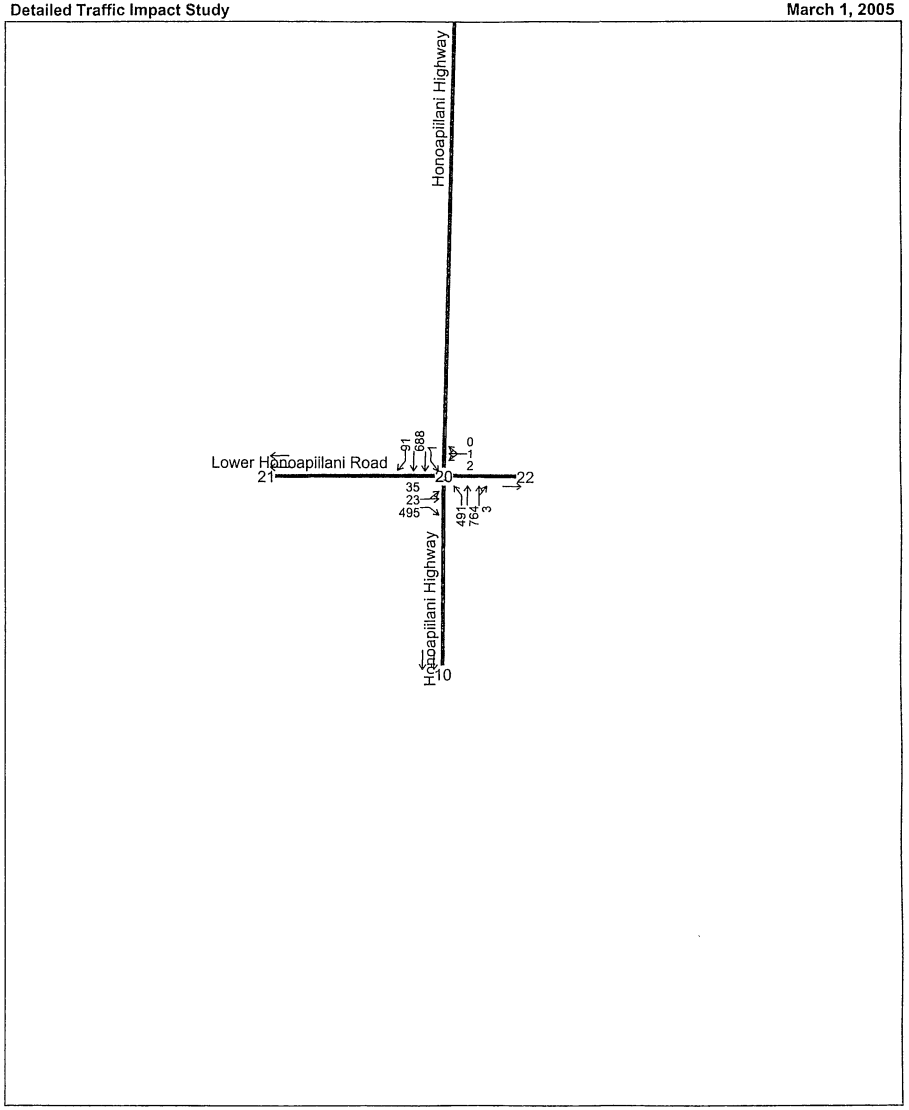

Honoapiilani Highway
110
Office Road
101
102
66
175
5
8
5
5
66
8
380
234
146
8
Honoapiilani Highway


Honc
Office Road
101
102
66
175
5
8
5
5
66
8
380
234
146
8
Honoapiilani Highway
71
312
4
3
5
9
Napilihau Street
91
90
92
57
6
358
350
215
12
Honoapiilani Highway



Arterial LOS Analysis
Detailed Traffic Impact Study

PM Pk Hr Existing Conditions 2004
March 1, 2005



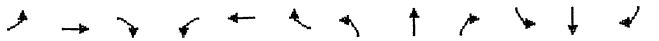
Hall Planning & Engineering, Inc.

Arterial Level of Service: NB Honoapiilani Highway

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Lower Honoapiilani R	II	45	33.6	7.0	40.6	0.35	31.0	B
Akahele Street	II	45	103.9	10.9	114.8	1.30	40.7	A
Hoohui Road	II	45	49.1	9.3	58.4	0.61	37.9	A
Napilihau Street	II	45	90.7	5.8	96.5	1.13	42.3	A
Total	II		277.3	33.0	310.3	3.40	39.4	A

Arterial Level of Service: SB Honoapiilani Highway

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Napilihau Street	II	45	95.7	13.7	109.4	1.20	39.4	A
Hoohui Road	II	45	90.7	6.2	96.9	1.13	42.1	A
Akahele Street	II	45	49.1	17.2	66.3	0.61	33.3	B
Lower Honoapiilani R	II	45	103.9	33.1	137.0	1.30	34.1	B
Total	II		339.4	70.2	409.6	4.24	37.3	A



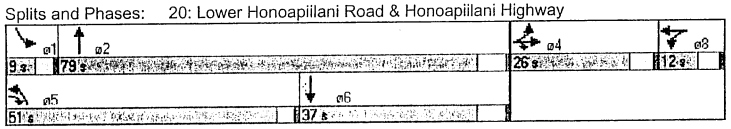
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		0	0		0	200		0	0		200
Storage Lanes	0		1	0		0	1		0	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	1.00
Frt			0.850					0.999				0.850
Flt Protected		0.971			0.968		0.950			0.950		
Satd. Flow (prot)	0	1809	1583	0	1803	0	1770	3536	0	1770	3539	1583
Flt Permitted		0.971			0.968		0.950			0.950		
Satd. Flow (perm)	0	1809	1583	0	1803	0	1770	3536	0	1770	3539	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			213									88
Headway 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
Link Speed (mph)		30			30			45			45	
Link Distance (ft)		1680			766			1848			6856	
Travel Time (s)		38.2			17.4			28.0			103.9	
Volume (vph)	35	23	495	2	1	0	491	764	3	1	688	91
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	39	26	550	2	1	0	546	849	3	1	764	101
Lane Group Flow (vph)	0	65	550	0	3	0	546	852	0	1	764	101
Turn Type	Split		pt+ov	Split			Prot			Prot		Perm
Protected Phases	4	4	4 5	8	8		5	2		1	6	
Permitted Phases												6
Detector Phases	4	4	4 5	8	8		5	2		1	6	6
Minimum Initial (s)	5.0	5.0		5.0	5.0		3.0	15.0		3.0	15.0	15.0
Minimum Split (s)	26.0	26.0		12.0	12.0		9.0	29.0		9.0	36.0	36.0
Total Split (s)	26.0	26.0	77.0	12.0	12.0	0.0	51.0	79.0	0.0	9.0	37.0	37.0
Total Split (%)	20.6%	20.6%	61.1%	9.5%	9.5%	0.0%	40.5%	62.7%	0.0%	7.1%	29.4%	29.4%
Maximum Green (s)	21.0	21.0		7.0	7.0		47.0	73.0		5.0	31.0	31.0
Yellow Time (s)	4.0	4.0		4.0	4.0		3.0	5.0		3.0	5.0	5.0
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0		1.0	1.0	1.0
Lead/Lag							Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0		3.0	3.0		2.0	5.0		2.0	5.0	5.0
Recall Mode	None	None		None	None		None	Max		None	Max	Max
Walk Time (s)	7.0	7.0						7.0			7.0	7.0
Flash Dont Walk (s)	14.0	14.0						16.0			23.0	23.0
Pedestrian Calls (#/hr)	0	0						0			0	0
Act Effct Green (s)		20.1	59.7		7.8		37.1	77.9		5.7	39.3	39.3
Actuated g/C Ratio		0.19	0.56		0.07		0.35	0.72		0.05	0.37	0.37
v/c Ratio		0.19	0.56		0.02		0.89	0.33		0.01	0.59	0.16
Control Delay		39.8	9.1		54.3		40.7	7.0		56.0	33.1	9.4
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	0.0
Total Delay		39.8	9.1		54.3		40.7	7.0		56.0	33.1	9.4
LOS		D	A		D		D	A		E	C	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		12.4			54.3			20.2			30.4	
Approach LOS		B			D			C			C	
90th %ile Green (s)	21.0	21.0		6.5	6.5		47.0	73.0		5.0	31.0	31.0
90th %ile Term Code	Max	Max		Gap	Gap		Max	MaxR		Max	MaxR	MaxR
70th %ile Green (s)	21.0	21.0		0.0	0.0		44.4	79.4		0.0	31.0	31.0
70th %ile Term Code	Max	Max		Skip	Skip		Gap	Hold		Skip	MaxR	MaxR
50th %ile Green (s)	19.7	19.7		0.0	0.0		37.5	73.0		0.0	31.5	31.5
50th %ile Term Code	Gap	Gap		Skip	Skip		Gap	MaxR		Skip	Hold	Hold
30th %ile Green (s)	16.8	16.8		0.0	0.0		30.1	73.0		0.0	38.9	38.9
30th %ile Term Code	Gap	Gap		Skip	Skip		Gap	MaxR		Skip	Hold	Hold
10th %ile Green (s)	12.3	12.3		0.0	0.0		23.6	73.0		0.0	45.4	45.4
10th %ile Term Code	Gap	Gap		Skip	Skip		Gap	MaxR		Skip	Hold	Hold

Intersection Summary

Area Type: Other
Cycle Length: 126
Actuated Cycle Length: 107.5
Natural Cycle: 105
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.89
Intersection Signal Delay: 21.6 — Intersection LOS: C
Intersection Capacity Utilization 63.8% — ICU Level of Service B
Analysis Period (min) 15
90th %ile Actuated Cycle: 125.5
70th %ile Actuated Cycle: 111.4
50th %ile Actuated Cycle: 103.7
30th %ile Actuated Cycle: 100.8
10th %ile Actuated Cycle: 96.3

Splits and Phases: 20: Lower Honoapiilani Road & Honoapiilani Highway



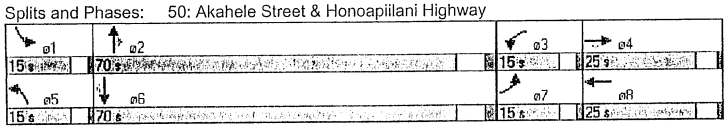
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		200	200		200
Storage Lanes	1		1	1		0	1		1	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50		50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0	0	0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850		0.873				0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1863	1583	1770	1626	0	1770	1863	1583	1770	1863	1583
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	1863	1583	1770	1626	0	1770	1863	1583	1770	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			160		11				15			53
Headway 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
Link Speed (mph)		30			30			45			45	
Link Distance (ft)		1291			1428			6856			3242	
Travel Time (s)		29.3			32.5			103.9			49.1	
Volume (vph)	61	3	152	20	2	10	126	800	21	28	855	82
Peak Hour Factor	0.95	0.95	0.95	0.90	0.90	0.90	0.95	0.95	0.90	0.90	0.95	0.95
Adj. Flow (vph)	64	3	160	22	2	11	133	842	23	31	900	86
Lane Group Flow (vph)	64	3	160	22	13	0	133	842	23	31	900	86
Turn Type	Prot		Perm	Prot			Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4						2			6
Detector Phases	7	4	4	3	8		5	2	2	1	6	6
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0		5.0	10.0	10.0	5.0	15.0	15.0
Minimum Split (s)	9.0	25.0	25.0	9.0	20.0		9.0	25.0	25.0	9.0	35.0	35.0
Total Split (s)	15.0	25.0	25.0	15.0	25.0	0.0	15.0	70.0	70.0	15.0	70.0	70.0
Total Split (%)	12.0%	20.0%	20.0%	12.0%	20.0%	0.0%	12.0%	56.0%	56.0%	12.0%	56.0%	56.0%
Maximum Green (s)	11.0	20.0	20.0	11.0	20.0		11.0	63.0	63.0	11.0	63.0	63.0
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0		3.0	5.0	5.0	3.0	5.0	5.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0		1.0	2.0	2.0	1.0	2.0	2.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0		2.0	5.0	5.0	2.0	5.0	5.0
Recall Mode	None	None	None	None	None		None	Min	Min	None	Min	Min
Walk Time (s)		7.0	7.0					7.0	7.0		7.0	7.0
Flash Dont Walk (s)		13.0	13.0					11.0	11.0		21.0	21.0
Pedestrian Calls (#/hr)		0	0					0	0		0	0
Act Effct Green (s)	8.5	9.7	9.7	7.0	8.6		10.7	69.1	69.1	7.4	58.3	58.3
Actuated g/C Ratio	0.09	0.11	0.11	0.07	0.09		0.12	0.78	0.78	0.08	0.66	0.66
v/c Ratio	0.39	0.02	0.51	0.17	0.08		0.63	0.58	0.02	0.22	0.74	0.08
Control Delay	47.1	43.0	9.7	48.2	26.7		50.6	10.9	4.6	47.8	17.2	4.5
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	47.1	43.0	9.7	48.2	26.7		50.6	10.9	4.6	47.8	17.2	4.5
LOS	D	D	A	D	C		D	B	A	D	B	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		20.7			40.2			16.0			17.1	
Approach LOS		C			D			B			B	
90th %ile Green (s)	11.0	12.6	12.6	8.0	9.6		11.0	65.0	65.0	9.0	63.0	63.0
90th %ile Term Code	Max	Gap	Gap	Gap	Hold		Max	Hold	Hold	Gap	Max	Max
70th %ile Green (s)	9.2	8.9	8.9	6.6	6.3		11.0	66.7	66.7	7.3	63.0	63.0
70th %ile Term Code	Gap	Hold	Hold	Gap	Gap		Max	Hold	Hold	Gap	Max	Max
50th %ile Green (s)	7.4	6.4	6.4	0.0	0.0		11.0	65.3	65.3	0.0	50.3	50.3
50th %ile Term Code	Gap	Hold	Hold	Skip	Skip		Max	Hold	Hold	Skip	Gap	Gap
30th %ile Green (s)	0.0	5.5	5.5	0.0	5.5		8.7	51.7	51.7	0.0	39.0	39.0
30th %ile Term Code	Skip	Gap	Gap	Skip	Hold		Gap	Hold	Hold	Skip	Gap	Gap
10th %ile Green (s)	0.0	0.0	0.0	0.0	0.0		5.9	61.0	61.0	0.0	51.1	51.1
10th %ile Term Code	Skip	Skip	Skip	Skip	Skip		Gap	Dwell	Dwell	Skip	Dwell	Dwell

Intersection Summary

Area Type: Other
Cycle Length: 125
Actuated Cycle Length: 89
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.74
Intersection Signal Delay: 17.3 — Intersection LOS: B
Intersection Capacity Utilization 72.0% — ICU Level of Service C
Analysis Period (min) 15
90th %ile Actuated Cycle: 114.6
70th %ile Actuated Cycle: 109.5
50th %ile Actuated Cycle: 83.7
30th %ile Actuated Cycle: 69.2
10th %ile Actuated Cycle: 68

Splits and Phases: 50: Akahele Street & Honoapiilani Highway



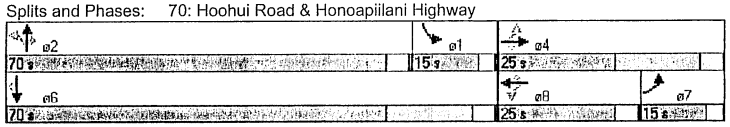
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		200	200		200
Storage Lanes	0		1	0		1	1		1	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50	50	50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850			0.850			0.850			0.850
Flt Protected		0.957			0.970		0.950			0.950		
Satd. Flow (prot)	0	1783	1583	0	1807	1583	1770	1863	1583	1770	1863	1583
Flt Permitted		0.666			0.582		0.354			0.950		
Satd. Flow (perm)	0	1241	1583	0	1084	1583	659	1863	1583	1770	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			257			17			41			140
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		998			1017			3242			5984	
Travel Time (s)		34.0			34.7			49.1			90.7	
Volume (vph)	177	19	231	38	24	15	235	498	37	22	490	126
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	197	21	257	42	27	17	261	553	41	24	544	140
Lane Group Flow (vph)	0	218	257	0	69	17	261	553	41	24	544	140
Turn Type	pm+pt		Perm	Perm		Perm	Perm		Perm	Prot		Perm
Protected Phases	7	4			8			2		1	6	
Permitted Phases	4		4	8		8	2		2			6
Detector Phases	7	4	4	8	8	8	2	2	2	1	6	6
Minimum Initial (s)	3.0	4.0	4.0	4.0	4.0	4.0	15.0	15.0	15.0	3.0	15.0	15.0
Minimum Split (s)	9.5	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	9.5	20.0	20.0
Total Split (s)	15.0	25.0	25.0	25.0	25.0	25.0	70.0	70.0	70.0	15.0	70.0	70.0
Total Split (%)	12.0%	20.0%	20.0%	20.0%	20.0%	20.0%	56.0%	56.0%	56.0%	12.0%	56.0%	56.0%
Maximum Green (s)	11.5	20.5	20.5	20.5	20.5	20.5	65.5	65.5	65.5	11.5	65.5	65.5
Yellow Time (s)	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lead/Lag	Lag			Lead	Lead	Lead	Lead	Lead	Lead	Lag		
Lead-Lag Optimize?												
Vehicle Extension (s)	2.0	4.0	4.0	4.0	4.0	4.0	5.0	5.0	5.0	2.0	5.0	5.0
Recall Mode	None	None	None	None	None	None	Min	Min	Min	None	Max	Max
Act Effct Green (s)		20.1	20.1		20.1	20.1	65.2	65.2	65.2	6.5	69.3	69.3
Actuated g/C Ratio		0.21	0.21		0.21	0.21	0.68	0.68	0.68	0.06	0.73	0.73
v/c Ratio		0.84	0.48		0.30	0.05	0.58	0.43	0.04	0.21	0.40	0.12
Control Delay		42.8	6.2		36.1	14.7	16.4	9.3	2.5	46.3	6.2	0.9
Queue Delay		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		42.8	6.2		36.1	14.7	16.4	9.3	2.5	46.3	6.2	0.9
LOS		D	A		D	B	B	A	A	D	A	A
Approach Delay		23.0			31.9			11.1			6.5	
Approach LOS		C			C			B			A	
90th %ile Green (s)	0.0	20.5	20.5	20.5	20.5	20.5	65.5	65.5	65.5	8.0	77.0	77.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
90th %ile Term Code	Skip	Max	Max	Hold	Hold	Hold	Max	Max	Max	Gap	Hold	Hold
70th %ile Green (s)	0.0	20.5	20.5	20.5	20.5	20.5	55.3	55.3	55.3	6.7	65.5	65.5
70th %ile Term Code	Skip	Max	Max	Hold	Hold	Hold	Gap	Gap	Gap	Hold	MaxR	MaxR
50th %ile Green (s)	0.0	20.5	20.5	20.5	20.5	20.5	65.5	65.5	65.5	0.0	65.5	65.5
50th %ile Term Code	Skip	Max	Max	Hold	Hold	Hold	Hold	Hold	Hold	Skip	MaxR	MaxR
30th %ile Green (s)	0.0	18.7	18.7	18.7	18.7	18.7	65.5	65.5	65.5	0.0	65.5	65.5
30th %ile Term Code	Skip	Gap	Gap	Hold	Hold	Hold	Hold	Hold	Hold	Skip	MaxR	MaxR
10th %ile Green (s)	0.0	13.0	13.0	13.0	13.0	13.0	65.5	65.5	65.5	0.0	65.5	65.5
10th %ile Term Code	Skip	Gap	Gap	Hold	Hold	Hold	Hold	Hold	Hold	Skip	MaxR	MaxR

Intersection Summary

Area Type: Other
Cycle Length: 125
Actuated Cycle Length: 95.4
Natural Cycle: 80
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.84
Intersection Signal Delay: 13.1 Intersection LOS: B
Intersection Capacity Utilization 66.3% ICU Level of Service C
Analysis Period (min) 15
90th %ile Actuated Cycle: 106.5
70th %ile Actuated Cycle: 95
50th %ile Actuated Cycle: 95
30th %ile Actuated Cycle: 93.2
10th %ile Actuated Cycle: 87.5

Splits and Phases: 70: Hoohui Road & Honoapiilani Highway



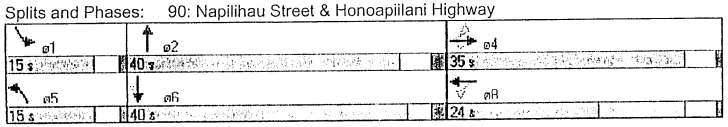
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		125	200		0
Storage Lanes	0		1	0		0	1		0	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850		0.978			0.992				0.850
Flt Protected		0.957			0.973		0.950			0.950		
Satd. Flow (prot)	0	1783	1583	0	1773	0	1770	1848	0	1770	1863	1583
Flt Permitted		0.789			0.907		0.950			0.950		
Satd. Flow (perm)	0	1470	1583	0	1652	0	1770	1848	0	1770	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			398		3			4				79
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		1254			1054			5984			5035	
Travel Time (s)		42.8			35.9			90.7			76.3	
Volume (vph)	57	6	358	9	5	3	350	218	12	4	312	71
Peak Hour Factor	0.90	0.91	0.90	0.92	0.93	0.90	0.95	0.95	0.93	0.90	0.95	0.90
Adj. Flow (vph)	63	7	398	10	5	3	368	229	13	4	328	79
Lane Group Flow (vph)	0	70	398	0	18	0	368	242	0	4	328	79
Turn Type	Perm		Perm	Perm			Prot			Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8								6
Detector Phases	4	4	4	8	8		5	2		1	6	6
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0		5.0	15.0		5.0	15.0	15.0
Minimum Split (s)	35.0	35.0	35.0	12.0	12.0		9.5	31.0		9.5	22.0	22.0
Total Split (s)	35.0	35.0	35.0	24.0	24.0	0.0	15.0	40.0	0.0	15.0	40.0	40.0
Total Split (%)	38.9%	38.9%	38.9%	26.7%	26.7%	0.0%	16.7%	44.4%	0.0%	16.7%	44.4%	44.4%
Maximum Green (s)	30.0	30.0	30.0	19.0	19.0		11.0	34.0		11.0	35.0	35.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		3.0	4.0		3.0	3.0	3.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0		1.0	2.0		1.0	2.0	2.0
Lead/Lag							Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	2.0	2.0	2.0	2.0	2.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None	None	None	None		None	None		None	None	None
Walk Time (s)	5.0	5.0	5.0					5.0			5.0	5.0
Flash Dont Walk (s)	19.0	19.0	19.0					20.0			12.0	12.0
Pedestrian Calls (#/hr)	0	0	0					0			0	0
Act Effct Green (s)		9.8	9.8		9.8		12.2	32.1		6.7	18.5	18.5
Actuated g/C Ratio		0.20	0.20		0.20		0.25	0.65		0.12	0.37	0.37
v/c Ratio		0.24	0.63		0.05		0.85	0.20		0.02	0.47	0.12
Control Delay		17.5	4.2		15.1		41.7	5.8		24.0	13.7	3.9
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	0.0
Total Delay		17.5	4.2		15.1		41.7	5.8		24.0	13.7	3.9
LOS		B	A		B		D	A		C	B	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		6.2			15.1			27.4			11.9	
Approach LOS		A			B			C			B	
90th %ile Green (s)	15.2	15.2	15.2	15.2	15.2		11.0	26.2		6.2	22.4	22.4
90th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Gap	Gap	Gap
70th %ile Green (s)	8.0	8.0	8.0	8.0	8.0		11.0	29.5		0.0	15.5	15.5
70th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	Gap	Gap
50th %ile Green (s)	6.6	6.6	6.6	6.6	6.6		11.0	29.0		0.0	15.0	15.0
50th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	Min	Min
30th %ile Green (s)	5.4	5.4	5.4	5.4	5.4		11.0	29.0		0.0	15.0	15.0
30th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	Min	Min
10th %ile Green (s)	5.0	5.0	5.0	5.0	5.0		11.0	29.0		0.0	15.0	15.0
10th %ile Term Code	Min	Min	Min	Hold	Hold		Max	Hold		Skip	Min	Min

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 49.6
Natural Cycle: 80
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.85
Intersection Signal Delay: 16.4 Intersection LOS: B
Intersection Capacity Utilization 53.4% ICU Level of Service A
Analysis Period (min) 15
90th %ile Actuated Cycle: 62.6
70th %ile Actuated Cycle: 48.5
50th %ile Actuated Cycle: 46.6
30th %ile Actuated Cycle: 45.4
10th %ile Actuated Cycle: 45

Splits and Phases: 90: Napilihau Street & Honoapiilani Highway



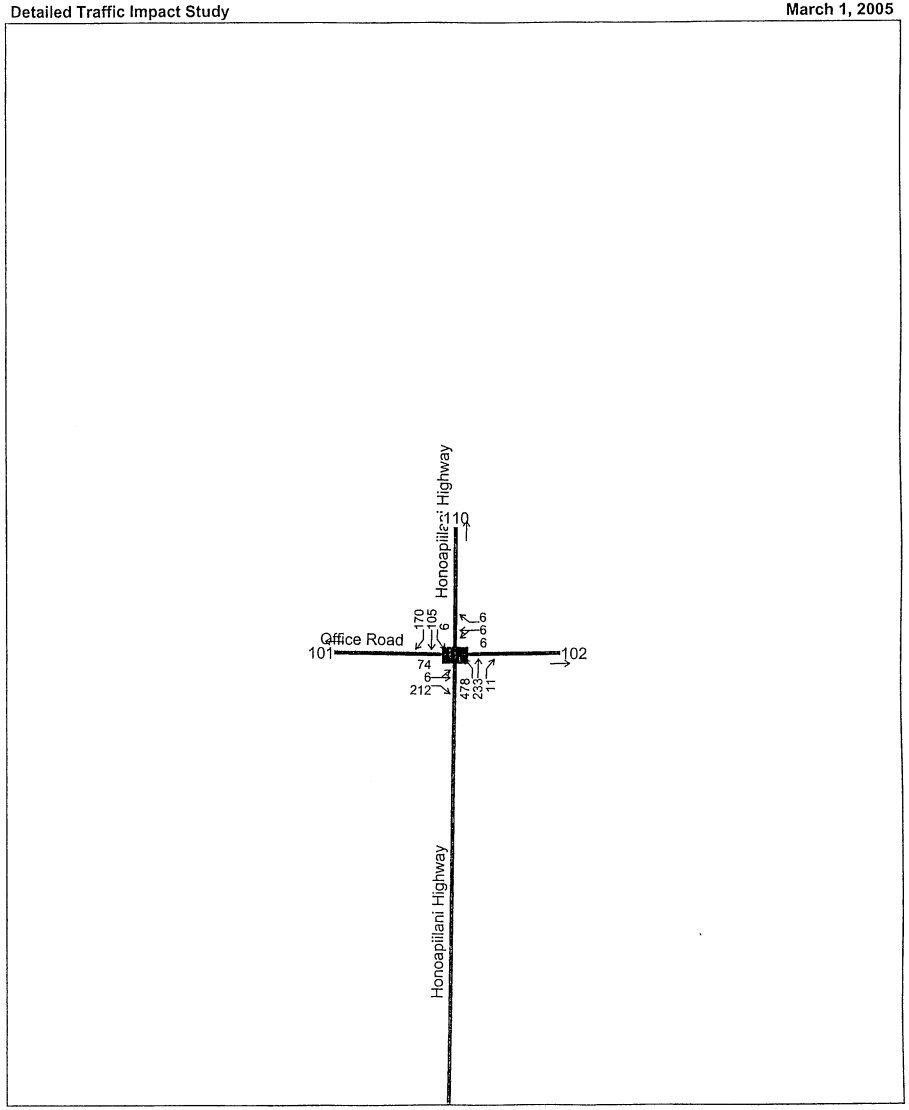
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		200	200		200
Storage Lanes	0		1	0		1	1		1	1		1
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850			0.850			0.850			0.850
Flt Protected		0.957			0.976		0.950			0.950		
Satd. Flow (prot)	0	1783	1583	0	1818	1583	1770	1863	1583	1770	1863	1583
Flt Permitted		0.957			0.976		0.950			0.950		
Satd. Flow (perm)	0	1783	1583	0	1818	1583	1770	1863	1583	1770	1863	1583
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		1268			1116			5035			1283	
Travel Time (s)		43.2			38.0			76.3			19.4	
Volume (vph)	66	8	380	5	5	8	234	146	8	5	175	66
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	73	9	422	6	6	9	260	162	9	6	194	73
Lane Group Flow (vph)	0	82	422	0	12	9	260	162	9	6	194	73
Sign Control		Stop			Stop			Free			Free	

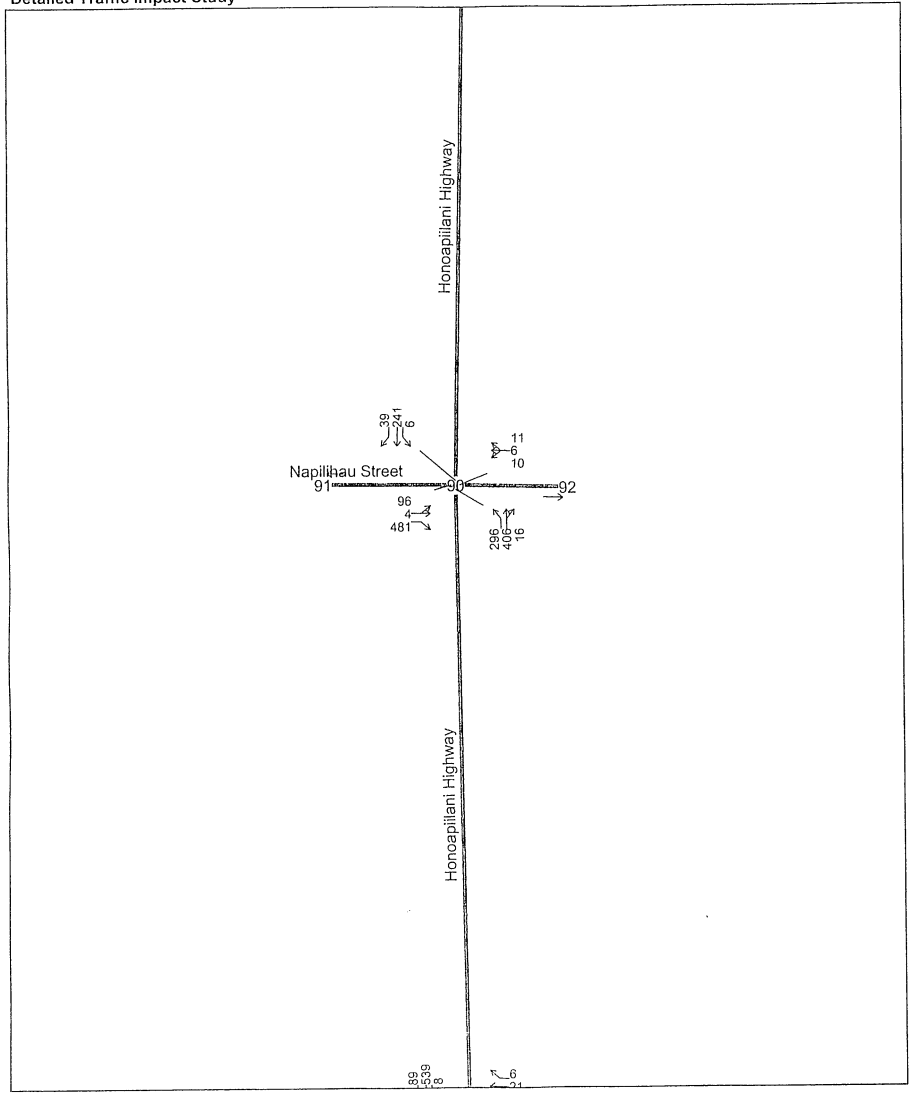
Intersection Summary

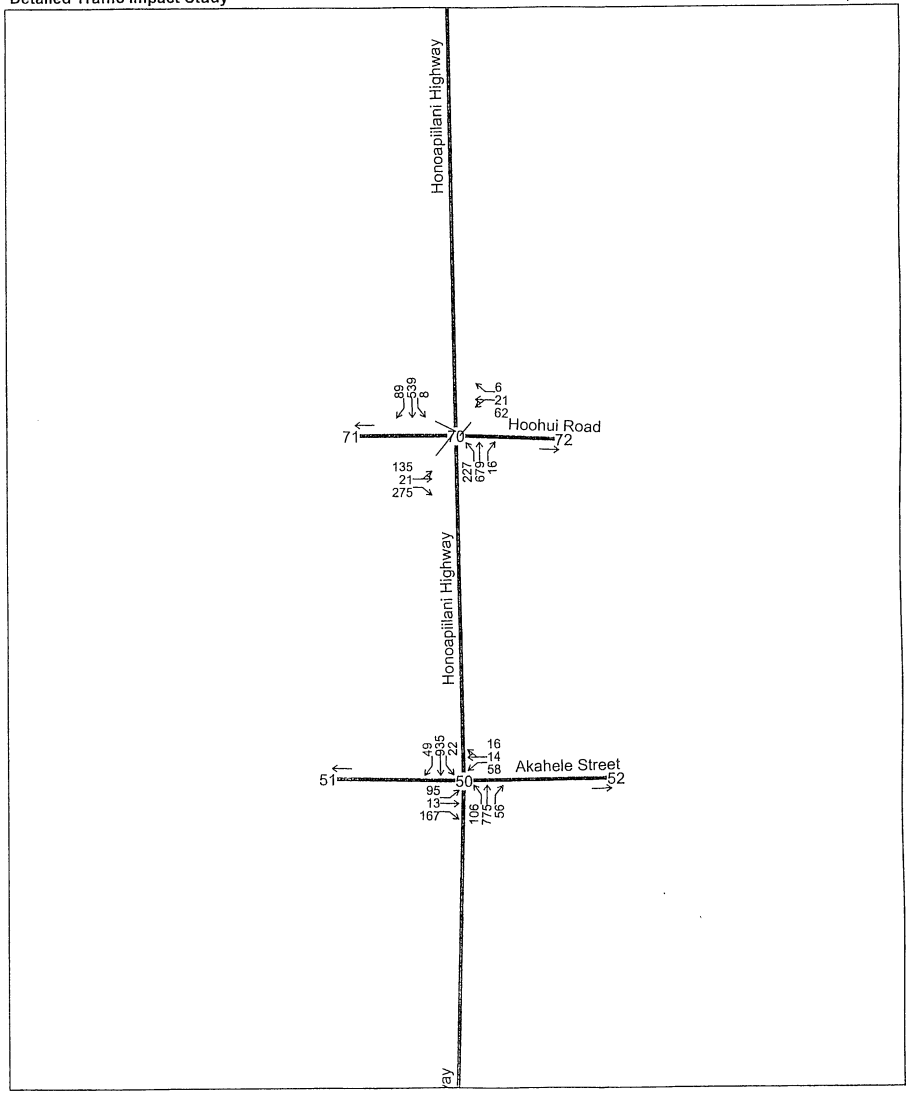
Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 46.1% ICU Level of Service A
Analysis Period (min) 15

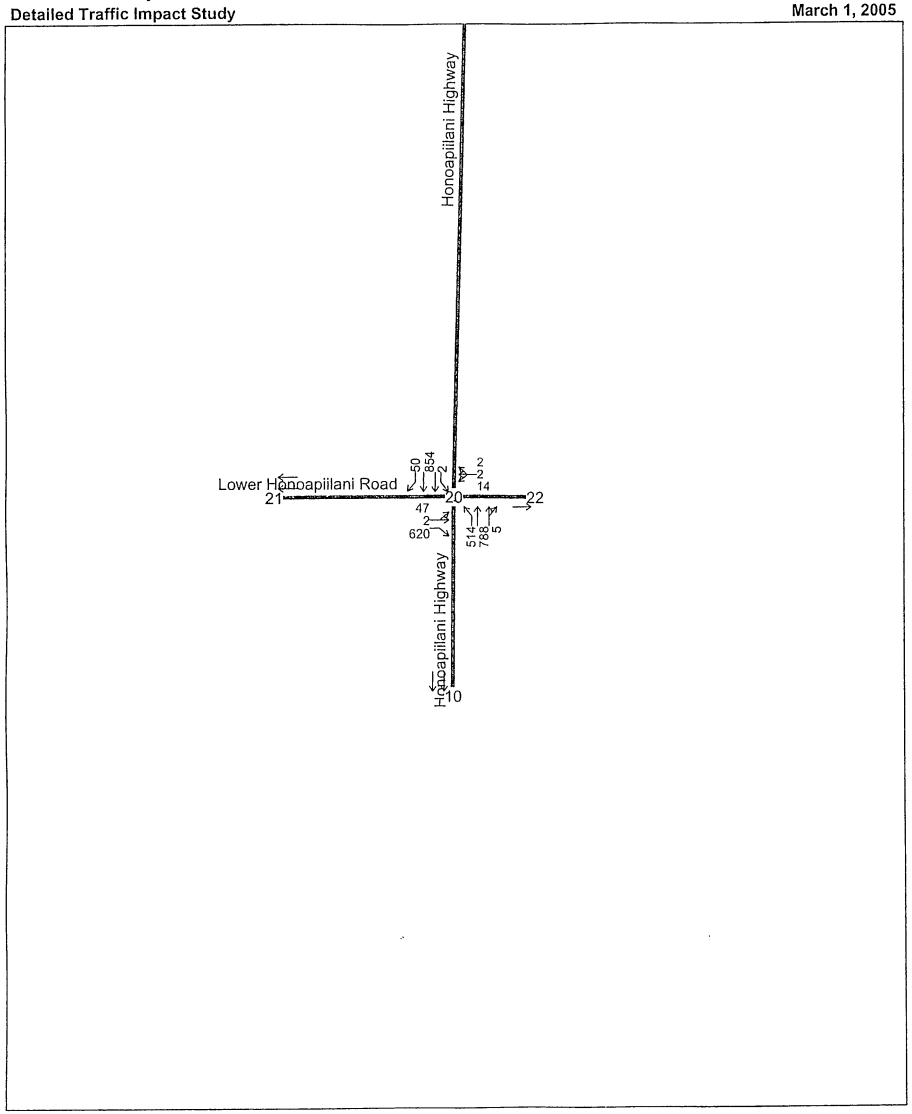
APPENDIX D

Honoapiilani Highway Arterial Level of Service Analysis 2011 AM Peak Hour with Akahele Signal, Future Projects without Pulelehua (SYNCHRO)




Honoapiilani Highway
Napilihau Street
91
90
92
39
241
6
11
6
10
96
4
481
296
406
16
Honoapiilani Highway
89
539
8
6
21


Honoapiilani Highway
89
539
8
6
21
62
Hoohui Road
71
70
72
135
21
275
227
679
16
Honoapiilani Highway
49
935
22
16
14
58
Akahele Street
51
50
52
95
13
167
106
775
56



Arterial Level of Service: NB Honoapiilani Highway

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Lower Honoapiilani R	II	45	33.6	9.3	42.9	0.35	29.4	B
Akahele Street	II	45	103.9	14.8	118.7	1.30	39.4	A
Hoohui Road	II	45	49.1	10.5	59.6	0.61	37.1	A
Napilihau Street	II	45	90.7	8.3	99.0	1.13	41.2	A
Total	II		277.3	42.9	320.2	3.40	38.2	A

Arterial Level of Service: SB Honoapiilani Highway

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Napilihau Street	II	45	95.7	14.6	110.3	1.20	39.1	A
Hoohui Road	II	45	90.7	13.8	104.5	1.13	39.0	A
Akahele Street	II	45	49.1	24.8	73.9	0.61	29.9	B
Lower Honoapiilani R	II	45	103.9	42.7	146.6	1.30	31.9	B
Total	II		339.4	95.9	435.3	4.24	35.1	A

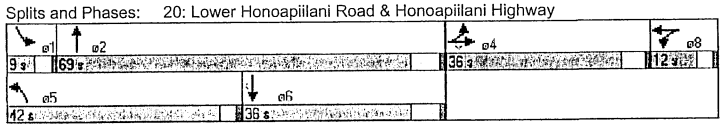
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		0	0		0	200		0	0		200
Storage Lanes	0		1	0		0	1		0	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	1.00
Frt			0.850		0.986			0.999				0.850
Flt Protected		0.954			0.962		0.950			0.950		
Satd. Flow (prot)	0	1777	1583	0	1767	0	1770	3536	0	1770	3539	1583
Flt Permitted		0.954			0.962		0.950			0.950		
Satd. Flow (perm)	0	1777	1583	0	1767	0	1770	3536	0	1770	3539	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			609		2			1				39
Headway 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
Link Speed (mph)		30			30			45			45	
Link Distance (ft)		1680			766			1848			6856	
Travel Time (s)		38.2			17.4			28.0			103.9	
Volume (vph)	47	2	620	14	2	2	514	788	5	2	854	50
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	52	2	689	16	2	2	571	876	6	2	949	56
Lane Group Flow (vph)	0	54	689	0	20	0	571	882	0	2	949	56
Turn Type	Split		Perm	Split			Prot			Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4									6
Detector Phases	4	4	4	8	8		5	2		1	6	6
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0		3.0	15.0		3.0	15.0	15.0
Minimum Split (s)	36.0	36.0	36.0	12.0	12.0		9.0	29.0		9.0	36.0	36.0
Total Split (s)	36.0	36.0	36.0	12.0	12.0	0.0	42.0	69.0	0.0	9.0	36.0	36.0
Total Split (%)	28.6%	28.6%	28.6%	9.5%	9.5%	0.0%	33.3%	54.8%	0.0%	7.1%	28.6%	28.6%
Maximum Green (s)	31.0	31.0	31.0	8.0	8.0		38.0	63.0		5.0	30.0	30.0
Yellow Time (s)	4.0	4.0	4.0	3.0	3.0		3.0	5.0		3.0	5.0	5.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0		1.0	1.0		1.0	1.0	1.0
Lead/Lag							Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		2.0	5.0		2.0	5.0	5.0
Recall Mode	None	None	None	None	None		None	Max		None	Max	Max
Walk Time (s)	7.0	7.0	7.0					7.0			7.0	7.0
Flash Dont Walk (s)	23.0	23.0	23.0					16.0			23.0	23.0
Pedestrian Calls (#/hr)	0	0	0					0			0	0
Act Effct Green (s)		17.9	17.9		7.6		39.9	75.1		5.8	33.7	33.7
Actuated g/C Ratio		0.17	0.17		0.07		0.38	0.72		0.05	0.32	0.32
v/c Ratio		0.18	0.89		0.16		0.85	0.35		0.02	0.83	0.10
Control Delay		36.7	13.2		51.1		45.9	9.3		57.5	42.7	15.3
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	0.0
Total Delay		36.7	13.2		51.1		45.9	9.3		57.5	42.7	15.3
LOS		D	B		D		D	A		E	D	B

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		14.9			51.1			23.7			41.2	
Approach LOS		B			D			C			D	
90th %ile Green (s)	31.0	31.0	31.0	8.0	8.0		38.0	63.0		5.0	30.0	30.0
90th %ile Term Code	Max	Max	Max	Max	Max		Max	MaxR		Max	MaxR	MaxR
70th %ile Green (s)	26.0	26.0	26.0	7.5	7.5		38.0	72.0		0.0	30.0	30.0
70th %ile Term Code	Gap	Gap	Gap	Gap	Gap		Max	Hold		Skip	MaxR	MaxR
50th %ile Green (s)	14.3	14.3	14.3	0.0	0.0		38.0	72.0		0.0	30.0	30.0
50th %ile Term Code	Gap	Gap	Gap	Skip	Skip		Max	Hold		Skip	MaxR	MaxR
30th %ile Green (s)	7.9	7.9	7.9	0.0	0.0		38.0	72.0		0.0	30.0	30.0
30th %ile Term Code	Gap	Gap	Gap	Skip	Skip		Max	Hold		Skip	MaxR	MaxR
10th %ile Green (s)	5.6	5.6	5.6	0.0	0.0		38.0	72.0		0.0	30.0	30.0
10th %ile Term Code	Gap	Gap	Gap	Skip	Skip		Max	Hold		Skip	MaxR	MaxR

Intersection Summary

Area Type: Other
Cycle Length: 126
Actuated Cycle Length: 104.7
Natural Cycle: 125
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.89
Intersection Signal Delay: 27.3 Intersection LOS: C
Intersection Capacity Utilization 76.2% ICU Level of Service D
Analysis Period (min) 15
90th %ile Actuated Cycle: 126
70th %ile Actuated Cycle: 120.5
50th %ile Actuated Cycle: 97.3
30th %ile Actuated Cycle: 90.9
10th %ile Actuated Cycle: 88.6

Splits and Phases: 20: Lower Honoapiilani Road & Honoapiilani Highway



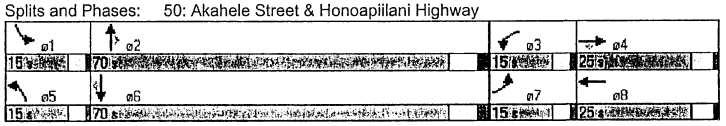
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		200	200		200
Storage Lanes	1		1	1		0	1		1	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50		50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0	0	0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850		0.921				0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1863	1583	1770	1716	0	1770	1863	1583	1770	1863	1583
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	1863	1583	1770	1716	0	1770	1863	1583	1770	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			176		18				42			30
Headway 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
Link Speed (mph)		30			30			45			45	
Link Distance (ft)		1291			1428			6856			3242	
Travel Time (s)		29.3			32.5			103.9			49.1	
Volume (vph)	95	13	167	58	14	16	106	775	56	22	935	49
Peak Hour Factor	0.95	0.95	0.95	0.90	0.90	0.90	0.95	0.95	0.90	0.90	0.95	0.95
Adj. Flow (vph)	100	14	176	64	16	18	112	816	62	24	984	52
Lane Group Flow (vph)	100	14	176	64	34	0	112	816	62	24	984	52
Turn Type	Prot		Perm	Prot			Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4						2			6
Detector Phases	7	4	4	3	8		5	2	2	1	6	6
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0		5.0	10.0	10.0	5.0	15.0	15.0
Minimum Split (s)	9.0	25.0	25.0	9.0	20.0		9.0	25.0	25.0	9.0	35.0	35.0
Total Split (s)	15.0	25.0	25.0	15.0	25.0	0.0	15.0	70.0	70.0	15.0	70.0	70.0
Total Split (%)	12.0%	20.0%	20.0%	12.0%	20.0%	0.0%	12.0%	56.0%	56.0%	12.0%	56.0%	56.0%
Maximum Green (s)	11.0	20.0	20.0	11.0	20.0		11.0	63.0	63.0	11.0	63.0	63.0
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0		3.0	5.0	5.0	3.0	5.0	5.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0		1.0	2.0	2.0	1.0	2.0	2.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0		2.0	5.0	5.0	2.0	5.0	5.0
Recall Mode	None	None	None	None	None		None	Min	Min	None	Min	Min
Walk Time (s)		7.0	7.0					7.0	7.0		7.0	7.0
Flash Dont Walk (s)		13.0	13.0					11.0	11.0		21.0	21.0
Pedestrian Calls (#/hr)		0	0					0	0		0	0
Act Effct Green (s)	11.8	10.3	10.3	9.1	9.7		10.4	71.3	71.3	7.3	66.5	66.5
Actuated g/C Ratio	0.11	0.10	0.10	0.09	0.09		0.10	0.69	0.69	0.07	0.64	0.64
v/c Ratio	0.50	0.08	0.56	0.42	0.19		0.64	0.64	0.06	0.20	0.82	0.05
Control Delay	53.8	46.3	10.0	53.3	28.8		59.2	14.8	4.3	52.0	24.8	5.7
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	53.8	46.3	10.0	53.3	28.8		59.2	14.8	4.3	52.0	24.8	5.7
LOS	D	D	B	D	C		E	B	A	D	C	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		26.9			44.8			19.1			24.5	
Approach LOS		C			D			B			C	
90th %ile Green (s)	11.0	13.1	13.1	11.0	13.1		11.0	65.7	65.7	8.3	63.0	63.0
90th %ile Term Code	Max	Gap	Gap	Max	Hold		Max	Hold	Hold	Gap	Max	Max
70th %ile Green (s)	11.0	8.7	8.7	9.9	7.6		11.0	67.1	67.1	6.9	63.0	63.0
70th %ile Term Code	Max	Hold	Hold	Gap	Gap		Max	Hold	Hold	Gap	Max	Max
50th %ile Green (s)	10.6	8.7	8.7	8.4	6.5		11.0	68.1	68.1	5.9	63.0	63.0
50th %ile Term Code	Gap	Hold	Hold	Gap	Gap		Max	Hold	Hold	Gap	Max	Max
30th %ile Green (s)	17.3	5.6	5.6	6.7	0.0		9.3	76.3	76.3	0.0	63.0	63.0
30th %ile Term Code	Hold	Gap	Gap	Gap	Skip		Gap	Hold	Hold	Skip	Max	Max
10th %ile Green (s)	0.0	5.5	5.5	0.0	5.5		0.0	53.1	53.1	0.0	53.1	53.1
10th %ile Term Code	Skip	Gap	Gap	Skip	Hold		Skip	Dwell	Dwell	Skip	Dwell	Dwell

Intersection Summary

Area Type: Other
Cycle Length: 125
Actuated Cycle Length: 103.4
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.82
Intersection Signal Delay: 23.4 Intersection LOS: C
Intersection Capacity Utilization 77.0% ICU Level of Service D
Analysis Period (min) 15
90th %ile Actuated Cycle: 118.1
70th %ile Actuated Cycle: 112.6
50th %ile Actuated Cycle: 111.1
30th %ile Actuated Cycle: 104.6
10th %ile Actuated Cycle: 70.6

Splits and Phases: 50: Akahele Street & Honoapiilani Highway



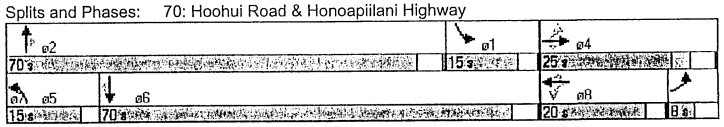
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		200	200		200
Storage Lanes	0		1	0		1	1		1	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50	50	50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850			0.850			0.850			0.850
Flt Protected		0.958			0.964		0.950			0.950		
Satd. Flow (prot)	0	1785	1583	0	1796	1583	1770	1863	1583	1770	1863	1583
Flt Permitted		0.616			0.484		0.950			0.950		
Satd. Flow (perm)	0	1147	1583	0	902	1583	1770	1863	1583	1770	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			306			7			17			99
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		998			1017			3242			5984	
Travel Time (s)		34.0			34.7			49.1			90.7	
Volume (vph)	135	21	275	62	21	6	227	679	16	8	539	89
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	150	23	306	69	23	7	252	754	18	9	599	99
Lane Group Flow (vph)	0	173	306	0	92	7	252	754	18	9	599	99
Turn Type	pm+pt		Perm	Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Detector Phases	7	4	4	8	8	8	5	2	2	1	6	6
Minimum Initial (s)	4.0	5.0	5.0	5.0	5.0	5.0	3.0	15.0	15.0	3.0	15.0	15.0
Minimum Split (s)	8.0	20.0	20.0	20.0	20.0	20.0	8.0	20.0	20.0	9.5	20.0	20.0
Total Split (s)	8.0	25.0	25.0	20.0	20.0	20.0	15.0	70.0	70.0	15.0	70.0	70.0
Total Split (%)	7.1%	22.1%	22.1%	17.7%	17.7%	17.7%	13.3%	61.9%	61.9%	13.3%	61.9%	61.9%
Maximum Green (s)	4.0	20.5	20.5	16.5	16.5	16.5	12.0	65.5	65.5	11.5	65.5	65.5
Yellow Time (s)	4.0	4.0	4.0	3.0	3.0	3.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	0.0	0.5	0.5	0.5	0.5	0.5	0.0	0.5	0.5	0.5	0.5	0.5
Lead/Lag	Lag			Lead	Lead	Lead	Lead	Lead	Lead	Lag	Lag	Lag
Lead-Lag Optimize?				Yes	Yes	Yes						
Vehicle Extension (s)	3.0	4.0	4.0	4.0	4.0	4.0	2.0	5.0	5.0	2.0	5.0	5.0
Recall Mode	None	None	None	None	None	None	None	Min	Min	None	Max	Max
Act Effct Green (s)		20.0	20.0		20.0	20.0	12.0	78.6	78.6	7.3	67.0	67.0
Actuated g/C Ratio		0.19	0.19		0.19	0.19	0.11	0.73	0.73	0.06	0.62	0.62
v/c Ratio		0.82	0.56		0.55	0.02	1.28	0.56	0.02	0.08	0.52	0.10
Control Delay		57.0	7.8		52.5	20.2	199.3	10.5	3.6	48.2	13.8	2.0
Queue Delay		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		57.0	7.8		52.5	20.2	199.3	10.5	3.6	48.2	13.8	2.0
LOS		E	A		D	C	F	B	A	D	B	A
Approach Delay		25.6			50.2			56.8			12.6	
Approach LOS		C			D			E			B	
90th %ile Green (s)	0.0	20.5	20.5	21.5	21.5	21.5	12.0	62.9	62.9	14.1	65.5	65.5

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
90th %ile Term Code	Skip	Max	Max	Hold	Hold	Hold	Max	Gap	Gap	Hold	MaxR	MaxR
70th %ile Green (s)	0.0	20.5	20.5	21.5	21.5	21.5	12.0	80.5	80.5	0.0	65.5	65.5
70th %ile Term Code	Skip	Max	Max	Hold	Hold	Hold	Max	Hold	Hold	Skip	MaxR	MaxR
50th %ile Green (s)	0.0	20.5	20.5	21.5	21.5	21.5	12.0	80.5	80.5	0.0	65.5	65.5
50th %ile Term Code	Skip	Max	Max	Hold	Hold	Hold	Max	Hold	Hold	Skip	MaxR	MaxR
30th %ile Green (s)	0.0	18.5	18.5	19.5	19.5	19.5	12.0	80.5	80.5	0.0	65.5	65.5
30th %ile Term Code	Skip	Gap	Gap	Hold	Hold	Hold	Max	Hold	Hold	Skip	MaxR	MaxR
10th %ile Green (s)	0.0	12.7	12.7	13.7	13.7	13.7	12.0	80.5	80.5	0.0	65.5	65.5
10th %ile Term Code	Skip	Gap	Gap	Hold	Hold	Hold	Max	Hold	Hold	Skip	MaxR	MaxR

Intersection Summary

Area Type: Other
Cycle Length: 113
Actuated Cycle Length: 108
Natural Cycle: 75
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 1.28
Intersection Signal Delay: 36.5 — Intersection LOS: D
Intersection Capacity Utilization 66.2% — ICU Level of Service C
Analysis Period (min) 15
90th %ile Actuated Cycle: 110
70th %ile Actuated Cycle: 110
50th %ile Actuated Cycle: 110
30th %ile Actuated Cycle: 108
10th %ile Actuated Cycle: 102.2

Splits and Phases: 70: Hoohui Road & Honoapiilani Highway



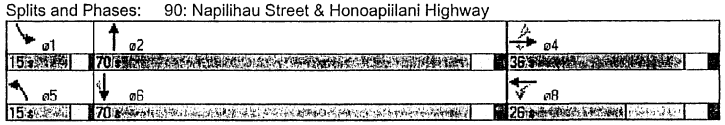
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		125	200		0
Storage Lanes	0		1	0		0	1		0	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850		0.944			0.994				0.850
Flt Protected		0.954			0.981		0.950			0.950		
Satd. Flow (prot)	0	1777	1583	0	1725	0	1770	1852	0	1770	1863	1583
Flt Permitted		0.725			0.911		0.950			0.950		
Satd. Flow (perm)	0	1350	1583	0	1602	0	1770	1852	0	1770	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			534		12			3				43
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		1254			1054			5984			5035	
Travel Time (s)		42.8			35.9			90.7			76.3	
Volume (vph)	96	4	481	10	6	11	296	406	16	6	241	39
Peak Hour Factor	0.90	0.91	0.90	0.92	0.93	0.90	0.95	0.95	0.93	0.90	0.95	0.90
Adj. Flow (vph)	107	4	534	11	6	12	312	427	17	7	254	43
Lane Group Flow (vph)	0	111	534	0	29	0	312	444	0	7	254	43
Turn Type	Perm		Perm	Perm			Prot			Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8								6
Detector Phases	4	4	4	8	8		5	2		1	6	6
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0		5.0	15.0		5.0	15.0	15.0
Minimum Split (s)	36.0	36.0	36.0	12.0	12.0		9.5	31.0		9.5	23.0	23.0
Total Split (s)	36.0	36.0	36.0	26.0	26.0	0.0	15.0	70.0	0.0	15.0	70.0	70.0
Total Split (%)	29.8%	29.8%	29.8%	21.5%	21.5%	0.0%	12.4%	57.9%	0.0%	12.4%	57.9%	57.9%
Maximum Green (s)	30.0	30.0	30.0	20.0	20.0		11.0	64.0		11.0	64.0	64.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		3.0	4.0		3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		1.0	2.0		1.0	2.0	2.0
Lead/Lag							Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		2.0	4.5		2.0	4.5	4.5
Recall Mode	None	None	None	None	None		None	None		None	None	None
Walk Time (s)	5.0	5.0	5.0					5.0			5.0	5.0
Flash Dont Walk (s)	19.0	19.0	19.0					20.0			12.0	12.0
Pedestrian Calls (#/hr)	0	0	0					0			0	0
Act Effct Green (s)		13.6	13.6		13.6		14.9	31.0		6.3	20.3	20.3
Actuated g/C Ratio		0.26	0.26		0.26		0.28	0.59		0.11	0.36	0.36
v/c Ratio		0.32	0.66		0.07		0.62	0.40		0.04	0.38	0.07
Control Delay		18.4	4.2		12.5		31.1	8.3		29.2	14.6	5.1
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	0.0
Total Delay		18.4	4.2		12.5		31.1	8.3		29.2	14.6	5.1
LOS		B	A		B		C	A		C	B	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		6.7			12.5			17.7			13.6	
Approach LOS		A			B			B			B	
90th %ile Green (s)	20.6	20.6	20.6	20.6	20.6		11.0	32.2		5.7	26.9	26.9
90th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Gap		Gap	Hold	Hold
70th %ile Green (s)	12.0	12.0	12.0	12.0	12.0		11.0	30.6		0.0	15.6	15.6
70th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	Gap	Gap
50th %ile Green (s)	9.9	9.9	9.9	9.9	9.9		11.0	30.0		0.0	15.0	15.0
50th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	Min	Min
30th %ile Green (s)	7.2	7.2	7.2	7.2	7.2		11.0	30.0		0.0	15.0	15.0
30th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	Min	Min
10th %ile Green (s)	5.0	5.0	5.0	5.0	5.0		17.0	15.0		0.0	0.0	0.0
10th %ile Term Code	Min	Min	Min	Hold	Hold		Hold	Min		Skip	Skip	Skip

Intersection Summary

Area Type: Other
Cycle Length: 121
Actuated Cycle Length: 52.4
Natural Cycle: 80
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.66
Intersection Signal Delay: 12.8 Intersection LOS: B
Intersection Capacity Utilization 56.6% ICU Level of Service B
Analysis Period (min) 15
90th %ile Actuated Cycle: 74.5
70th %ile Actuated Cycle: 54.6
50th %ile Actuated Cycle: 51.9
30th %ile Actuated Cycle: 49.2
10th %ile Actuated Cycle: 32

Splits and Phases: 90: Napilihau Street & Honoapiilani Highway



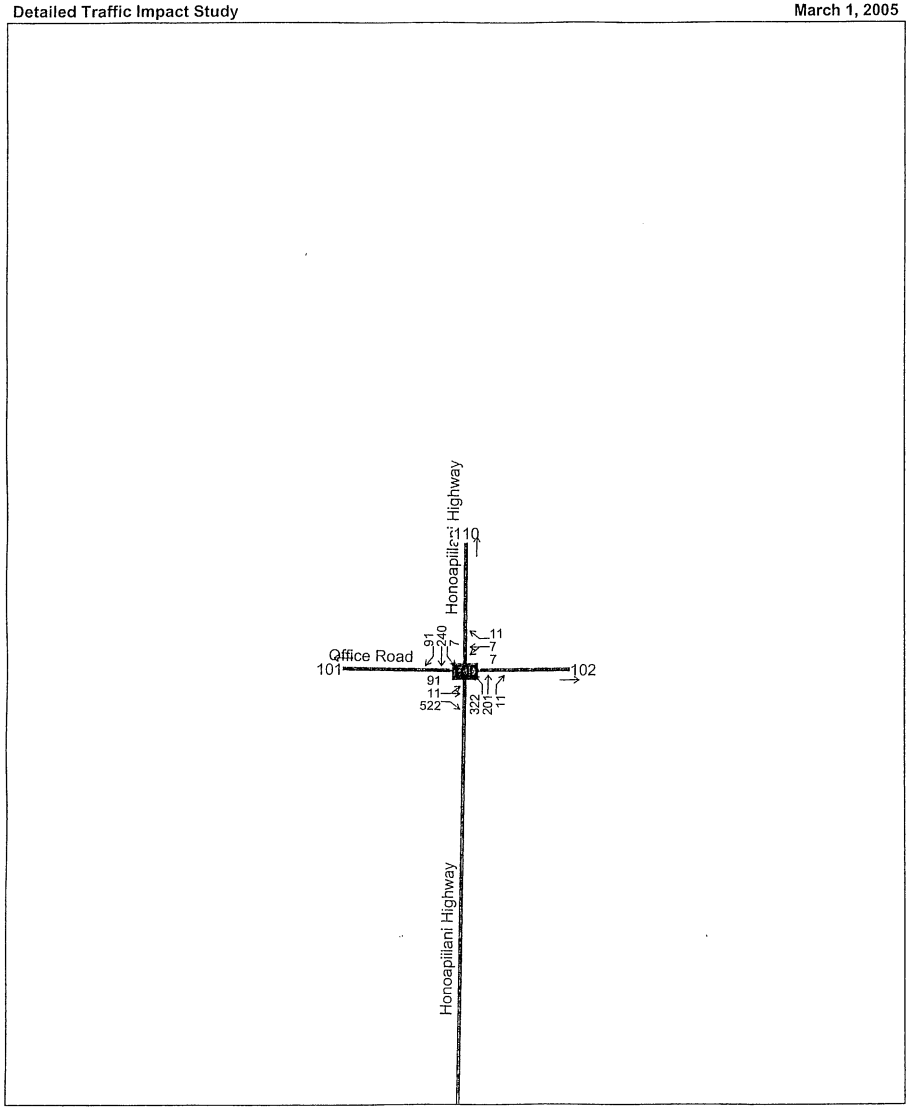
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		200	200		200
Storage Lanes	0		1	0		1	1		1	1		1
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850			0.850			0.850			0.850
Flt Protected		0.956			0.976		0.950			0.950		
Satd. Flow (prot)	0	1781	1583	0	1818	1583	1770	1863	1583	1770	1863	1583
Flt Permitted		0.956			0.976		0.950			0.950		
Satd. Flow (perm)	0	1781	1583	0	1818	1583	1770	1863	1583	1770	1863	1583
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		1268			1116			5035			1283	
Travel Time (s)		43.2			38.0			76.3			19.4	
Volume (vph)	74	6	212	6	6	6	478	233	11	6	105	170
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	82	7	236	7	7	7	531	259	12	7	117	189
Lane Group Flow (vph)	0	89	236	0	14	7	531	259	12	7	117	189
Sign Control		Stop			Stop			Free			Free	

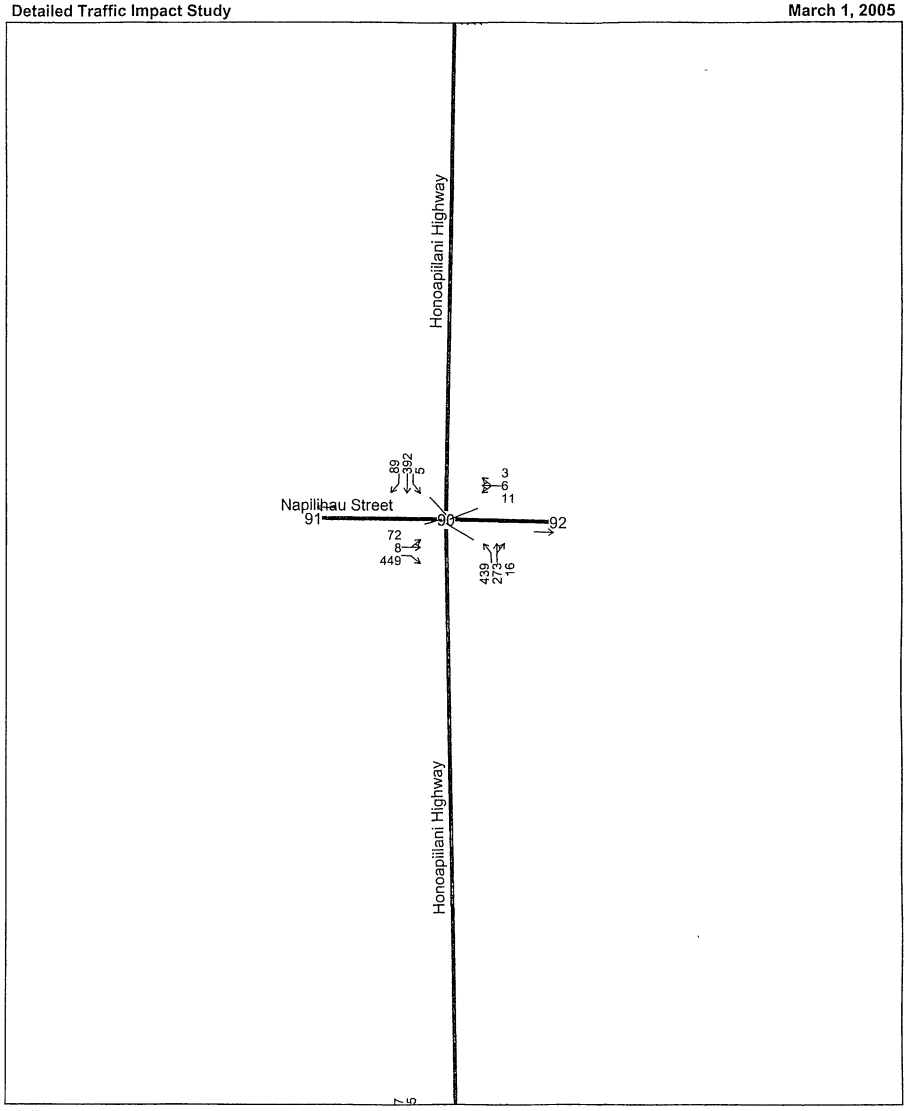
Intersection Summary

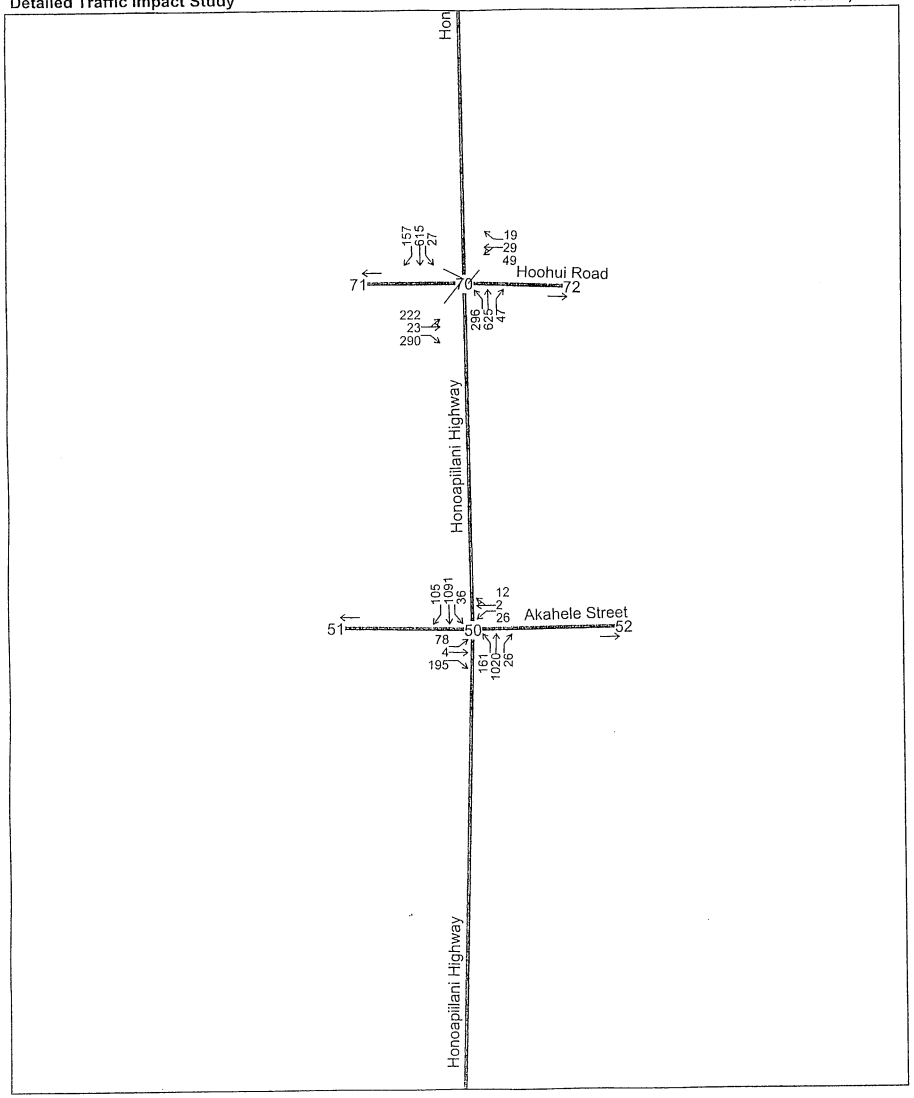
Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 50.9%
ICU Level of Service A
Analysis Period (min) 15

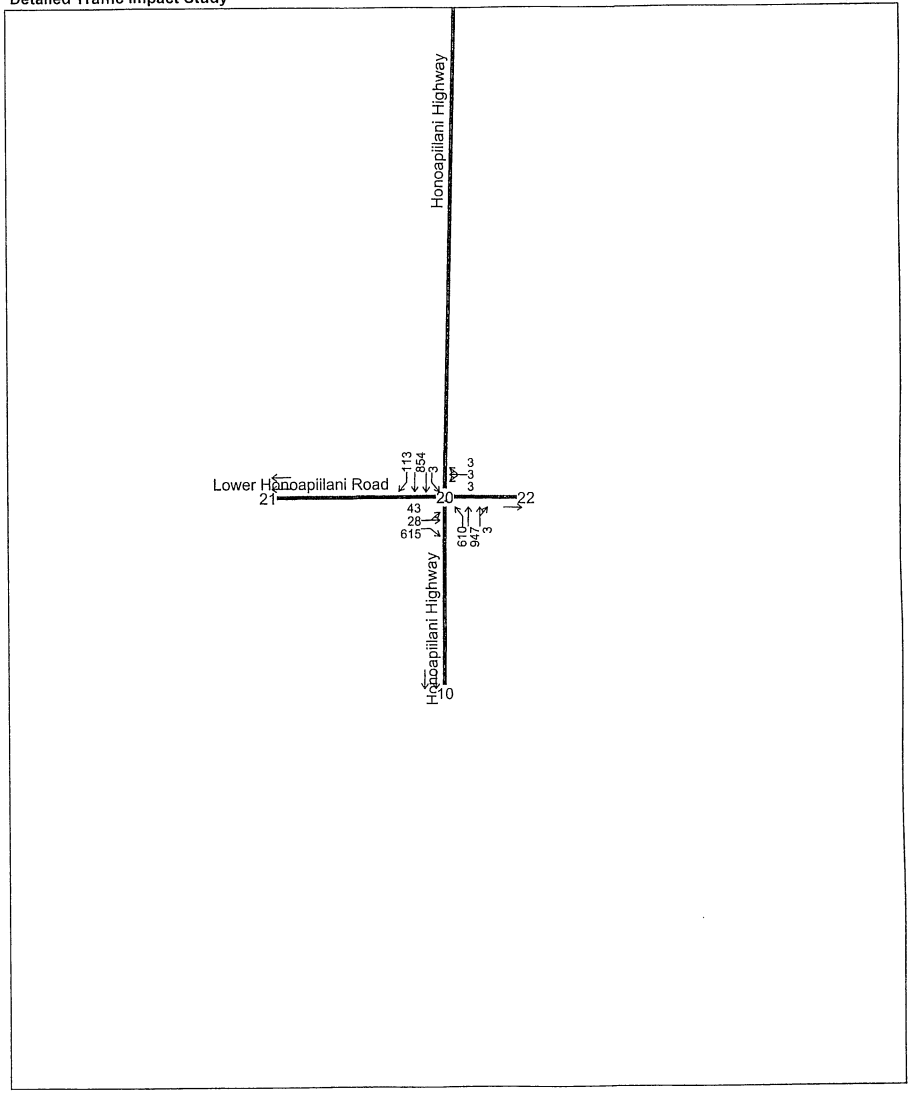
APPENDIX E

Honoapiilani Highway Arterial Level of Service Analysis 2011 PM Peak Hour with Akahele Signal, Future Projects without Pulelehua (SYNCHRO)


Honoapiilani Highway
10
Office Road
101
102
91
240
7
11
7
7
91
11
522
322
201
11
Honoapiilani Highway


Honoapiilani Highway
89
392
5
3
6
11
Napilihau Street
91
90
92
72
8
449
439
27
16
Honoapiilani Highway


Hon
Hoohui Road
71
70
72
157
615
27
19
29
49
222
23
290
296
625
47
Honoapiilani Highway
105
1091
36
12
2
26
Akahele Street
51
50
52
78
4
195
161
1025
26
Honoapiilani Highway


Honoapiilani Highway
Lower Honoapiilani Road
21
20
22
113
854
3
3
3
3
43
28
615
610
947
3
Honoapiilani Highway
10

Arterial Level of Service: NB Honoapiilani Highway

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Lower Honoapiilani R	II	45	33.6	6.0	39.6	0.35	31.8	B
Akahele Street	II	45	103.9	20.5	124.4	1.30	37.6	A
Hoohui Road	II	45	49.1	17.0	66.1	0.61	33.4	B
Napilihau Street	II	45	90.7	6.7	97.4	1.13	41.9	A
Total	II		277.3	50.2	327.5	3.40	37.3	A

Arterial Level of Service: SB Honoapiilani Highway

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Napilihau Street	II	45	95.7	15.4	111.1	1.20	38.8	A
Hoohui Road	II	45	90.7	16.1	106.8	1.13	38.2	A
Akahele Street	II	45	49.1	38.8	87.9	0.61	25.1	C
Lower Honoapiilani R	II	45	103.9	41.7	145.6	1.30	32.1	B
Total	II		339.4	112.0	451.4	4.24	33.8	B

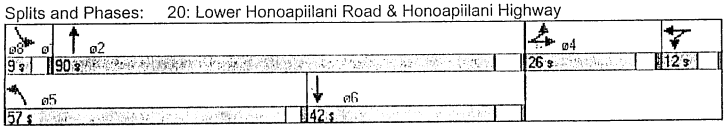
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		0	0		0	200		0	0		200
Storage Lanes	0		1	0		0	1		0	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	1.00
Ped Bike Factor		0.99										
Frt			0.850		0.955							0.850
Flt Protected		0.971			0.984		0.950			0.950		
Satd. Flow (prot)	0	1809	1583	0	1750	0	1770	3539	0	1770	3539	1583
Flt Permitted		0.971			0.984		0.950			0.950		
Satd. Flow (perm)	0	1798	1583	0	1750	0	1770	3539	0	1770	3539	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			664		3							83
Headway 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
Link Speed (mph)		30			30			45			45	
Link Distance (ft)		1680			766			1848			6856	
Travel Time (s)		38.2			17.4			28.0			103.9	
Volume (vph)	43	28	615	3	3	3	610	947	3	3	854	113
Confl. Peds. (#/hr)	3											
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	48	31	683	3	3	3	678	1052	3	3	949	126
Lane Group Flow (vph)	0	79	683	0	9	0	678	1055	0	3	949	126
Turn Type	Split		Perm	Split			Prot			Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4									6
Detector Phases	4	4	4	8	8		5	2		1	6	6
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0		3.0	15.0		3.0	15.0	15.0
Minimum Split (s)	26.0	26.0	26.0	12.0	12.0		9.0	36.0		9.0	36.0	36.0
Total Split (s)	26.0	26.0	26.0	12.0	12.0	0.0	57.0	90.0	0.0	9.0	42.0	42.0
Total Split (%)	19.0%	19.0%	19.0%	8.8%	8.8%	0.0%	41.6%	65.7%	0.0%	6.6%	30.7%	30.7%
Maximum Green (s)	21.0	21.0	21.0	7.0	7.0		53.0	84.0		5.0	36.0	36.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		3.0	5.0		3.0	5.0	5.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0		1.0	1.0		1.0	1.0	1.0
Lead/Lag							Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		2.0	5.0		2.0	5.0	5.0
Recall Mode	None	None	None	None	None		None	Max		None	Max	Max
Walk Time (s)	7.0	7.0	7.0					7.0			7.0	7.0
Flash Dont Walk (s)	14.0	14.0	14.0					16.0			23.0	23.0
Pedestrian Calls (#/hr)	0	0	0					0			0	0
Act Effct Green (s)		15.4	15.4		8.0		50.2	92.2		5.7	40.6	40.6
Actuated g/C Ratio		0.13	0.13		0.06		0.43	0.79		0.05	0.35	0.35
v/c Ratio		0.33	0.87		0.08		0.90	0.38		0.04	0.78	0.21
Control Delay		49.0	13.6		51.2		44.0	6.0		62.7	41.7	13.9
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	0.0

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay		49.0	13.6		51.2		44.0	6.0		62.7	41.7	13.9
LOS		D	B		D		D	A		E	D	B
Approach Delay		17.2			51.3			20.8			38.5	
Approach LOS		B			D			C			D	
90th %ile Green (s)	21.0	21.0	21.0	7.0	7.0		53.0	84.0		5.0	36.0	36.0
90th %ile Term Code	Max	Max	Max	Max	Max		Max	MaxR		Max	MaxR	MaxR
70th %ile Green (s)	21.0	21.0	21.0	0.0	0.0		53.0	93.0		0.0	36.0	36.0
70th %ile Term Code	Max	Max	Max	Skip	Skip		Max	Hold		Skip	MaxR	MaxR
50th %ile Green (s)	11.3	11.3	11.3	0.0	0.0		53.0	93.0		0.0	36.0	36.0
50th %ile Term Code	Gap	Gap	Gap	Skip	Skip		Max	Hold		Skip	MaxR	MaxR
30th %ile Green (s)	9.4	9.4	9.4	0.0	0.0		47.4	87.4		0.0	36.0	36.0
30th %ile Term Code	Gap	Gap	Gap	Skip	Skip		Gap	Hold		Skip	MaxR	MaxR
10th %ile Green (s)	6.6	6.6	6.6	0.0	0.0		39.1	84.0		0.0	40.9	40.9
10th %ile Term Code	Gap	Gap	Gap	Skip	Skip		Gap	MaxR		Skip	Hold	Hold

Intersection Summary

Area Type: Other
Cycle Length: 137
Actuated Cycle Length: 117.3
Natural Cycle: 125
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.90
Intersection Signal Delay: 25.5 Intersection LOS: C
Intersection Capacity Utilization 75.9% ICU Level of Service D
Analysis Period (min) 15
90th %ile Actuated Cycle: 137
70th %ile Actuated Cycle: 125
50th %ile Actuated Cycle: 115.3
30th %ile Actuated Cycle: 107.8
10th %ile Actuated Cycle: 101.6

Splits and Phases: 20: Lower Honoapiilani Road & Honoapiilani Highway



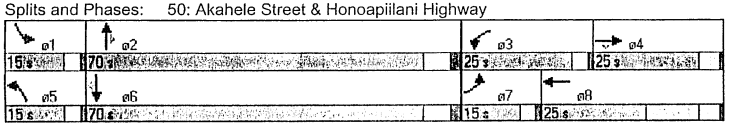
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		200	200		200
Storage Lanes	1		1	1		0	1		1	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50		50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0	0	0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850		0.870				0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1863	1583	1770	1621	0	1770	1863	1583	1770	1863	1583
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	1863	1583	1770	1621	0	1770	1863	1583	1770	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			205		13				13			46
Headway 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
Link Speed (mph)		30			30			45			45	
Link Distance (ft)		1291			1428			6856			3242	
Travel Time (s)		29.3			32.5			103.9			49.1	
Volume (vph)	78	4	195	26	2	12	161	1020	26	36	1091	105
Peak Hour Factor	0.95	0.95	0.95	0.90	0.90	0.90	0.95	0.95	0.90	0.90	0.95	0.95
Adj. Flow (vph)	82	4	205	29	2	13	169	1074	29	40	1148	111
Lane Group Flow (vph)	82	4	205	29	15	0	169	1074	29	40	1148	111
Turn Type	Prot		Perm	Prot			Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4						2			6
Detector Phases	7	4	4	3	8		5	2	2	1	6	6
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0		5.0	10.0	10.0	5.0	15.0	15.0
Minimum Split (s)	9.0	25.0	25.0	9.0	20.0		9.0	25.0	25.0	9.0	35.0	35.0
Total Split (s)	15.0	25.0	25.0	25.0	25.0	0.0	15.0	70.0	70.0	15.0	70.0	70.0
Total Split (%)	11.1%	18.5%	18.5%	18.5%	18.5%	0.0%	11.1%	51.9%	51.9%	11.1%	51.9%	51.9%
Maximum Green (s)	11.0	20.0	20.0	21.0	20.0		11.0	63.0	63.0	11.0	63.0	63.0
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0		3.0	5.0	5.0	3.0	5.0	5.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0		1.0	2.0	2.0	1.0	2.0	2.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0		2.0	5.0	5.0	2.0	5.0	5.0
Recall Mode	None	None	None	None	None		None	Min	Min	None	Min	Min
Walk Time (s)		7.0	7.0					7.0	7.0		7.0	7.0
Flash Dont Walk (s)		13.0	13.0					11.0	11.0		21.0	21.0
Pedestrian Calls (#/hr)		0	0					0	0		0	0
Act Effct Green (s)	11.2	10.2	10.2	7.4	8.9		12.1	75.6	75.6	8.0	67.4	67.4
Actuated g/C Ratio	0.10	0.10	0.10	0.07	0.08		0.12	0.72	0.72	0.07	0.64	0.64
v/c Ratio	0.44	0.02	0.61	0.24	0.10		0.83	0.80	0.03	0.31	0.96	0.11
Control Delay	51.1	44.2	9.7	49.8	24.8		79.2	20.5	6.0	51.3	38.8	6.0
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.1	44.2	9.7	49.8	24.8		79.2	20.5	6.0	51.3	38.8	6.0
LOS	D	D	A	D	C		E	C	A	D	D	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		21.8			41.3			28.0			36.4	
Approach LOS		C			D			C			D	
90th %ile Green (s)	11.0	13.9	13.9	8.8	11.7		11.0	64.1	64.1	9.9	63.0	63.0
90th %ile Term Code	Max	Gap	Gap	Gap	Hold		Max	Hold	Hold	Gap	Max	Max
70th %ile Green (s)	11.0	10.2	10.2	7.2	6.4		11.0	65.9	65.9	8.1	63.0	63.0
70th %ile Term Code	Max	Hold	Hold	Gap	Gap		Max	Hold	Hold	Gap	Max	Max
50th %ile Green (s)	16.9	5.7	5.7	6.2	0.0		11.0	67.2	67.2	6.8	63.0	63.0
50th %ile Term Code	Hold	Gap	Gap	Gap	Skip		Max	Hold	Hold	Gap	Max	Max
30th %ile Green (s)	7.3	6.3	6.3	0.0	0.0		11.0	78.0	78.0	0.0	63.0	63.0
30th %ile Term Code	Gap	Hold	Hold	Skip	Skip		Max	Hold	Hold	Skip	Max	Max
10th %ile Green (s)	0.0	5.5	5.5	0.0	5.5		11.0	78.0	78.0	0.0	63.0	63.0
10th %ile Term Code	Skip	Gap	Gap	Skip	Hold		Max	Hold	Hold	Skip	Max	Max

Intersection Summary

Area Type: Other
Cycle Length: 135
Actuated Cycle Length: 105.2
Natural Cycle: 140
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.96
Intersection Signal Delay: 31.3 Intersection LOS: C
Intersection Capacity Utilization 87.3% ICU Level of Service E
Analysis Period (min) 15
90th %ile Actuated Cycle: 116.7
70th %ile Actuated Cycle: 111.4
50th %ile Actuated Cycle: 105.9
30th %ile Actuated Cycle: 96.3
10th %ile Actuated Cycle: 95.5

Splits and Phases: 50: Akahele Street & Honoapiilani Highway



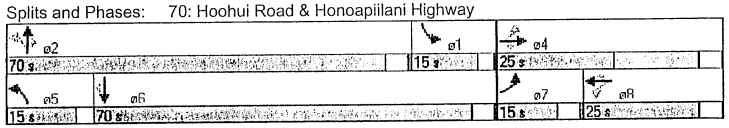
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		200	200		200
Storage Lanes	0		1	0		1	1		1	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50	50	50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850			0.850			0.850			0.850
Flt Protected		0.957			0.970		0.950			0.950		
Satd. Flow (prot)	0	1783	1583	0	1807	1583	1770	1863	1583	1770	1863	1583
Flt Permitted		0.544			0.700		0.144			0.950		
Satd. Flow (perm)	0	1013	1583	0	1304	1583	268	1863	1583	1770	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			290			21			42			142
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		998			1017			3242			5984	
Travel Time (s)		34.0			34.7			49.1			90.7	
Volume (vph)	222	23	290	49	29	19	296	625	47	27	615	157
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	247	26	322	54	32	21	329	694	52	30	683	174
Lane Group Flow (vph)	0	273	322	0	86	21	329	694	52	30	683	174
Turn Type	pm+pt		Perm	Perm		Perm	pm+pt		Perm	Prot		Perm
Protected Phases	7	4			8		5	2		1	6	
Permitted Phases	4		4	8		8	2		2			6
Detector Phases	7	4	4	8	8	8	5	2	2	1	6	6
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	15.0	15.0	5.0	15.0	15.0
Minimum Split (s)	9.5	20.0	20.0	20.0	20.0	20.0	9.0	20.0	20.0	9.5	20.0	20.0
Total Split (s)	15.0	25.0	25.0	25.0	25.0	25.0	15.0	70.0	70.0	15.0	70.0	70.0
Total Split (%)	12.0%	20.0%	20.0%	20.0%	20.0%	20.0%	12.0%	56.0%	56.0%	12.0%	56.0%	56.0%
Maximum Green (s)	10.5	20.5	20.5	20.5	20.5	20.5	12.0	65.5	65.5	11.5	65.5	65.5
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.5	0.5	0.5	0.5	0.5
Lead/Lag	Lead			Lag	Lag	Lag	Lead	Lead	Lead	Lag	Lag	Lag
Lead-Lag Optimize?											Yes	Yes
Vehicle Extension (s)	2.0	4.0	4.0	4.0	4.0	4.0	2.0	4.0	4.0	2.0	4.0	4.0
Recall Mode	None	None	None	None	None	None	None	Min	Min	None	Max	Max
Act Effct Green (s)		22.0	22.0		22.0	22.0	70.7	70.7	70.7	14.0	67.0	67.0
Actuated g/C Ratio		0.20	0.20		0.20	0.20	0.64	0.64	0.64	0.12	0.61	0.61
v/c Ratio		1.34	0.59		0.33	0.06	0.98	0.58	0.05	0.14	0.60	0.17
Control Delay		81.7	9.3		41.8	14.9	64.3	17.0	5.6	40.4	16.1	2.8
Queue Delay		0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay		81.7	9.3		41.8	14.9	64.3	17.0	5.6	40.4	16.1	2.8
LOS		F	A		D	B	E	B	A	D	B	A
Approach Delay		42.5			36.6			30.9			14.3	
Approach LOS		D			D			C			B	
90th %ile Green (s)	0.0	20.5	20.5	20.5	20.5	20.5	12.0	53.2	53.2	23.8	65.5	65.5

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
90th %ile Term Code	Skip	Max	Max	Hold	Hold	Hold	Max	Gap	Gap	Hold	MaxR	MaxR
70th %ile Green (s)	0.0	20.5	20.5	20.5	20.5	20.5	12.0	51.4	51.4	25.6	65.5	65.5
70th %ile Term Code	Skip	Max	Max	Hold	Hold	Hold	Max	Gap	Gap	Hold	MaxR	MaxR
50th %ile Green (s)	0.0	20.5	20.5	20.5	20.5	20.5	12.0	80.5	80.5	0.0	65.5	65.5
50th %ile Term Code	Skip	Max	Max	Hold	Hold	Hold	Max	Hold	Hold	Skip	MaxR	MaxR
30th %ile Green (s)	0.0	20.5	20.5	20.5	20.5	20.5	12.0	80.5	80.5	0.0	65.5	65.5
30th %ile Term Code	Skip	Max	Max	Hold	Hold	Hold	Max	Hold	Hold	Skip	MaxR	MaxR
10th %ile Green (s)	0.0	20.5	20.5	20.5	20.5	20.5	12.0	80.5	80.5	0.0	65.5	65.5
10th %ile Term Code	Skip	Max	Max	Hold	Hold	Hold	Max	Hold	Hold	Skip	MaxR	MaxR

Intersection Summary

Area Type: Other
Cycle Length: 125
Actuated Cycle Length: 110
Natural Cycle: 90
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 1.34
Intersection Signal Delay: 28.2 Intersection LOS: C
Intersection Capacity Utilization 78.9% ICU Level of Service D
Analysis Period (min) 15
90th %ile Actuated Cycle: 110
70th %ile Actuated Cycle: 110
50th %ile Actuated Cycle: 110
30th %ile Actuated Cycle: 110
10th %ile Actuated Cycle: 110

Splits and Phases: 70: Hoohui Road & Honoapiilani Highway



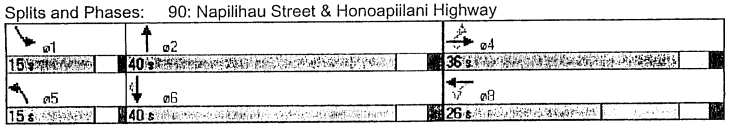
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		125	200		0
Storage Lanes	0		1	0		0	1		0	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850		0.981			0.992				0.850
Flt Protected		0.957			0.972		0.950			0.950		
Satd. Flow (prot)	0	1783	1583	0	1776	0	1770	1848	0	1770	1863	1583
Flt Permitted		0.772			0.890		0.950			0.950		
Satd. Flow (perm)	0	1438	1583	0	1626	0	1770	1848	0	1770	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			487		3			4				99
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		1254			1054			5984			5035	
Travel Time (s)		42.8			35.9			90.7			76.3	
Volume (vph)	72	8	449	11	6	3	439	273	16	5	392	89
Peak Hour Factor	0.90	0.91	0.90	0.92	0.93	0.90	0.95	0.95	0.93	0.90	0.95	0.90
Adj. Flow (vph)	80	9	499	12	6	3	462	287	17	6	413	99
Lane Group Flow (vph)	0	89	499	0	21	0	462	304	0	6	413	99
Turn Type	Perm		Perm	Perm			Prot			Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8								6
Detector Phases	4	4	4	8	8		5	2		1	6	6
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0		5.0	15.0		5.0	15.0	15.0
Minimum Split (s)	36.0	36.0	36.0	12.0	12.0		9.5	31.0		9.5	23.0	23.0
Total Split (s)	36.0	36.0	36.0	26.0	26.0	0.0	15.0	40.0	0.0	15.0	40.0	40.0
Total Split (%)	39.6%	39.6%	39.6%	28.6%	28.6%	0.0%	16.5%	44.0%	0.0%	16.5%	44.0%	44.0%
Maximum Green (s)	30.0	30.0	30.0	20.0	20.0		11.0	34.0		11.0	34.0	34.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		3.0	4.0		3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		1.0	2.0		1.0	2.0	2.0
Lead/Lag							Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		2.0	4.5		2.0	4.5	4.5
Recall Mode	None	None	None	None	None		None	None		None	None	None
Walk Time (s)	5.0	5.0	5.0					5.0			5.0	5.0
Flash Dont Walk (s)	19.0	19.0	19.0					20.0			12.0	12.0
Pedestrian Calls (#/hr)	0	0	0					0			0	0
Act Effct Green (s)		12.8	12.8		12.8		12.5	37.9		6.2	23.7	23.7
Actuated g/C Ratio		0.22	0.22		0.22		0.21	0.65		0.09	0.41	0.41
v/c Ratio		0.28	0.69		0.06		1.22	0.25		0.04	0.55	0.14
Control Delay		20.7	5.0		18.1		148.8	6.7		32.0	15.4	3.5
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	0.0
Total Delay		20.7	5.0		18.1		148.8	6.7		32.0	15.4	3.5
LOS		C	A		B		F	A		C	B	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		7.4			18.1			92.4			13.3	
Approach LOS		A			B			F			B	
90th %ile Green (s)	21.0	21.0	21.0	21.0	21.0		11.0	37.8		5.6	32.4	32.4
90th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Gap	Gap	Gap
70th %ile Green (s)	11.3	11.3	11.3	11.3	11.3		11.0	38.9		0.0	23.9	23.9
70th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	Gap	Gap
50th %ile Green (s)	8.1	8.1	8.1	8.1	8.1		11.0	33.8		0.0	18.8	18.8
50th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	Gap	Gap
30th %ile Green (s)	6.4	6.4	6.4	6.4	6.4		11.0	30.0		0.0	15.0	15.0
30th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	Min	Min
10th %ile Green (s)	5.0	5.0	5.0	5.0	5.0		11.0	30.0		0.0	15.0	15.0
10th %ile Term Code	Min	Min	Min	Hold	Hold		Max	Hold		Skip	Min	Min

Intersection Summary

Area Type: Other
Cycle Length: 91
Actuated Cycle Length: 58.4
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.22
Intersection Signal Delay: 43.6 Intersection LOS: D
Intersection Capacity Utilization 62.7% ICU Level of Service B
Analysis Period (min) 15
90th %ile Actuated Cycle: 80.4
70th %ile Actuated Cycle: 62.2
50th %ile Actuated Cycle: 53.9
30th %ile Actuated Cycle: 48.4
10th %ile Actuated Cycle: 47

Splits and Phases: 90: Napilihau Street & Honoapiilani Highway



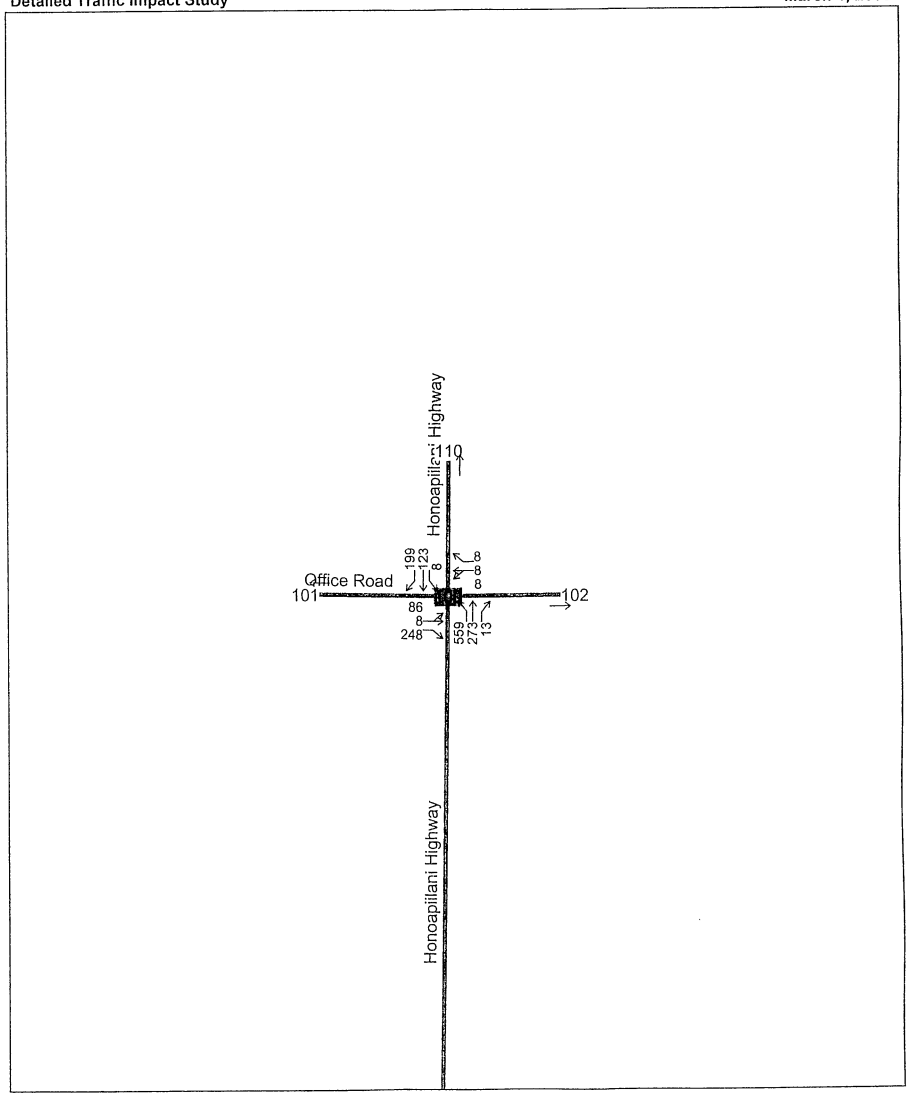
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		200	200		200
Storage Lanes	0		1	0		1	1		1	1		1
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850			0.850			0.850			0.850
Flt Protected		0.957			0.976		0.950			0.950		
Satd. Flow (prot)	0	1783	1583	0	1818	1583	1770	1863	1583	1770	1863	1583
Flt Permitted		0.957			0.976		0.950			0.950		
Satd. Flow (perm)	0	1783	1583	0	1818	1583	1770	1863	1583	1770	1863	1583
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		1268			1116			5035			1283	
Travel Time (s)		43.2			38.0			76.3			19.4	
Volume (vph)	91	11	522	7	7	11	322	201	11	7	240	91
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	101	12	580	8	8	12	358	223	12	8	267	101
Lane Group Flow (vph)	0	113	580	0	16	12	358	223	12	8	267	101
Sign Control		Stop			Stop			Free			Free	

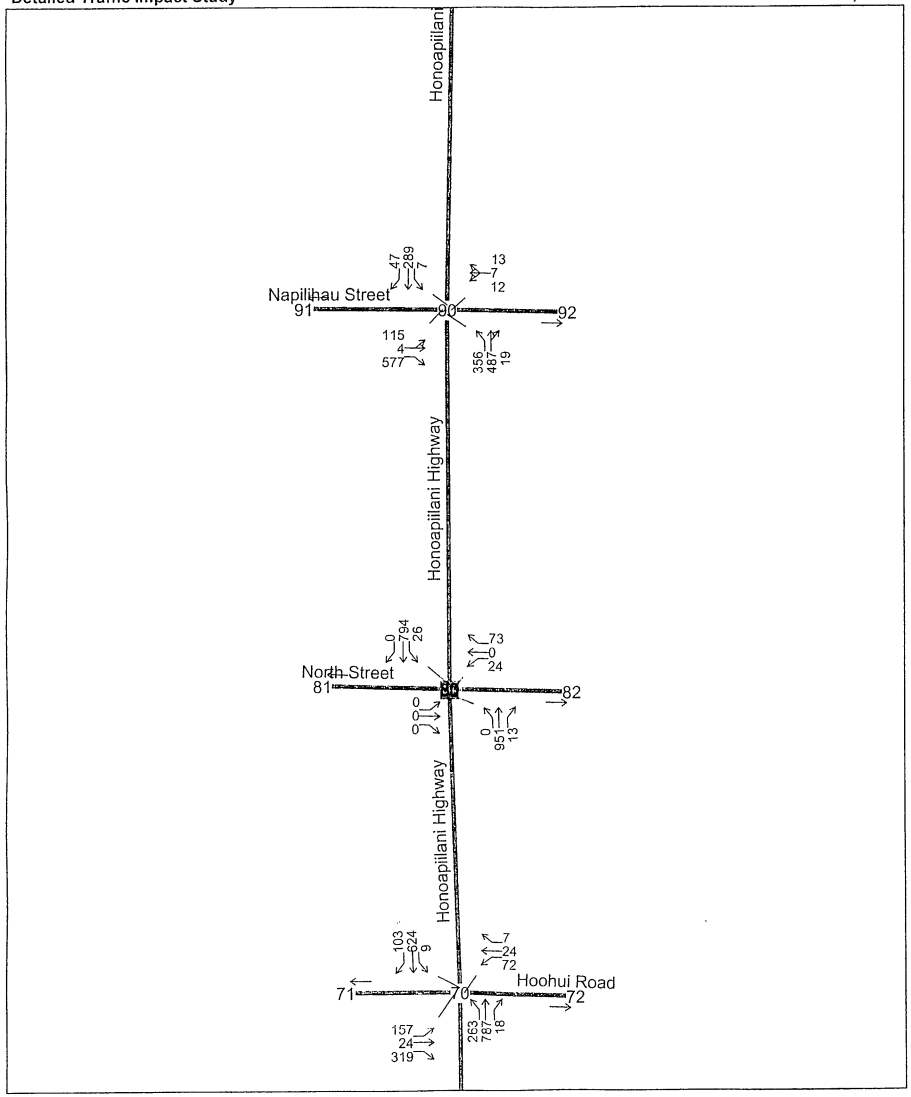
Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 58.3% ICU Level of Service B
Analysis Period (min) 15

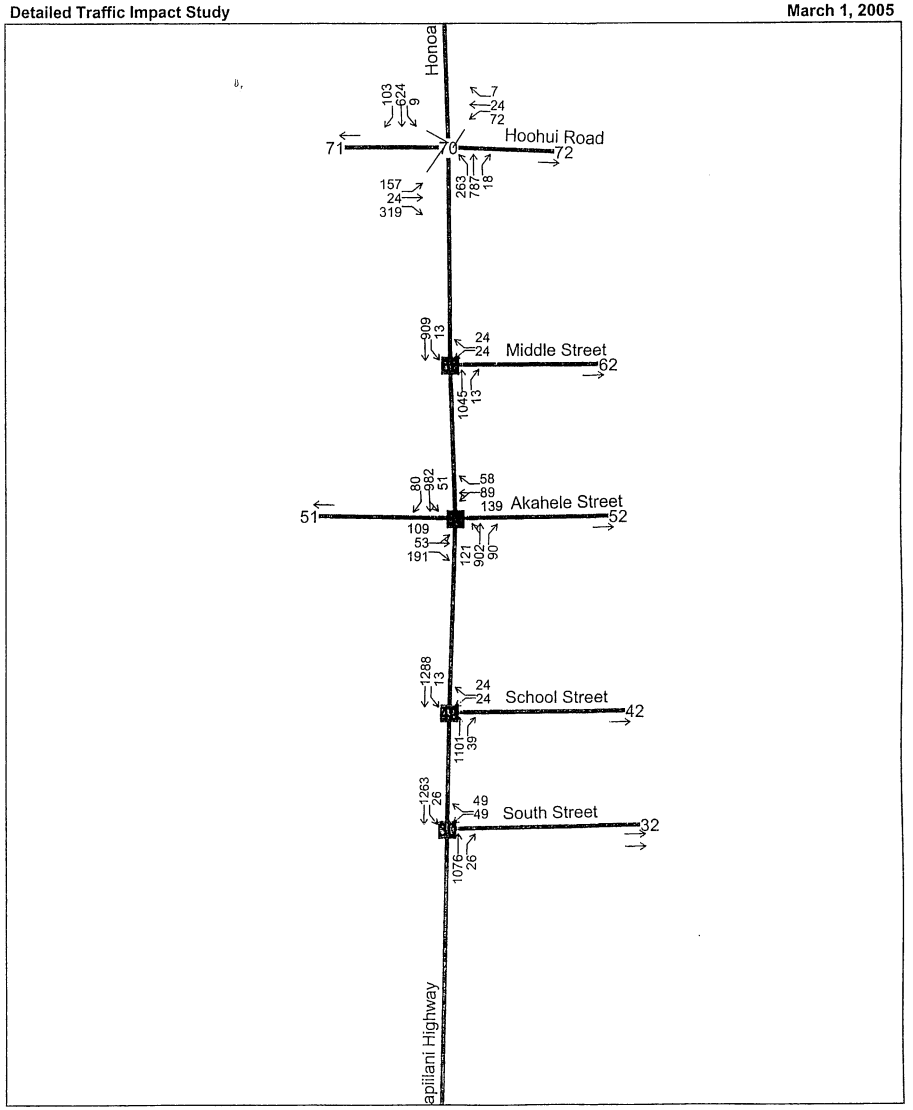
APPENDIX F

Honoapiilani Highway Arterial Level of Service Analysis 2011 AM Peak Hour with Akahele Roundabout , Future Projects with Pulelehua (SYNCHRO)

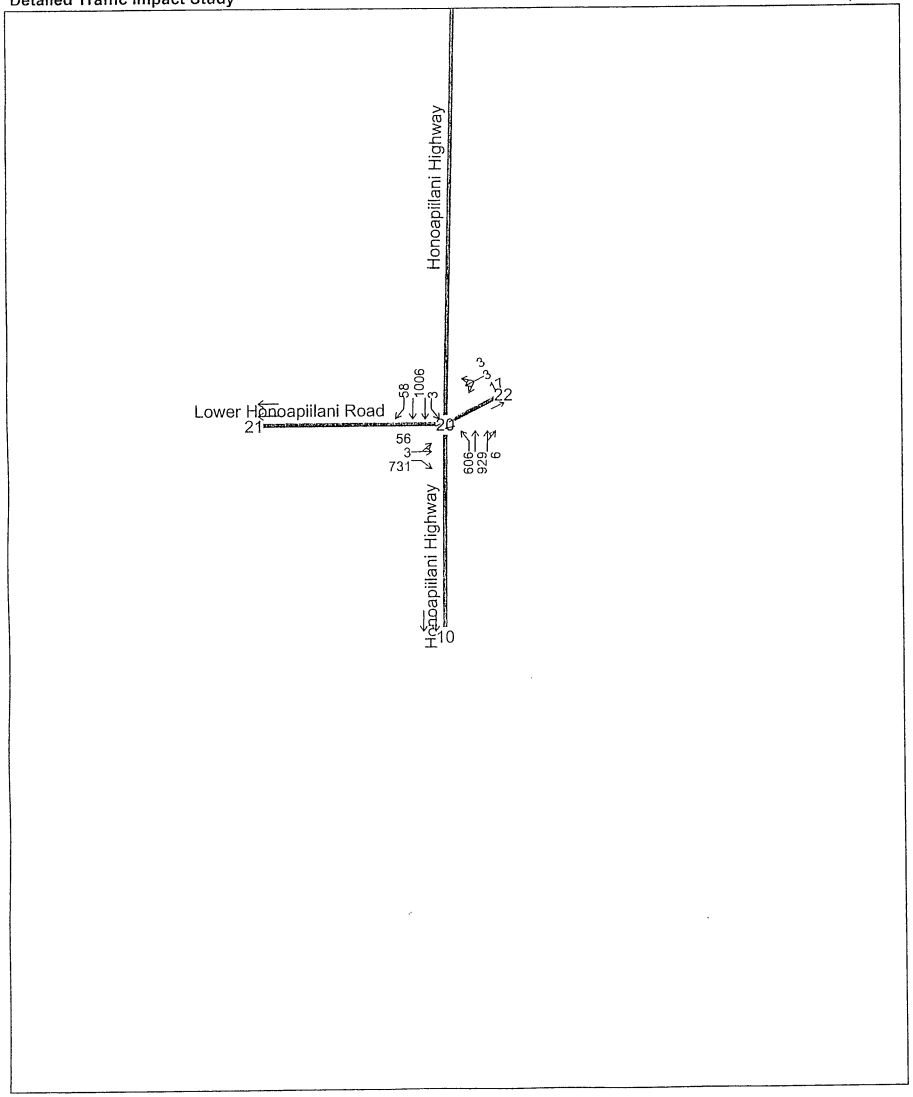




Arterial LOS Analysis
Detailed Traffic Impact Study
AM Pk Hr Future Projects w/Pulelehua and Roundabout 2011
March 1, 2005



Hall Planning & Engineering, Inc.



Pulelehua

Arterial Level of Service: NB Honoapiilani Highway

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Lower Honoapiilani R	II	45	33.6	6.2	39.8	0.35	31.7	B
Hoohui Road	II	45	49.1	11.0	60.1	0.61	36.8	A
Napilihau Street	II	45	90.7	9.6	100.3	1.13	40.7	A
Total	II		173.4	26.8	200.2	2.10	37.7	A

Arterial Level of Service: SB Honoapiilani Highway

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Napilihau Street	II	45	95.7	14.4	110.1	1.20	39.1	A
Hoohui Road	II	45	90.7	15.8	106.5	1.13	38.3	A
Lower Honoapiilani R	II	45	103.9	40.6	144.5	1.30	32.3	B
Total	II		290.3	70.8	361.1	3.63	36.2	A

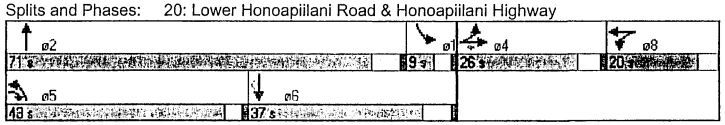
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	0		0	200		200	200		200
Storage Lanes	0		1	0		0	1		0	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	1.00
Frt			0.850		0.984			0.999				0.850
Flt Protected		0.954			0.963		0.950			0.950		
Satd. Flow (prot)	0	1777	1583	0	1765	0	1770	3536	0	1770	3539	1583
Flt Permitted		0.954			0.963		0.950			0.950		
Satd. Flow (perm)	0	1777	1583	0	1765	0	1770	3536	0	1770	3539	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			359		3			1				40
Headway 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
Link Speed (mph)		30			30			45			45	
Link Distance (ft)		1680			575			1848			4133	
Travel Time (s)		38.2			13.1			28.0			62.6	
Volume (vph)	56	3	731	17	3	3	606	929	6	3	1006	58
Peak Hour Factor	0.90	0.90	0.95	0.90	0.90	0.90	0.90	0.95	0.90	0.90	0.95	0.90
Adj. Flow (vph)	62	3	769	19	3	3	673	978	7	3	1059	64
Lane Group Flow (vph)	0	65	769	0	25	0	673	985	0	3	1059	64
Turn Type	Split		pm+ov	Split			Prot			Prot		Perm
Protected Phases	4	4	5	8	8		5	2		1	6	
Permitted Phases			4									6
Detector Phases	4	4	5	8	8		5	2		1	6	6
Minimum Initial (s)	5.0	5.0	3.0	5.0	5.0		3.0	15.0		3.0	15.0	15.0
Minimum Split (s)	26.0	26.0	9.0	20.0	20.0		9.0	36.0		9.0	36.0	36.0
Total Split (s)	26.0	26.0	43.0	20.0	20.0	0.0	43.0	71.0	0.0	9.0	37.0	37.0
Total Split (%)	20.6%	20.6%	34.1%	15.9%	15.9%	0.0%	34.1%	56.3%	0.0%	7.1%	29.4%	29.4%
Maximum Green (s)	21.0	21.0	39.0	16.0	16.0		39.0	65.0		5.0	31.0	31.0
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0		3.0	5.0		3.0	5.0	5.0
All-Red Time (s)	1.0	1.0	1.0	0.0	0.0		1.0	1.0		1.0	1.0	1.0
Lead/Lag			Lead				Lead	Lead		Lag	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	2.0	3.0	3.0		2.0	5.0		2.0	5.0	5.0
Recall Mode	None	None	None	None	None		None	Max		None	Max	Max
Walk Time (s)	7.0	7.0						7.0			7.0	7.0
Flash Dont Walk (s)	14.0	14.0						16.0			23.0	23.0
Pedestrian Calls (#/hr)	0	0						0			0	0
Act Effct Green (s)		11.0	50.4		7.9		40.6	77.2		5.7	34.5	34.5
Actuated g/C Ratio		0.11	0.51		0.08		0.41	0.78		0.05	0.35	0.35
v/c Ratio		0.34	0.78		0.18		0.93	0.36		0.03	0.86	0.11
Control Delay		44.5	15.8		43.2		51.5	6.2		51.7	40.6	13.7
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	0.0
Total Delay		44.5	15.8		43.2		51.5	6.2		51.7	40.6	13.7
LOS		D	B		D		D	A		D	D	B

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		18.1			43.2			24.6			39.1	
Approach LOS		B			D			C			D	
90th %ile Green (s)	13.0	13.0	39.0	9.0	9.0		39.0	65.0		5.0	31.0	31.0
90th %ile Term Code	Gap	Gap	Max	Gap	Gap		Max	MaxR		Max	MaxR	MaxR
70th %ile Green (s)	10.7	10.7	39.0	7.7	7.7		39.0	74.0		0.0	31.0	31.0
70th %ile Term Code	Gap	Gap	Max	Gap	Gap		Max	Hold		Skip	MaxR	MaxR
50th %ile Green (s)	9.2	9.2	39.0	6.7	6.7		39.0	74.0		0.0	31.0	31.0
50th %ile Term Code	Gap	Gap	Max	Gap	Gap		Max	Hold		Skip	MaxR	MaxR
30th %ile Green (s)	7.4	7.4	39.0	0.0	0.0		39.0	74.0		0.0	31.0	31.0
30th %ile Term Code	Gap	Gap	Max	Skip	Skip		Max	Hold		Skip	MaxR	MaxR
10th %ile Green (s)	0.0	0.0	39.0	0.0	0.0		39.0	74.0		0.0	31.0	31.0
10th %ile Term Code	Skip	Skip	Max	Skip	Skip		Max	Hold		Skip	MaxR	MaxR

Intersection Summary

Area Type: Other
Cycle Length: 126
Actuated Cycle Length: 99.1
Natural Cycle: 155
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.93
Intersection Signal Delay: 27.7 Intersection LOS: C
Intersection Capacity Utilization 87.2% ICU Level of Service E
Analysis Period (min) 15
90th %ile Actuated Cycle: 111
70th %ile Actuated Cycle: 107.4
50th %ile Actuated Cycle: 104.9
30th %ile Actuated Cycle: 92.4
10th %ile Actuated Cycle: 80

Splits and Phases: 20: Lower Honoapiilani Road & Honoapiilani Highway



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125	0		200	200	
Storage Lanes	1	1		1	1	
Turning Speed (mph)	15	9		9	15	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)	30		45			45
Link Distance (ft)	1775		4133			1028
Travel Time (s)	40.3		62.6			15.6
Volume (vph)	49	49	1076	26	26	1263
Peak Hour Factor	0.90	0.90	0.95	0.90	0.90	0.95
Adj. Flow (vph)	54	54	1133	29	29	1329
Lane Group Flow (vph)	54	54	1133	29	29	1329
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 76.5% ICU Level of Service D
Analysis Period (min) 15

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200	0		200	200	
Storage Lanes	1	1		1	1	
Turning Speed (mph)	15	9		9	15	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)	30		45			45
Link Distance (ft)	1628		1028			1695
Travel Time (s)	37.0		15.6			25.7
Volume (vph)	24	24	1101	39	13	1288
Peak Hour Factor	0.90	0.90	0.95	0.90	0.90	0.95
Adj. Flow (vph)	27	27	1159	43	14	1356
Lane Group Flow (vph)	27	27	1159	43	14	1356
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 77.8% ICU Level of Service D
Analysis Period (min) 15

Lane Group	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
Storage Length (ft)	300		300	300		300	800		800	800		800
Storage Lanes	0		1	0		1	0		1	0		1
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850			0.850			0.850			0.850
Flt Protected		0.967			0.970			0.994			0.997	
Satd. Flow (prot)	0	1801	1583	0	1807	1583	0	1852	1583	0	1857	1583
Flt Permitted		0.967			0.970			0.994			0.997	
Satd. Flow (perm)	0	1801	1583	0	1807	1583	0	1852	1583	0	1857	1583
Headway 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
Link Speed (mph)		30			30			45			45	
Link Distance (ft)		1291			1428			1695			1353	
Travel Time (s)		29.3			32.5			25.7			20.5	
Volume (vph)	109	53	191	139	89	58	121	902	90	51	982	80
Peak Hour Factor	0.95	0.95	0.95	0.90	0.90	0.90	0.95	0.95	0.90	0.90	0.95	0.95
Adj. Flow (vph)	115	56	201	154	99	64	127	949	100	57	1034	84
Lane Group Flow (vph)	0	171	201	0	253	64	0	1076	100	0	1091	84
Sign Control		Yield			Yield			Yield			Yield	

Intersection Summary

Area Type: Other
Control Type: Roundabout
Intersection Capacity Utilization 137.7% ICU Level of Service H
Analysis Period (min) 15

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑	↱	↰	↑
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200	0		200	200	
Storage Lanes	1	1		1	1	
Turning Speed (mph)	15	9		9	15	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)	20		45			45
Link Distance (ft)	1386		1353			1890
Travel Time (s)	47.3		20.5			28.6
Volume (vph)	24	24	1045	13	13	909
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	27	27	1161	14	14	1010
Lane Group Flow (vph)	27	27	1161	14	14	1010
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 65.0% ICU Level of Service C
Analysis Period (min) 15

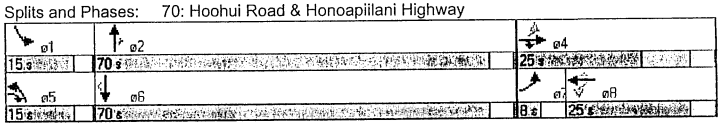
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		200	200		200
Storage Lanes	1		1	1		1	1		1	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50	50	50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.651			0.740			0.950			0.950		
Satd. Flow (perm)	1213	1863	1583	1378	1863	1583	1770	1863	1583	1770	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			222			8			15			105
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		998			1017			1890			2672	
Travel Time (s)		34.0			34.7			28.6			40.5	
Volume (vph)	157	24	319	72	24	7	263	787	18	9	624	103
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	174	27	354	80	27	8	292	874	20	10	693	114
Lane Group Flow (vph)	174	27	354	80	27	8	292	874	20	10	693	114
Turn Type	pm+pt		pt+ov	Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4	4 5		8		5	2		1	6	
Permitted Phases	4			8		8			2			6
Detector Phases	7	4	4 5	8	8	8	5	2	2	1	6	6
Minimum Initial (s)	4.0	5.0		5.0	5.0	5.0	3.0	15.0	15.0	3.0	15.0	15.0
Minimum Split (s)	8.0	20.0		20.0	20.0	20.0	9.0	21.0	21.0	9.5	21.0	21.0
Total Split (s)	8.0	25.0	40.0	25.0	25.0	25.0	15.0	70.0	70.0	15.0	70.0	70.0
Total Split (%)	6.8%	21.2%	33.9%	21.2%	21.2%	21.2%	12.7%	59.3%	59.3%	12.7%	59.3%	59.3%
Maximum Green (s)	4.0	20.5		20.5	20.5	20.5	11.5	65.5	65.5	11.5	65.5	65.5
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	0.0	0.5		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lead/Lag	Lead			Lag	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?				Yes	Yes	Yes						
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	2.0	5.0	5.0	2.0	5.0	5.0
Recall Mode	None	None		None	None	None	None	Min	Min	None	Max	Max
Act Effct Green (s)	19.0	19.0	34.1	13.0	13.0	13.0	12.0	80.5	80.5	5.7	67.3	67.3
Actuated g/C Ratio	0.18	0.18	0.32	0.12	0.12	0.12	0.11	0.75	0.75	0.05	0.63	0.63
v/c Ratio	0.72	0.08	0.54	0.49	0.12	0.04	1.47	0.63	0.02	0.11	0.59	0.11
Control Delay	57.1	35.7	12.7	48.0	42.6	22.1	271.7	11.0	3.5	53.4	15.8	2.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	57.1	35.7	12.7	48.0	42.6	22.1	271.7	11.0	3.5	53.4	15.8	2.6
LOS	E	D	B	D	D	C	F	B	A	D	B	A
Approach Delay		27.7			45.0			75.1			14.4	
Approach LOS		C			D			E			B	
90th %ile Green (s)	4.0	25.1		17.1	17.1	17.1	11.5	70.5	70.5	6.5	65.5	65.5

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
90th %ile Term Code	Max	Hold		Gap	Gap	Gap	Max	Hold	Hold	Gap	MaxR	MaxR
70th %ile Green (s)	4.0	21.9		13.9	13.9	13.9	11.5	80.5	80.5	0.0	65.5	65.5
70th %ile Term Code	Max	Hold		Gap	Gap	Gap	Max	Hold	Hold	Skip	MaxR	MaxR
50th %ile Green (s)	4.0	19.6		11.6	11.6	11.6	11.5	80.5	80.5	0.0	65.5	65.5
50th %ile Term Code	Max	Hold		Gap	Gap	Gap	Max	Hold	Hold	Skip	MaxR	MaxR
30th %ile Green (s)	4.0	17.5		9.5	9.5	9.5	11.5	80.5	80.5	0.0	65.5	65.5
30th %ile Term Code	Max	Hold		Gap	Gap	Gap	Max	Hold	Hold	Skip	MaxR	MaxR
10th %ile Green (s)	6.0	5.5		0.0	0.0	0.0	11.5	80.5	80.5	0.0	65.5	65.5
10th %ile Term Code	Hold	Gap		Skip	Skip	Skip	Max	Hold	Hold	Skip	MaxR	MaxR

Intersection Summary

Area Type: Other
Cycle Length: 118
Actuated Cycle Length: 107.4
Natural Cycle: 90
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 1.47
Intersection Signal Delay: 45.4 — Intersection LOS: D
Intersection Capacity Utilization 72.8% — ICU Level of Service C
Analysis Period (min) 15
90th %ile Actuated Cycle: 114.6
70th %ile Actuated Cycle: 111.4
50th %ile Actuated Cycle: 109.1
30th %ile Actuated Cycle: 107
10th %ile Actuated Cycle: 95

Splits and Phases: 70: Hoohui Road & Honoapiilani Highway



Lane Group	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
Storage Length (ft)	125		125	125		125	200		200	200		200
Storage Lanes	1		1	1		1	1		1	1		1
Turning Speed (mph)	15		9	15		9	15		9	15		9
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						0.850			0.850			
Flt Protected				0.950						0.950		
Satd. Flow (prot)	1863	1863	1863	1770	1863	1583	1863	1863	1583	1770	1863	1863
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	1863	1863	1863	1770	1863	1583	1863	1863	1583	1770	1863	1863
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		1111			1074			2672			3312	
Travel Time (s)		37.9			36.6			40.5			50.2	
Volume (vph)	0	0	0	24	0	73	0	951	13	26	794	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.92	0.95	0.90	0.90	0.95	0.90
Adj. Flow (vph)	0	0	0	27	0	81	0	1001	14	29	836	0
Lane Group Flow (vph)	0	0	0	27	0	81	0	1001	14	29	836	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 61.2% ICU Level of Service B
Analysis Period (min) 15

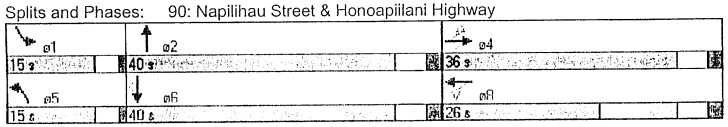
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		125	200		200
Storage Lanes	0		1	0		0	1		0	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850		0.946			0.994				0.850
Flt Protected		0.954			0.982		0.950			0.950		
Satd. Flow (prot)	0	1777	1583	0	1730	0	1770	1852	0	1770	1863	1583
Flt Permitted		0.724			0.911		0.950			0.950		
Satd. Flow (perm)	0	1349	1583	0	1605	0	1770	1852	0	1770	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			581		14			3				52
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		1254			1054			3312			5035	
Travel Time (s)		42.8			35.9			50.2			76.3	
Volume (vph)	115	4	577	12	7	13	356	487	19	7	289	47
Peak Hour Factor	0.90	0.90	0.95	0.90	0.90	0.90	0.95	0.95	0.90	0.90	0.95	0.90
Adj. Flow (vph)	128	4	607	13	8	14	375	513	21	8	304	52
Lane Group Flow (vph)	0	132	607	0	35	0	375	534	0	8	304	52
Turn Type	Perm		Perm	Perm			Prot			Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8								6
Detector Phases	4	4	4	8	8		5	2		1	6	6
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0		5.0	15.0		5.0	15.0	15.0
Minimum Split (s)	36.0	36.0	36.0	20.0	20.0		10.0	31.0		10.0	23.0	23.0
Total Split (s)	36.0	36.0	36.0	26.0	26.0	0.0	15.0	40.0	0.0	15.0	40.0	40.0
Total Split (%)	39.6%	39.6%	39.6%	28.6%	28.6%	0.0%	16.5%	44.0%	0.0%	16.5%	44.0%	44.0%
Maximum Green (s)	30.0	30.0	30.0	20.0	20.0		11.0	34.0		11.0	34.0	34.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		3.0	4.0		3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		1.0	2.0		1.0	2.0	2.0
Lead/Lag							Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		2.0	4.5		2.0	4.5	4.5
Recall Mode	None	None	None	None	None		None	Max		None	Max	Max
Walk Time (s)	5.0	5.0	5.0					5.0			5.0	5.0
Flash Dont Walk (s)	19.0	19.0	19.0					20.0			12.0	12.0
Pedestrian Calls (#/hr)	0	0	0					0			0	0
Act Effct Green (s)		17.0	17.0		17.0		12.1	50.7		6.2	37.3	37.3
Actuated g/C Ratio		0.23	0.23		0.23		0.16	0.67		0.07	0.49	0.49
v/c Ratio		0.43	0.75		0.09		1.32	0.43		0.06	0.33	0.06
Control Delay		25.7	6.4		15.2		197.5	9.6		37.7	14.4	4.6
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	0.0
Total Delay		25.7	6.4		15.2		197.5	9.6		37.7	14.4	4.6
LOS		C	A		B		F	A		D	B	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		9.8			15.2			87.1			13.5	
Approach LOS		A			B			F			B	
90th %ile Green (s)	26.8	26.8	26.8	26.8	26.8		11.0	39.1		5.9	34.0	34.0
90th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Gap	MaxR	MaxR
70th %ile Green (s)	16.3	16.3	16.3	16.3	16.3		11.0	49.0		0.0	34.0	34.0
70th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	MaxR	MaxR
50th %ile Green (s)	12.8	12.8	12.8	12.8	12.8		11.0	49.0		0.0	34.0	34.0
50th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	MaxR	MaxR
30th %ile Green (s)	10.4	10.4	10.4	10.4	10.4		11.0	49.0		0.0	34.0	34.0
30th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	MaxR	MaxR
10th %ile Green (s)	6.1	6.1	6.1	6.1	6.1		11.0	49.0		0.0	34.0	34.0
10th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	MaxR	MaxR

Intersection Summary

Area Type: Other
Cycle Length: 91
Actuated Cycle Length: 75.5
Natural Cycle: 80
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 1.32
Intersection Signal Delay: 44.9 Intersection LOS: D
Intersection Capacity Utilization 65.1% ICU Level of Service C
Analysis Period (min) 15
90th %ile Actuated Cycle: 87.8
70th %ile Actuated Cycle: 77.3
50th %ile Actuated Cycle: 73.8
30th %ile Actuated Cycle: 71.4
10th %ile Actuated Cycle: 67.1

Splits and Phases: 90: Napilihau Street & Honoapiilani Highway



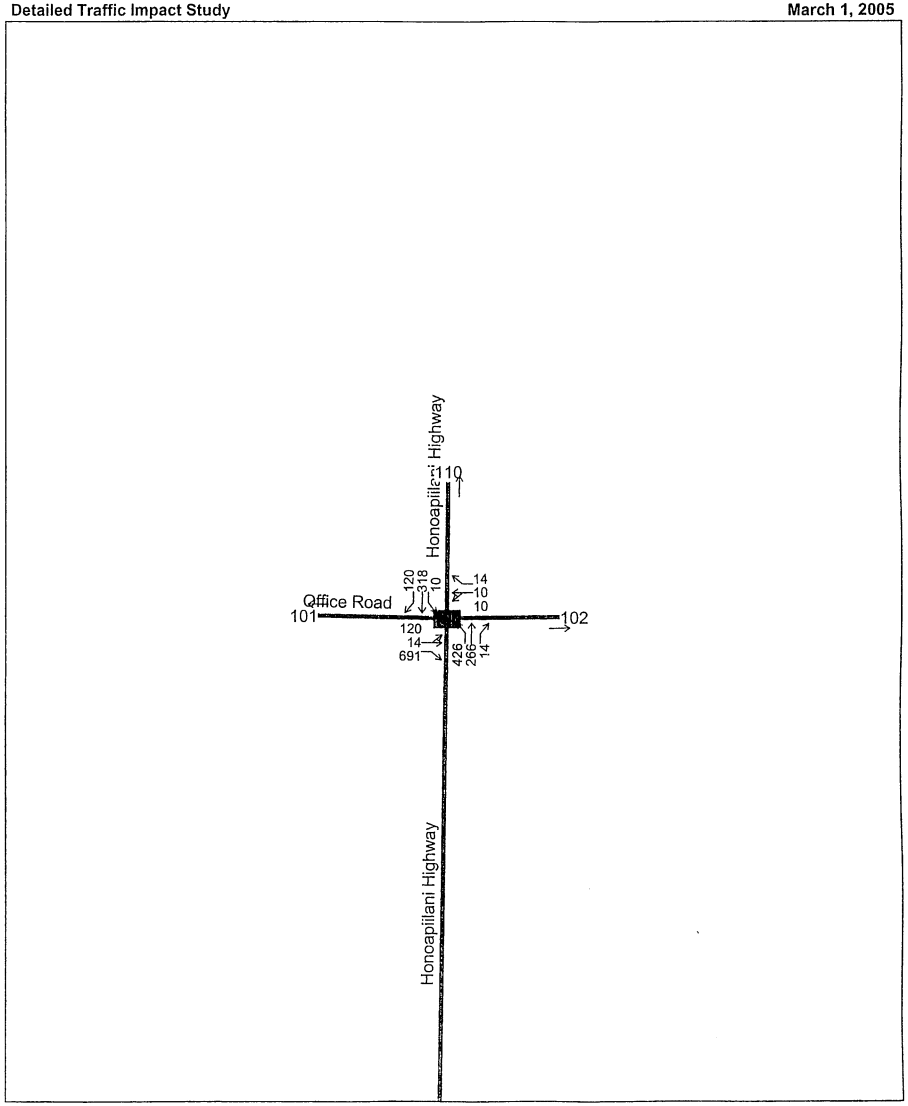
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		200	200		200
Storage Lanes	0		1	0		1	1		1	1		1
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850			0.850			0.850			0.850
Flt Protected		0.956			0.976		0.950			0.950		
Satd. Flow (prot)	0	1781	1583	0	1818	1583	1770	1863	1583	1770	1863	1583
Flt Permitted		0.956			0.976		0.950			0.950		
Satd. Flow (perm)	0	1781	1583	0	1818	1583	1770	1863	1583	1770	1863	1583
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		1268			1116			5035			1283	
Travel Time (s)		43.2			38.0			76.3			19.4	
Volume (vph)	86	8	248	8	8	8	559	273	13	8	123	199
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	96	9	276	9	9	9	621	303	14	9	137	221
Lane Group Flow (vph)	0	105	276	0	18	9	621	303	14	9	137	221
Sign Control		Stop			Stop			Free			Free	

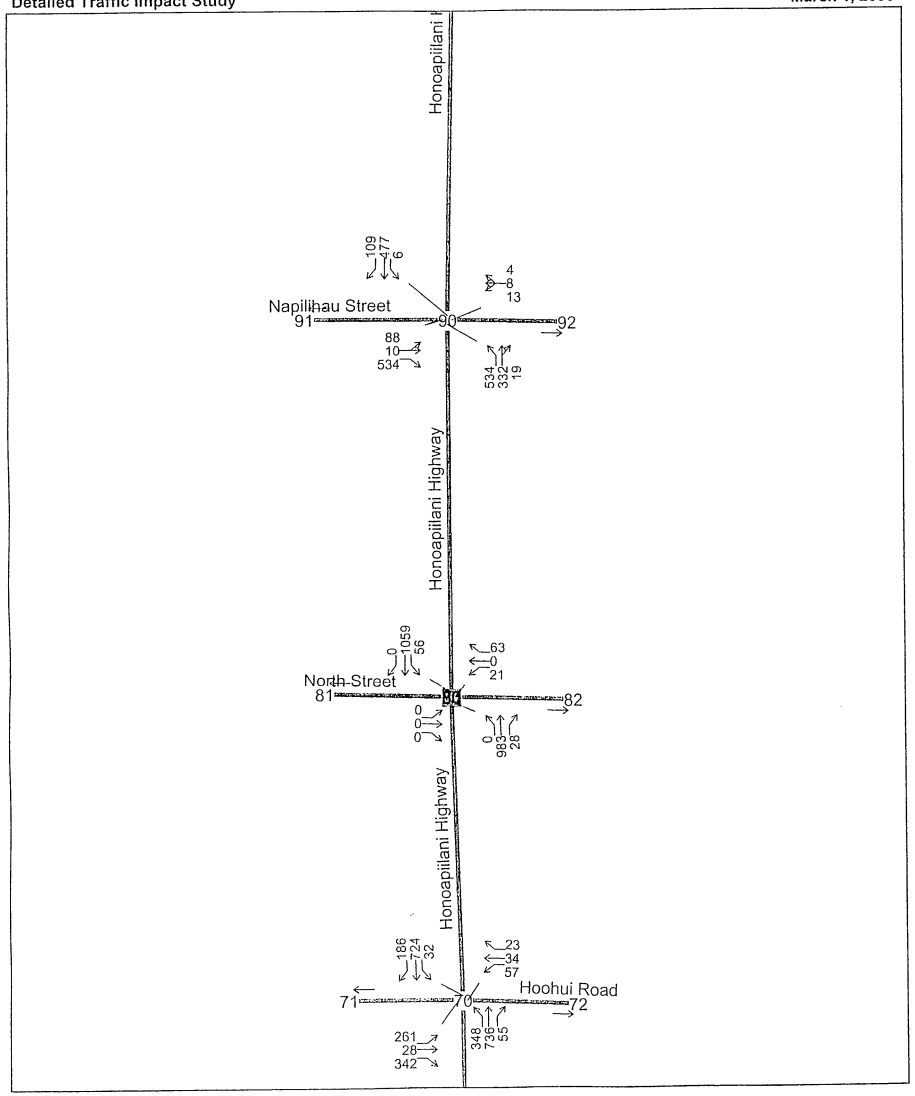
Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 59.3% ICU Level of Service B
Analysis Period (min) 15

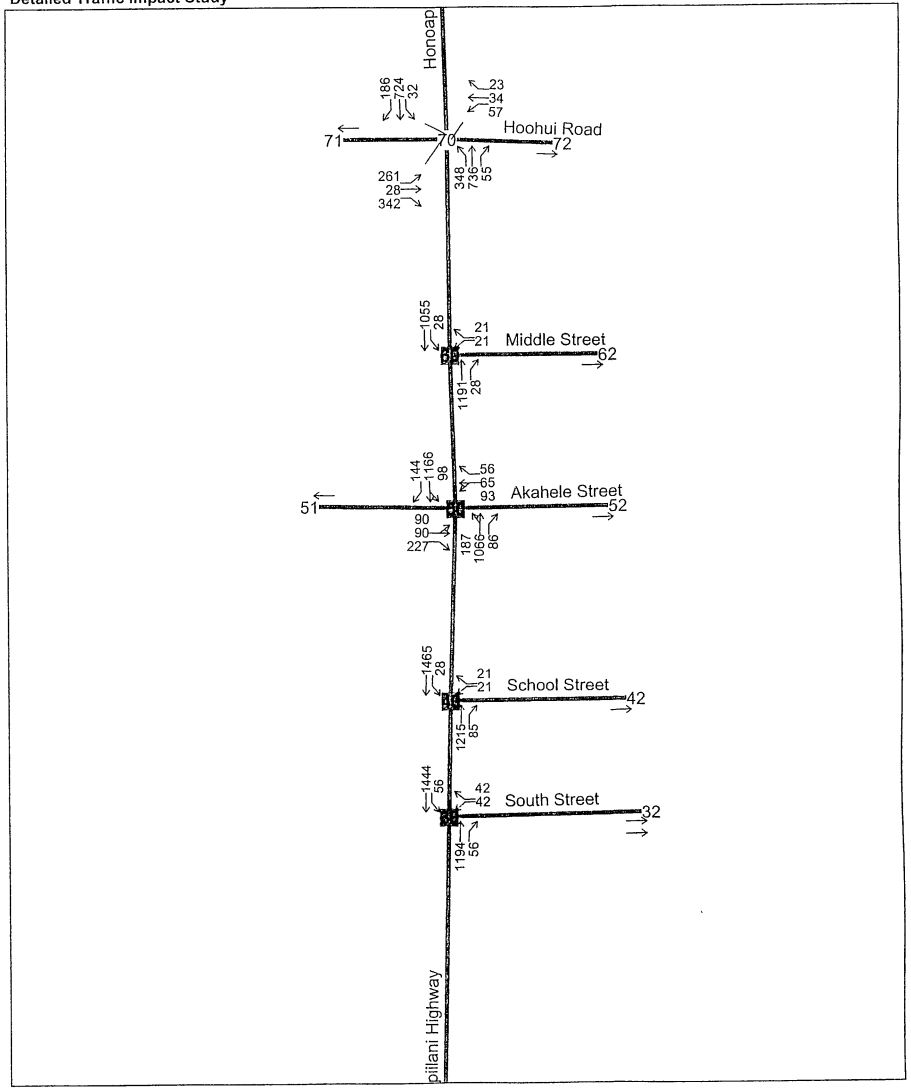
APPENDIX G

Honoapiilani Highway Arterial Level of Service Analysis 2011 PM Peak Hour with Akahele Roundabout, Future Projects with Pulelehua (SYNCHRO)

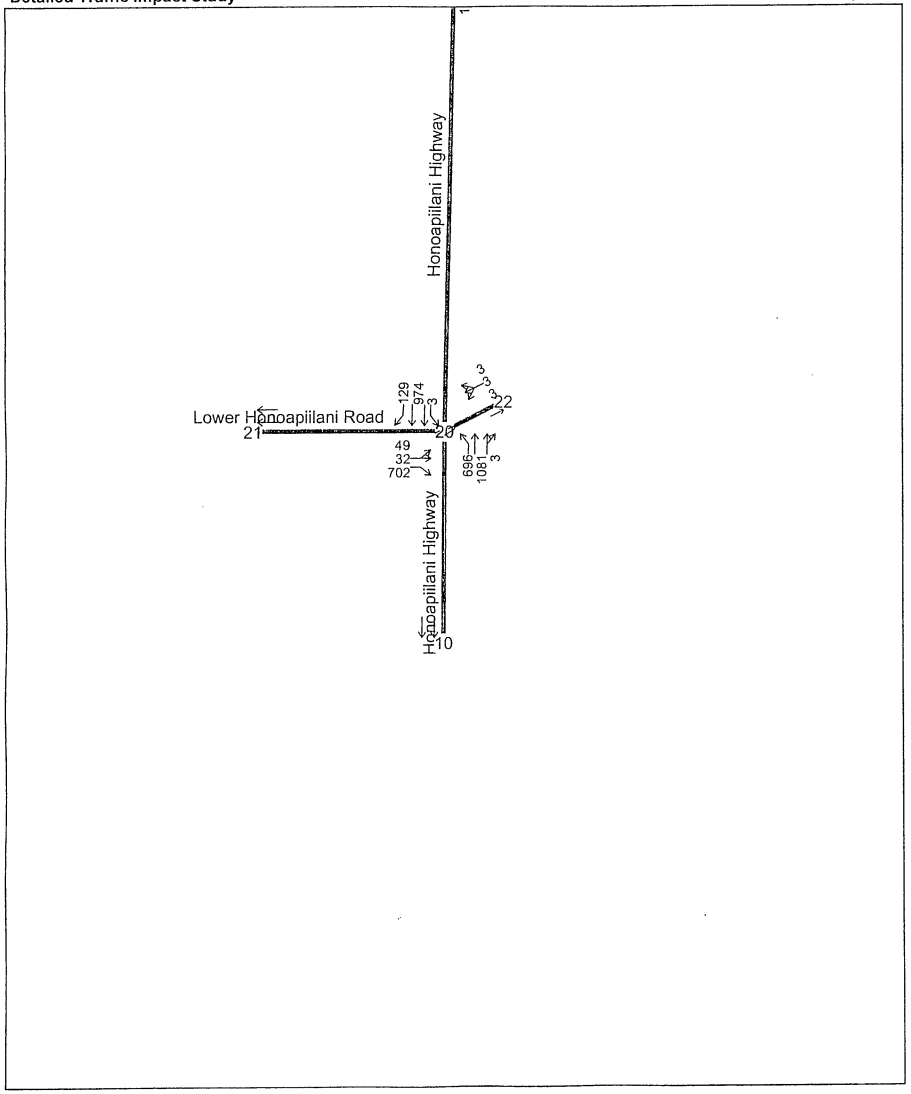




Arterial LOS Analysis
Detailed Traffic Impact Study
PM Pk Hr Future Projects w/Pulelehua and Roundabout 2011
March 1, 2005



Hall Planning & Engineering, Inc.



Arterial Level of Service: NB Honoapiilani Highway

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist. (mi)	Arterial Speed	Arterial LOS
Lower Honoapiilani R	II	45	33.6	5.5	39.1	0.35	32.2	B
Hoohui Road	II	45	49.1	19.4	68.5	0.61	32.3	B
Napilihau Street	II	45	90.7	6.1	96.8	1.13	42.1	A
Total	II		173.4	31.0	204.4	2.10	36.9	A

Arterial Level of Service: SB Honoapiilani Highway

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist. (mi)	Arterial Speed	Arterial LOS
Napilihau Street	II	45	95.7	31.1	126.8	1.20	34.0	B
Hoohui Road	II	45	90.7	43.1	133.8	1.13	30.5	B
Lower Honoapiilani R	II	45	103.9	37.1	141.0	1.30	33.2	B
Total	II		290.3	111.3	401.6	3.63	32.5	B

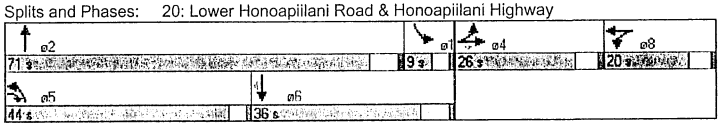
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	0		0	200		200	200		200
Storage Lanes	0		1	0		0	1		0	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	1.00
Frt			0.850		0.955							0.850
Flt Protected		0.971			0.984		0.950			0.950		
Satd. Flow (prot)	0	1809	1583	0	1750	0	1770	3539	0	1770	3539	1583
Flt Permitted		0.971			0.984		0.950			0.950		
Satd. Flow (perm)	0	1809	1583	0	1750	0	1770	3539	0	1770	3539	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			411		3							92
Headway 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
Link Speed (mph)		30			30			45			45	
Link Distance (ft)		1680			575			1848			4133	
Travel Time (s)		38.2			13.1			28.0			62.6	
Volume (vph)	49	32	702	3	3	3	696	1081	3	3	974	129
Peak Hour Factor	0.90	0.90	0.95	0.90	0.90	0.90	0.90	0.95	0.90	0.90	0.95	0.90
Adj. Flow (vph)	54	36	739	3	3	3	773	1138	3	3	1025	143
Lane Group Flow (vph)	0	90	739	0	9	0	773	1141	0	3	1025	143
Turn Type	Split		pm+ov	Split			Prot			Prot		Perm
Protected Phases	4	4	5	8	8		5	2		1	6	
Permitted Phases			4									6
Detector Phases	4	4	5	8	8		5	2		1	6	6
Minimum Initial (s)	5.0	5.0	3.0	5.0	5.0		3.0	15.0		3.0	15.0	15.0
Minimum Split (s)	26.0	26.0	9.0	20.0	20.0		9.0	29.0		9.0	36.0	36.0
Total Split (s)	26.0	26.0	44.0	20.0	20.0	0.0	44.0	71.0	0.0	9.0	36.0	36.0
Total Split (%)	20.6%	20.6%	34.9%	15.9%	15.9%	0.0%	34.9%	56.3%	0.0%	7.1%	28.6%	28.6%
Maximum Green (s)	21.0	21.0	40.0	15.0	15.0		40.0	65.0		5.0	30.0	30.0
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0		3.0	5.0		3.0	5.0	5.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0		1.0	1.0		1.0	1.0	1.0
Lead/Lag			Lead				Lead	Lead		Lag	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Recall Mode	None	None	None	None	None		None	Max		None	Max	Max
Walk Time (s)	7.0	7.0						7.0			7.0	7.0
Flash Dont Walk (s)	14.0	14.0						16.0			23.0	23.0
Pedestrian Calls (#/hr)	0	0						0			0	0
Act Effct Green (s)		12.1	53.5		8.1		41.5	77.1		6.0	33.4	33.4
Actuated g/C Ratio		0.12	0.56		0.08		0.43	0.81		0.06	0.35	0.35
v/c Ratio		0.40	0.69		0.07		1.01	0.40		0.03	0.83	0.23
Control Delay		41.7	9.7		40.1		63.7	5.5		49.7	37.1	11.7
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	0.0
Total Delay		41.7	9.7		40.1		63.7	5.5		49.7	37.1	11.7
LOS		D	A		D		E	A		D	D	B

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		13.2			40.1			29.0			34.0	
Approach LOS		B			D			C			C	
90th %ile Green (s)	15.1	15.1	40.0	7.2	7.2		40.0	65.0		5.0	30.0	30.0
90th %ile Term Code	Gap	Gap	Max	Gap	Gap		Max	MaxR		Max	MaxR	MaxR
70th %ile Green (s)	11.7	11.7	40.0	0.0	0.0		40.0	74.0		0.0	30.0	30.0
70th %ile Term Code	Gap	Gap	Max	Skip	Skip		Max	Hold		Skip	MaxR	MaxR
50th %ile Green (s)	10.0	10.0	40.0	0.0	0.0		40.0	74.0		0.0	30.0	30.0
50th %ile Term Code	Gap	Gap	Max	Skip	Skip		Max	Hold		Skip	MaxR	MaxR
30th %ile Green (s)	8.4	8.4	40.0	0.0	0.0		40.0	74.0		0.0	30.0	30.0
30th %ile Term Code	Gap	Gap	Max	Skip	Skip		Max	Hold		Skip	MaxR	MaxR
10th %ile Green (s)	0.0	0.0	40.0	0.0	0.0		40.0	74.0		0.0	30.0	30.0
10th %ile Term Code	Skip	Skip	Max	Skip	Skip		Max	Hold		Skip	MaxR	MaxR

Intersection Summary

Area Type: Other
Cycle Length: 126
Actuated Cycle Length: 95.5
Natural Cycle: 175
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 1.01
Intersection Signal Delay: 27.2 Intersection LOS: C
Intersection Capacity Utilization 84.6% ICU Level of Service E
Analysis Period (min) 15
90th %ile Actuated Cycle: 112.3
70th %ile Actuated Cycle: 96.7
50th %ile Actuated Cycle: 95
30th %ile Actuated Cycle: 93.4
10th %ile Actuated Cycle: 80

Splits and Phases: 20: Lower Honoapiilani Road & Honoapiilani Highway



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125	0		200	200	
Storage Lanes	1	1		1	1	
Turning Speed (mph)	15	9		9	15	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)	30		45			45
Link Distance (ft)	1775		4133			1028
Travel Time (s)	40.3		62.6			15.6
Volume (vph)	42	42	1194	56	56	1444
Peak Hour Factor	0.90	0.90	0.95	0.90	0.90	0.95
Adj. Flow (vph)	47	47	1257	62	62	1520
Lane Group Flow (vph)	47	47	1257	62	62	1520
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 86.0% ICU Level of Service E
Analysis Period (min) 15

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200	0		200	200	
Storage Lanes	1	1		1	1	
Turning Speed (mph)	15	9		9	15	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)	30		45			45
Link Distance (ft)	1628		1028			1695
Travel Time (s)	37.0		15.6			25.7
Volume (vph)	21	21	1215	85	28	1465
Peak Hour Factor	0.90	0.90	0.95	0.90	0.90	0.95
Adj. Flow (vph)	23	23	1279	94	31	1542
Lane Group Flow (vph)	23	23	1279	94	31	1542
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 87.1% ICU Level of Service E
Analysis Period (min) 15

Lane Group	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
Storage Length (ft)	300		300	300		300	800		800	800		800
Storage Lanes	0		1	0		1	0		1	0		1
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850			0.850			0.850			0.850
Flt Protected		0.976			0.971			0.993			0.996	
Satd. Flow (prot)	0	1818	1583	0	1809	1583	0	1850	1583	0	1855	1583
Flt Permitted		0.976			0.971			0.993			0.996	
Satd. Flow (perm)	0	1818	1583	0	1809	1583	0	1850	1583	0	1855	1583
Headway 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
Link Speed (mph)		30			30			45			45	
Link Distance (ft)		1291			1428			1695			1353	
Travel Time (s)		29.3			32.5			25.7			20.5	
Volume (vph)	90	90	227	93	65	56	187	1066	86	98	1166	144
Peak Hour Factor	0.95	0.95	0.95	0.90	0.90	0.90	0.95	0.95	0.90	0.90	0.95	0.95
Adj. Flow (vph)	95	95	239	103	72	62	197	1122	96	109	1227	152
Lane Group Flow (vph)	0	190	239	0	175	62	0	1319	96	0	1336	152
Sign Control		Yield			Yield			Yield			Yield	

Intersection Summary

Area Type: Other
Control Type: Roundabout
Intersection Capacity Utilization 159.6% ICU Level of Service H
Analysis Period (min) 15

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰	↱	↑	↱	↰	↑
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200	0		200	200	
Storage Lanes	1	1		1	1	
Turning Speed (mph)	15	9		9	15	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)	20		45			45
Link Distance (ft)	1386		1353			1890
Travel Time (s)	47.3		20.5			28.6
Volume (vph)	21	21	1191	28	28	1055
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	23	23	1323	31	31	1172
Lane Group Flow (vph)	23	23	1323	31	31	1172
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 72.7% ICU Level of Service C
Analysis Period (min) 15

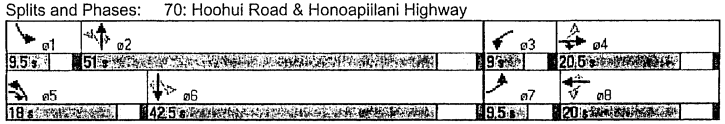
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		200	200		200
Storage Lanes	1		1	1		1	1		1	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50	50	50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.711			0.737			0.094			0.145		
Satd. Flow (perm)	1324	1863	1583	1373	1863	1583	175	1863	1583	270	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			175			26			58			165
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		998			1017			1890			2672	
Travel Time (s)		34.0			34.7			28.6			40.5	
Volume (vph)	261	28	342	57	34	23	348	736	55	32	724	186
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	290	31	380	63	38	26	387	818	61	36	804	207
Lane Group Flow (vph)	290	31	380	63	38	26	387	818	61	36	804	207
Turn Type	pm+pt		pt+ov	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm
Protected Phases	7	4	4 5	3	8		5	2		1	6	
Permitted Phases	4			8		8	2		2	6		6
Detector Phases	7	4	4 5	3	8	8	5	2	2	1	6	6
Minimum Initial (s)	3.0	5.0		3.0	5.0	5.0	3.0	15.0	15.0	3.0	15.0	15.0
Minimum Split (s)	9.5	20.0		9.0	20.0	20.0	9.0	21.0	21.0	9.5	21.0	21.0
Total Split (s)	9.5	20.5	38.5	9.0	20.0	20.0	18.0	51.0	51.0	9.5	42.5	42.5
Total Split (%)	10.6%	22.8%	42.8%	10.0%	22.2%	22.2%	20.0%	56.7%	56.7%	10.6%	47.2%	47.2%
Maximum Green (s)	5.5	15.5		5.0	15.0	15.0	14.0	45.0	45.0	5.5	36.5	36.5
Yellow Time (s)	3.0	4.0		3.0	4.0	4.0	3.0	5.0	5.0	3.0	5.0	5.0
All-Red Time (s)	1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	2.0	4.0		2.0	4.0	4.0	2.0	5.0	5.0	2.0	5.0	5.0
Recall Mode	None	None		None	None	None	None	Min	Min	None	Max	Max
Act Effct Green (s)	20.6	15.1	33.2	15.8	13.8	13.8	57.9	52.5	52.5	45.7	39.8	39.8
Actuated g/C Ratio	0.24	0.18	0.39	0.18	0.15	0.15	0.67	0.61	0.61	0.51	0.46	0.46
v/c Ratio	0.78	0.09	0.53	0.23	0.13	0.10	0.97	0.72	0.06	0.15	0.93	0.25
Control Delay	45.3	30.6	13.5	27.4	32.3	12.6	64.6	19.4	3.4	8.4	43.1	5.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	45.3	30.6	13.5	27.4	32.3	12.6	64.6	19.4	3.4	8.4	43.1	5.2
LOS	D	C	B	C	C	B	E	B	A	A	D	A
Approach Delay		27.4			25.8			32.4			34.4	
Approach LOS		C			C			C			C	
90th %ile Green (s)	5.5	15.5		5.0	15.0	15.0	14.0	45.0	45.0	5.5	36.5	36.5

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
90th %ile Term Code	Max	Max		Max	Hold	Hold	Max	Max	Max	Max	MaxR	MaxR
70th %ile Green (s)	5.5	15.5		5.0	15.0	15.0	14.0	45.0	45.0	5.5	36.5	36.5
70th %ile Term Code	Max	Max		Max	Hold	Hold	Max	Max	Max	Max	MaxR	MaxR
50th %ile Green (s)	5.5	15.5		5.0	15.0	15.0	14.0	45.4	45.4	5.1	36.5	36.5
50th %ile Term Code	Max	Max		Max	Hold	Hold	Max	Hold	Hold	Gap	MaxR	MaxR
30th %ile Green (s)	22.4	12.4		5.0	0.0	0.0	14.0	54.5	54.5	0.0	36.5	36.5
30th %ile Term Code	Hold	Gap		Max	Skip	Skip	Max	Hold	Hold	Skip	MaxR	MaxR
10th %ile Green (s)	8.4	7.4		0.0	0.0	0.0	14.0	54.5	54.5	0.0	36.5	36.5
10th %ile Term Code	Hold	Gap		Skip	Skip	Skip	Max	Hold	Hold	Skip	MaxR	MaxR

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 86
Natural Cycle: 90
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.97
Intersection Signal Delay: 31.7 Intersection LOS: C
Intersection Capacity Utilization 88.5% ICU Level of Service E
Analysis Period (min) 15
90th %ile Actuated Cycle: 90
70th %ile Actuated Cycle: 90
50th %ile Actuated Cycle: 90
30th %ile Actuated Cycle: 86.9
10th %ile Actuated Cycle: 72.9

Splits and Phases: 70: Hoohui Road & Honoapiilani Highway



Lane Group	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
Storage Length (ft)	125		125	125		125	200		200	200		200
Storage Lanes	1		1	1		1	1		1	1		1
Turning Speed (mph)	15		9	15		9	15		9	15		9
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						0.850			0.850			
Flt Protected				0.950						0.950		
Satd. Flow (prot)	1863	1863	1863	1770	1863	1583	1863	1863	1583	1770	1863	1863
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	1863	1863	1863	1770	1863	1583	1863	1863	1583	1770	1863	1863
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		1111			1074			2672			3312	
Travel Time (s)		37.9			36.6			40.5			50.2	
Volume (vph)	0	0	0	21	0	63	0	983	28	56	1059	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.92	0.95	0.90	0.90	0.95	0.90
Adj. Flow (vph)	0	0	0	23	0	70	0	1035	31	62	1115	0
Lane Group Flow (vph)	0	0	0	23	0	70	0	1035	31	62	1115	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 65.7% ICU Level of Service C
Analysis Period (min) 15

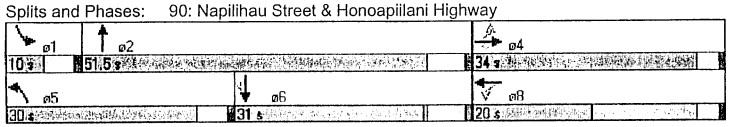
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		125	200		200
Storage Lanes	0		1	0		0	1		0	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850		0.980			0.991				0.850
Flt Protected		0.957			0.975		0.950			0.950		
Satd. Flow (prot)	0	1783	1583	0	1780	0	1770	1846	0	1770	1863	1583
Flt Permitted		0.757			0.893		0.950			0.950		
Satd. Flow (perm)	0	1410	1583	0	1630	0	1770	1846	0	1770	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			546		4			5				117
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		1254			1054			3312			5035	
Travel Time (s)		42.8			35.9			50.2			76.3	
Volume (vph)	88	10	534	13	8	4	534	332	19	6	477	109
Peak Hour Factor	0.90	0.90	0.95	0.90	0.90	0.90	0.95	0.95	0.90	0.90	0.95	0.90
Adj. Flow (vph)	98	11	562	14	9	4	562	349	21	7	502	121
Lane Group Flow (vph)	0	109	562	0	27	0	562	370	0	7	502	121
Turn Type	Perm		Perm	Perm			Prot			Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8								6
Detector Phases	4	4	4	8	8		5	2		1	6	6
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0		5.0	15.0		5.0	15.0	15.0
Minimum Split (s)	34.0	34.0	34.0	20.0	20.0		10.0	31.0		10.0	23.0	23.0
Total Split (s)	34.0	34.0	34.0	20.0	20.0	0.0	30.0	51.5	0.0	10.0	31.0	31.0
Total Split (%)	35.6%	35.6%	35.6%	20.9%	20.9%	0.0%	31.4%	53.9%	0.0%	10.5%	32.5%	32.5%
Maximum Green (s)	30.0	30.0	30.0	16.0	16.0		25.0	45.5		5.0	25.0	25.0
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0		4.0	5.0		4.0	5.0	5.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0		1.0	1.0		1.0	1.0	1.0
Lead/Lag							Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		2.0	4.5		2.0	4.5	4.5
Recall Mode	None	None	None	None	None		None	Max		None	Max	Max
Walk Time (s)	5.0	5.0	5.0					5.0			5.0	5.0
Flash Dont Walk (s)	19.0	19.0	19.0					20.0			12.0	12.0
Pedestrian Calls (#/hr)	0	0	0					0			0	0
Act Effct Green (s)		13.3	13.3		13.3		27.2	56.7		7.0	28.3	28.3
Actuated g/C Ratio		0.17	0.17		0.17		0.35	0.73		0.08	0.36	0.36
v/c Ratio		0.45	0.78		0.10		0.91	0.27		0.05	0.74	0.19
Control Delay		29.5	6.9		23.0		47.2	6.1		38.8	31.1	5.4
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	0.0
Total Delay		29.5	6.9		23.0		47.2	6.1		38.8	31.1	5.4
LOS		C	A		C		D	A		D	C	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		10.5			23.0			30.9			26.3	
Approach LOS		B			C			C			C	
90th %ile Green (s)	24.1	24.1	24.1	24.1	24.1		25.0	45.5		5.0	25.5	25.5
90th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	MaxR		Max	Hold	Hold
70th %ile Green (s)	13.7	13.7	13.7	13.7	13.7		25.0	55.0		0.0	25.0	25.0
70th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	MaxR	MaxR
50th %ile Green (s)	11.6	11.6	11.6	11.6	11.6		25.0	55.0		0.0	25.0	25.0
50th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	MaxR	MaxR
30th %ile Green (s)	8.5	8.5	8.5	8.5	8.5		25.0	55.0		0.0	25.0	25.0
30th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	MaxR	MaxR
10th %ile Green (s)	5.6	5.6	5.6	5.6	5.6		25.0	55.0		0.0	25.0	25.0
10th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	MaxR	MaxR

Intersection Summary

Area Type: Other
Cycle Length: 95.5
Actuated Cycle Length: 77.8
Natural Cycle: 90
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.91
Intersection Signal Delay: 23.4 Intersection LOS: C
Intersection Capacity Utilization 73.4% ICU Level of Service D
Analysis Period (min) 15
90th %ile Actuated Cycle: 89.6
70th %ile Actuated Cycle: 78.7
50th %ile Actuated Cycle: 76.6
30th %ile Actuated Cycle: 73.5
10th %ile Actuated Cycle: 70.6

Splits and Phases: 90: Napilihau Street & Honoapiilani Highway



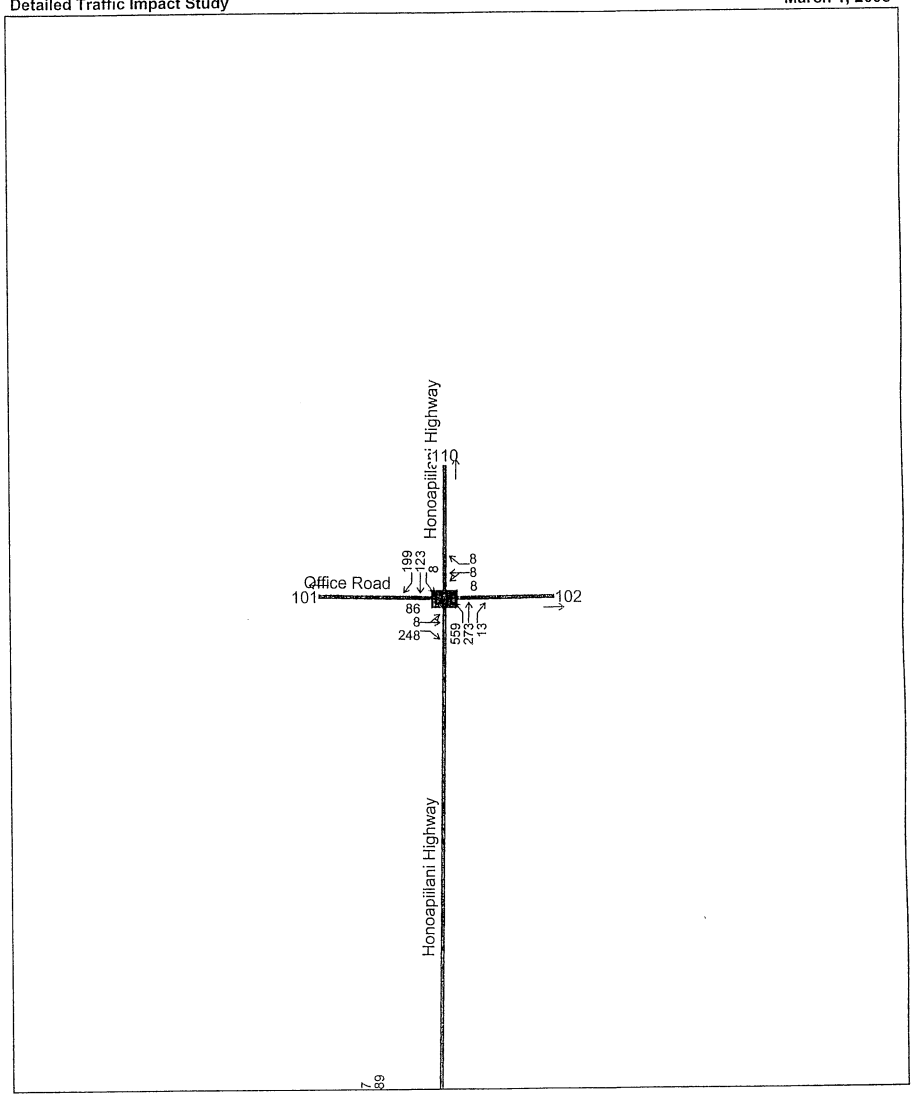
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		200	200		200
Storage Lanes	0		1	0		1	1		1	1		1
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850			0.850			0.850			0.850
Flt Protected		0.957			0.976		0.950			0.950		
Satd. Flow (prot)	0	1783	1583	0	1818	1583	1770	1863	1583	1770	1863	1583
Flt Permitted		0.957			0.976		0.950			0.950		
Satd. Flow (perm)	0	1783	1583	0	1818	1583	1770	1863	1583	1770	1863	1583
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		1268			1116			5035			1283	
Travel Time (s)		43.2			38.0			76.3			19.4	
Volume (vph)	120	14	691	10	10	14	426	266	14	10	318	120
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	133	16	768	11	11	16	473	296	16	11	353	133
Lane Group Flow (vph)	0	149	768	0	22	16	473	296	16	11	353	133
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 72.9% ICU Level of Service C
Analysis Period (min) 15

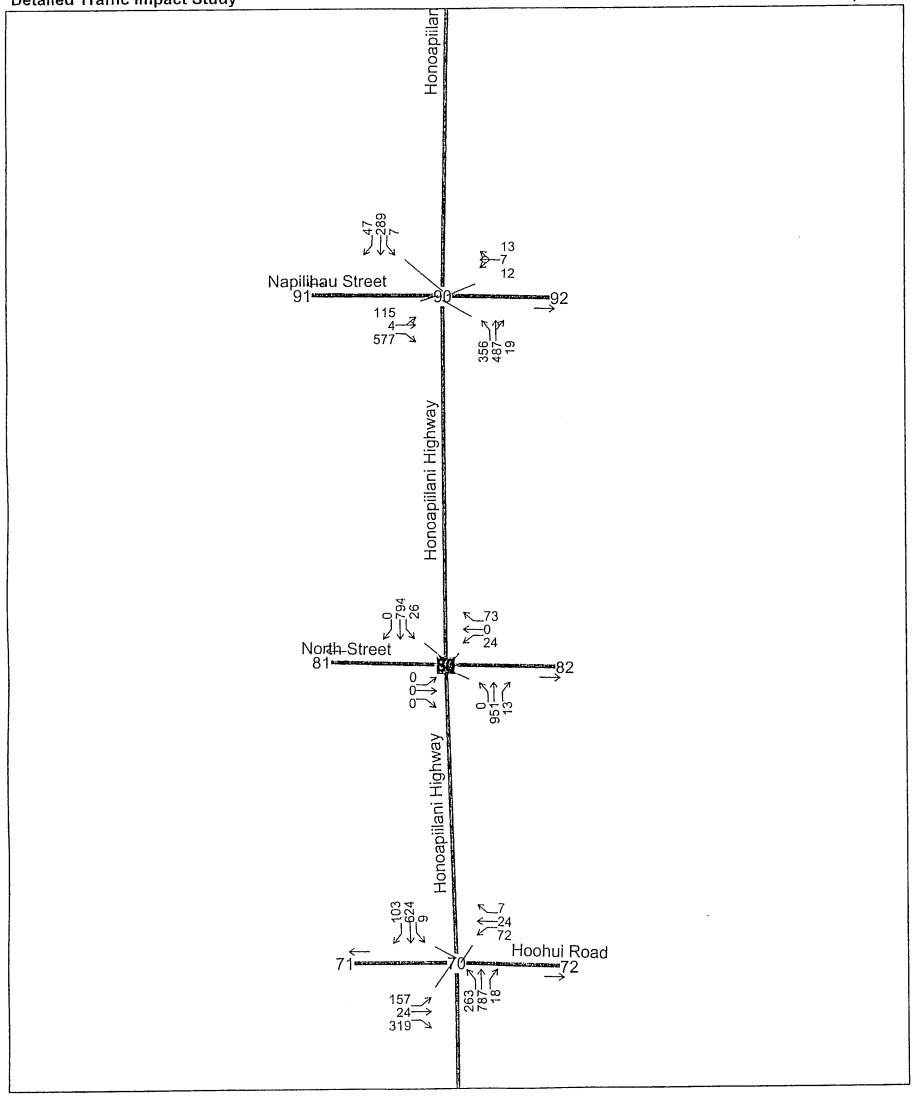
APPENDIX H

Honoapiilani Highway Arterial Level of Service Analysis 2011 AM Peak Hour with Akahele Signal, Future Projects with Pulelehua (SYNCHRO)



Arterial LOS Analysis
Detailed Traffic Impact Study

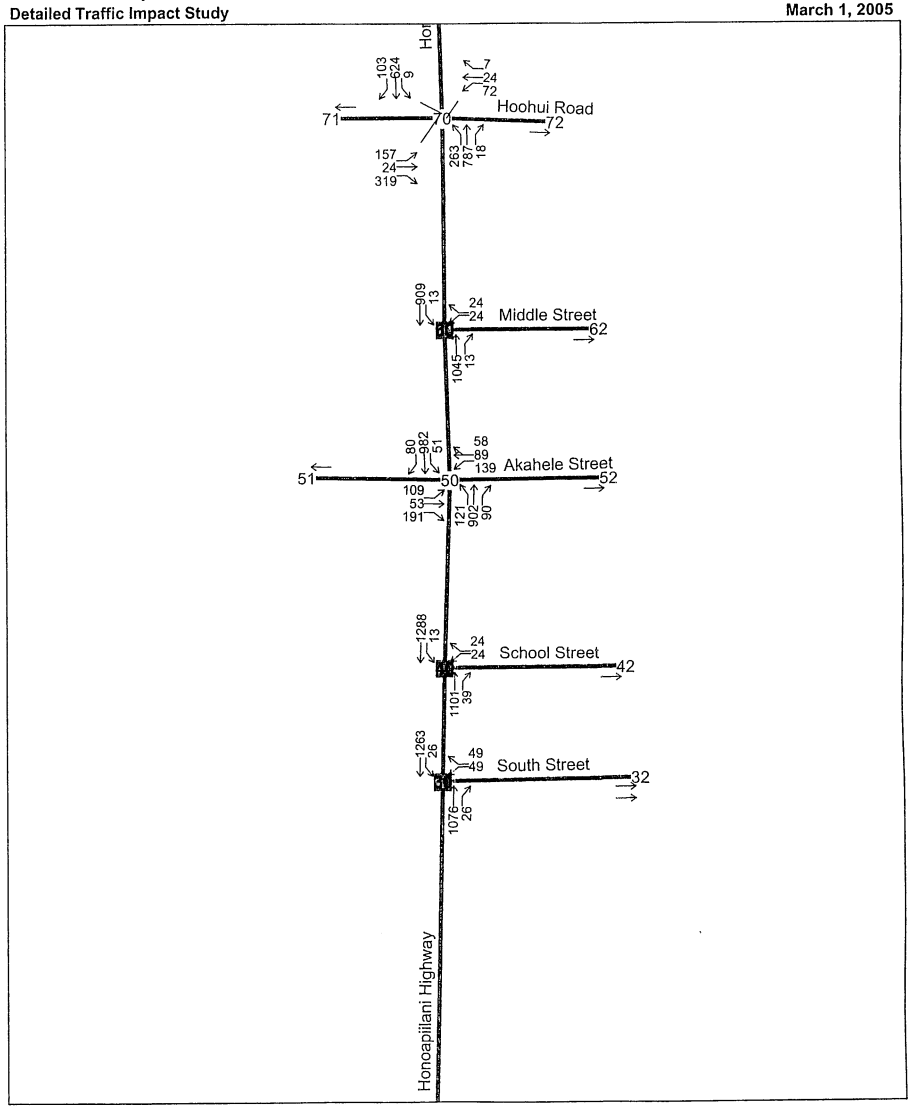
AM Pk Hr Future Projects w/Pulelehua and Signal 2011
March 1, 2005



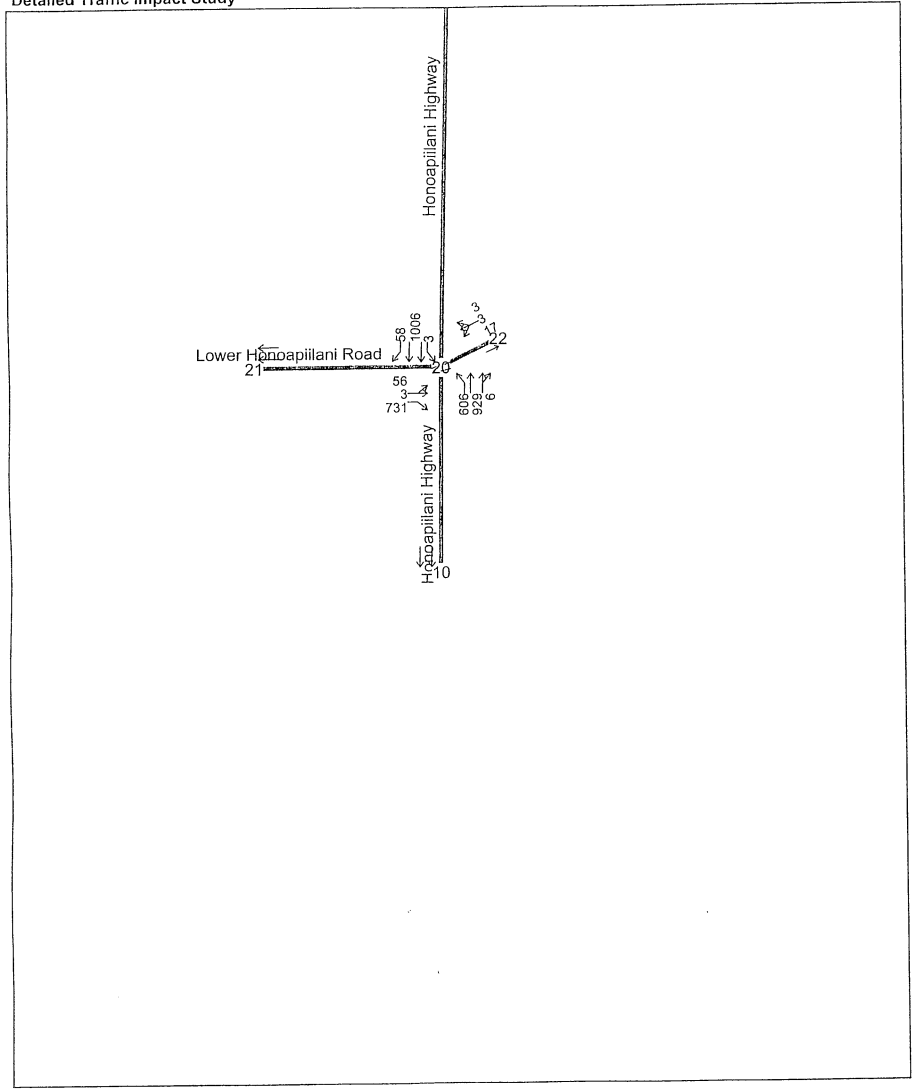
Hall Planning & Engineering, Inc.

Arterial LOS Analysis
Detailed Traffic Impact Study

AM Pk Hr Future Projects w/Pulelehua and Signal 2011
March 1, 2005



Hall Planning & Engineering, Inc.



Pulelehua

Arterial Level of Service: NB Honoapiilani Highway

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Lower Honoapiilani R	II	45	33.6	6.3	39.9	0.35	31.6	B
Akahele Street	II	45	103.9	32.6	136.5	1.30	34.2	B
Hoohui Road	II	45	49.1	11.8	60.9	0.61	36.3	A
Napilihau Street	II	45	90.7	9.6	100.3	1.13	40.7	A
Total	II		277.3	60.3	337.6	3.40	36.2	A

Arterial Level of Service: SB Honoapiilani Highway

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Napilihau Street	II	45	95.7	14.4	110.1	1.20	39.1	A
Hoohui Road	II	45	90.7	16.4	107.1	1.13	38.1	A
Akahele Street	II	45	49.1	48.8	97.9	0.61	22.6	C
Lower Honoapiilani R	II	45	103.9	45.4	149.3	1.30	31.3	B
Total	II		339.4	125.0	464.4	4.24	32.9	B

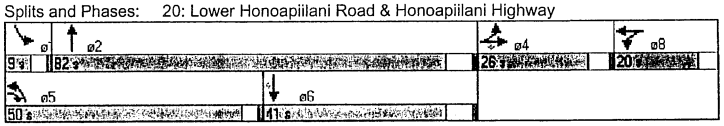
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	0		0	200		200	200		200
Storage Lanes	0		1	0		0	1		0	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	1.00
Frt			0.850		0.984			0.999				0.850
Flt Protected		0.954			0.963		0.950			0.950		
Satd. Flow (prot)	0	1777	1583	0	1765	0	1770	3536	0	1770	3539	1583
Flt Permitted		0.954			0.963		0.950			0.950		
Satd. Flow (perm)	0	1777	1583	0	1765	0	1770	3536	0	1770	3539	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			286		3			1				38
Headway 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
Link Speed (mph)		30			30			45			45	
Link Distance (ft)		1680			575			1848			4133	
Travel Time (s)		38.2			13.1			28.0			62.6	
Volume (vph)	56	3	731	17	3	3	606	929	6	3	1006	58
Peak Hour Factor	0.90	0.90	0.95	0.90	0.90	0.90	0.90	0.95	0.90	0.90	0.95	0.90
Adj. Flow (vph)	62	3	769	19	3	3	673	978	7	3	1059	64
Lane Group Flow (vph)	0	65	769	0	25	0	673	985	0	3	1059	64
Turn Type	Split		pm+ov	Split			Prot			Prot		Perm
Protected Phases	4	4	5	8	8		5	2		1	6	
Permitted Phases			4									6
Detector Phases	4	4	5	8	8		5	2		1	6	6
Minimum Initial (s)	5.0	5.0	3.0	5.0	5.0		3.0	15.0		3.0	15.0	15.0
Minimum Split (s)	26.0	26.0	9.0	20.0	20.0		9.0	36.0		9.0	36.0	36.0
Total Split (s)	26.0	26.0	50.0	20.0	20.0	0.0	50.0	82.0	0.0	9.0	41.0	41.0
Total Split (%)	19.0%	19.0%	36.5%	14.6%	14.6%	0.0%	36.5%	59.9%	0.0%	6.6%	29.9%	29.9%
Maximum Green (s)	21.0	21.0	46.0	16.0	16.0		46.0	76.0		5.0	35.0	35.0
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0		3.0	5.0		3.0	5.0	5.0
All-Red Time (s)	1.0	1.0	1.0	0.0	0.0		1.0	1.0		1.0	1.0	1.0
Lead/Lag			Lead				Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	4.0	4.0	2.0	4.0	4.0		2.0	5.0		2.0	5.0	5.0
Recall Mode	None	None	None	None	None		None	Max		None	Max	Max
Walk Time (s)	7.0	7.0						7.0			7.0	7.0
Flash Dont Walk (s)	14.0	14.0						16.0			23.0	23.0
Pedestrian Calls (#/hr)	0	0						0			0	0
Act Effct Green (s)		12.4	58.6		9.1		47.7	88.4		5.8	38.5	38.5
Actuated g/C Ratio		0.11	0.52		0.08		0.43	0.79		0.05	0.34	0.34
v/c Ratio		0.34	0.80		0.18		0.89	0.35		0.03	0.87	0.11
Control Delay		50.2	19.5		48.5		48.5	6.3		58.7	45.4	15.8
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	0.0
Total Delay		50.2	19.5		48.5		48.5	6.3		58.7	45.4	15.8
LOS		D	B		D		D	A		E	D	B

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		21.9			48.5			23.4			43.8	
Approach LOS		C			D			C			D	
90th %ile Green (s)	14.6	14.6	46.0	10.3	10.3		46.0	76.0		5.0	35.0	35.0
90th %ile Term Code	Gap	Gap	Max	Gap	Gap		Max	MaxR		Max	MaxR	MaxR
70th %ile Green (s)	12.3	12.3	46.0	8.9	8.9		46.0	85.0		0.0	35.0	35.0
70th %ile Term Code	Gap	Gap	Max	Gap	Gap		Max	Hold		Skip	MaxR	MaxR
50th %ile Green (s)	10.6	10.6	46.0	7.9	7.9		46.0	85.0		0.0	35.0	35.0
50th %ile Term Code	Gap	Gap	Max	Gap	Gap		Max	Hold		Skip	MaxR	MaxR
30th %ile Green (s)	8.7	8.7	46.0	0.0	0.0		46.0	85.0		0.0	35.0	35.0
30th %ile Term Code	Gap	Gap	Max	Skip	Skip		Max	Hold		Skip	MaxR	MaxR
10th %ile Green (s)	0.0	0.0	46.0	0.0	0.0		46.0	85.0		0.0	35.0	35.0
10th %ile Term Code	Skip	Skip	Max	Skip	Skip		Max	Hold		Skip	MaxR	MaxR

Intersection Summary

Area Type: Other
Cycle Length: 137
Actuated Cycle Length: 112.1
Natural Cycle: 155
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.89
Intersection Signal Delay: 29.5 Intersection LOS: C
Intersection Capacity Utilization 87.2% ICU Level of Service E
Analysis Period (min) 15
90th %ile Actuated Cycle: 124.9
70th %ile Actuated Cycle: 121.2
50th %ile Actuated Cycle: 118.5
30th %ile Actuated Cycle: 104.7
10th %ile Actuated Cycle: 91

Splits and Phases: 20: Lower Honoapiilani Road & Honoapiilani Highway



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125	0		200	200	
Storage Lanes	1	1		1	1	
Turning Speed (mph)	15	9		9	15	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)	30		45			45
Link Distance (ft)	1775		4133			1028
Travel Time (s)	40.3		62.6			15.6
Volume (vph)	49	49	1076	26	26	1263
Peak Hour Factor	0.90	0.90	0.95	0.90	0.90	0.95
Adj. Flow (vph)	54	54	1133	29	29	1329
Lane Group Flow (vph)	54	54	1133	29	29	1329
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 76.5% ICU Level of Service D
Analysis Period (min) 15

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200	0		200	200	
Storage Lanes	1	1		1	1	
Turning Speed (mph)	15	9		9	15	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)	30		45			45
Link Distance (ft)	1628		1028			1695
Travel Time (s)	37.0		15.6			25.7
Volume (vph)	24	24	1101	39	13	1288
Peak Hour Factor	0.90	0.90	0.95	0.90	0.90	0.95
Adj. Flow (vph)	27	27	1159	43	14	1356
Lane Group Flow (vph)	27	27	1159	43	14	1356
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 77.8% ICU Level of Service D
Analysis Period (min) 15

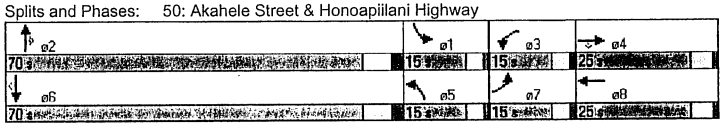
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	300		300	300		300	800		800	800		800
Storage Lanes	1		1	1		0	1		1	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50		50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0	0	0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850		0.941				0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1863	1583	1770	1753	0	1770	1863	1583	1770	1863	1583
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	1770	1863	1583	1770	1753	0	1770	1863	1583	1770	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			201		23				100			84
Headway 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
Link Speed (mph)		30			30			45			45	
Link Distance (ft)		1291			1428			1695			1353	
Travel Time (s)		29.3			32.5			25.7			20.5	
Volume (vph)	109	53	191	139	89	58	121	902	90	51	982	80
Peak Hour Factor	0.95	0.95	0.95	0.90	0.90	0.90	0.95	0.95	0.90	0.90	0.95	0.95
Adj. Flow (vph)	115	56	201	154	99	64	127	949	100	57	1034	84
Lane Group Flow (vph)	115	56	201	154	163	0	127	949	100	57	1034	84
Turn Type	Prot		Perm	Prot			Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4						2			6
Detector Phases	7	4	4	3	8		5	2	2	1	6	6
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0		5.0	15.0	15.0	5.0	15.0	15.0
Minimum Split (s)	9.0	23.0	23.0	9.0	20.0		10.0	25.0	25.0	10.0	35.0	35.0
Total Split (s)	15.0	25.0	25.0	15.0	25.0	0.0	15.0	70.0	70.0	15.0	70.0	70.0
Total Split (%)	12.0%	20.0%	20.0%	12.0%	20.0%	0.0%	12.0%	56.0%	56.0%	12.0%	56.0%	56.0%
Maximum Green (s)	11.0	20.0	20.0	11.0	20.0		11.0	63.0	63.0	11.0	63.0	63.0
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0		3.0	5.0	5.0	3.0	5.0	5.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0		1.0	2.0	2.0	1.0	2.0	2.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lag	Lead	Lead	Lag	Lead	Lead
Lead-Lag Optimize?												
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0		2.0	5.0	5.0	2.0	5.0	5.0
Recall Mode	None	None	None	None	None		None	Max	Max	None	Max	Max
Walk Time (s)		5.0	5.0					7.0	7.0		7.0	7.0
Flash Dont Walk (s)		13.0	13.0					11.0	11.0		21.0	21.0
Pedestrian Calls (#/hr)		0	0					0	0		0	0
Act Effct Green (s)	11.0	15.6	15.6	12.0	16.6		11.3	69.7	69.7	10.8	67.2	67.2
Actuated g/C Ratio	0.09	0.13	0.13	0.10	0.14		0.10	0.59	0.59	0.09	0.57	0.57
v/c Ratio	0.70	0.23	0.52	0.86	0.61		0.75	0.86	0.10	0.36	0.98	0.09
Control Delay	70.1	46.4	9.6	91.5	46.3		74.8	32.6	2.9	56.9	48.8	3.1
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	70.1	46.4	9.6	91.5	46.3		74.8	32.6	2.9	56.9	48.8	3.1
LOS	E	D	A	F	D		E	C	A	E	D	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		33.8			68.2			34.6			46.0	
Approach LOS		C			E			C			D	
90th %ile Green (s)	11.0	20.0	20.0	11.0	20.0		11.0	63.0	63.0	11.0	63.0	63.0
90th %ile Term Code	Max	Hold	Hold	Max	Max		Max	MaxR	MaxR	Max	MaxR	MaxR
70th %ile Green (s)	11.0	17.6	17.6	11.0	17.6		11.0	63.0	63.0	11.0	63.0	63.0
70th %ile Term Code	Max	Hold	Hold	Max	Gap		Max	MaxR	MaxR	Hold	MaxR	MaxR
50th %ile Green (s)	11.0	14.9	14.9	11.0	14.9		11.0	63.0	63.0	11.0	63.0	63.0
50th %ile Term Code	Max	Hold	Hold	Max	Gap		Max	MaxR	MaxR	Hold	MaxR	MaxR
30th %ile Green (s)	10.2	11.4	11.4	11.0	12.2		11.0	63.0	63.0	11.0	63.0	63.0
30th %ile Term Code	Gap	Hold	Hold	Max	Gap		Max	MaxR	MaxR	Hold	MaxR	MaxR
10th %ile Green (s)	6.9	5.5	5.5	10.7	9.3		7.6	74.6	74.6	0.0	63.0	63.0
10th %ile Term Code	Gap	Gap	Gap	Gap	Hold		Gap	Hold	Hold	Skip	MaxR	MaxR

Intersection Summary

Area Type: Other
Cycle Length: 125
Actuated Cycle Length: 118.1
Natural Cycle: 110
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.98
Intersection Signal Delay: 42.4 — Intersection LOS: D
Intersection Capacity Utilization 86.0% — ICU Level of Service E
Analysis Period (min) 15
90th %ile Actuated Cycle: 125
70th %ile Actuated Cycle: 122.6
50th %ile Actuated Cycle: 119.9
30th %ile Actuated Cycle: 116.4
10th %ile Actuated Cycle: 106.8

Splits and Phases: 50: Akahele Street & Honoapiilani Highway



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200	0		200	200	
Storage Lanes	1	1		1	1	
Turning Speed (mph)	15	9		9	15	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)	20		45			45
Link Distance (ft)	1386		1353			1890
Travel Time (s)	47.3		20.5			28.6
Volume (vph)	24	24	1045	13	13	909
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	27	27	1161	14	14	1010
Lane Group Flow (vph)	27	27	1161	14	14	1010
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 65.0% ICU Level of Service C
Analysis Period (min) 15

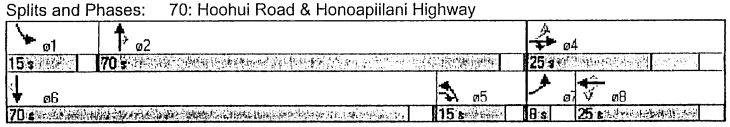
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		200	200		200
Storage Lanes	1		1	1		1	1			1	1	1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50	50	50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.651			0.740			0.950			0.950		
Satd. Flow (perm)	1213	1863	1583	1378	1863	1583	1770	1863	1583	1770	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			222			8			15			105
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		998			1017			1890			2672	
Travel Time (s)		34.0			34.7			28.6			40.5	
Volume (vph)	157	24	319	72	24	7	263	787	18	9	624	103
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	174	27	354	80	27	8	292	874	20	10	693	114
Lane Group Flow (vph)	174	27	354	80	27	8	292	874	20	10	693	114
Turn Type	pm+pt		pt+ov	Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4	4 5		8		5	2		1	6	
Permitted Phases	4			8		8			2			6
Detector Phases	7	4	4 5	8	8	8	5	2	2	1	6	6
Minimum Initial (s)	4.0	5.0		5.0	5.0	5.0	5.0	15.0	15.0	5.0	15.0	15.0
Minimum Split (s)	8.0	24.5		20.0	20.0	20.0	10.0	21.0	21.0	10.0	21.0	21.0
Total Split (s)	8.0	25.0	40.0	25.0	25.0	25.0	15.0	70.0	70.0	15.0	70.0	70.0
Total Split (%)	6.8%	21.2%	33.9%	21.2%	21.2%	21.2%	12.7%	59.3%	59.3%	12.7%	59.3%	59.3%
Maximum Green (s)	4.0	20.5		20.5	20.5	20.5	11.5	65.5	65.5	11.5	65.5	65.5
Yellow Time (s)	4.0	4.0		4.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	0.0	0.5		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lead/Lag	Lead			Lag	Lag	Lag	Lag	Lag	Lag	Lead	Lead	Lead
Lead-Lag Optimize?				Yes	Yes	Yes						
Vehicle Extension (s)	3.0	4.0		4.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
Recall Mode	None	None		None	None	None	None	Min	Min	None	Max	Max
Act Effct Green (s)	20.1	20.1	35.1	14.0	14.0	14.0	12.0	80.3	80.3	6.7	67.3	67.3
Actuated g/C Ratio	0.19	0.19	0.32	0.13	0.13	0.13	0.11	0.74	0.74	0.06	0.62	0.62
v/c Ratio	0.69	0.08	0.53	0.46	0.11	0.04	1.48	0.63	0.02	0.10	0.60	0.11
Control Delay	54.3	35.4	12.6	47.7	42.2	22.0	278.2	11.8	3.8	53.2	16.4	2.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.3	35.4	12.6	47.7	42.2	22.0	278.2	11.8	3.8	53.2	16.4	2.7
LOS	D	D	B	D	D	C	F	B	A	D	B	A
Approach Delay		26.8			44.6			77.3			14.9	
Approach LOS		C			D			E			B	
90th %ile Green (s)	4.0	26.1		18.1	18.1	18.1	11.5	69.5	69.5	7.5	65.5	65.5

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
90th %ile Term Code	Max	Hold		Gap	Gap	Gap	Max	Hold	Hold	Gap	MaxR	MaxR
70th %ile Green (s)	4.0	22.9		14.9	14.9	14.9	11.5	80.5	80.5	0.0	65.5	65.5
70th %ile Term Code	Max	Hold		Gap	Gap	Gap	Max	Hold	Hold	Skip	MaxR	MaxR
50th %ile Green (s)	4.0	20.6		12.6	12.6	12.6	11.5	80.5	80.5	0.0	65.5	65.5
50th %ile Term Code	Max	Hold		Gap	Gap	Gap	Max	Hold	Hold	Skip	MaxR	MaxR
30th %ile Green (s)	4.0	18.5		10.5	10.5	10.5	11.5	80.5	80.5	0.0	65.5	65.5
30th %ile Term Code	Max	Hold		Gap	Gap	Gap	Max	Hold	Hold	Skip	MaxR	MaxR
10th %ile Green (s)	7.0	6.5		0.0	0.0	0.0	11.5	80.5	80.5	0.0	65.5	65.5
10th %ile Term Code	Hold	Gap		Skip	Skip	Skip	Max	Hold	Hold	Skip	MaxR	MaxR

Intersection Summary

Area Type: Other
Cycle Length: 118
Actuated Cycle Length: 108.4
Natural Cycle: 90
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 1.48
Intersection Signal Delay: 46.3 Intersection LOS: D
Intersection Capacity Utilization 72.8% ICU Level of Service C
Analysis Period (min) 15
90th %ile Actuated Cycle: 115.6
70th %ile Actuated Cycle: 112.4
50th %ile Actuated Cycle: 110.1
30th %ile Actuated Cycle: 108
10th %ile Actuated Cycle: 96

Splits and Phases: 70: Hoohui Road & Honoapiilani Highway



Lane Group	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
Storage Length (ft)	125		125	125		125	200		200	200		200
Storage Lanes	1		1	1		1	1		1	1		1
Turning Speed (mph)	15		9	15		9	15		9	15		9
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						0.850			0.850			
Flt Protected				0.950						0.950		
Satd. Flow (prot)	1863	1863	1863	1770	1863	1583	1863	1863	1583	1770	1863	1863
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	1863	1863	1863	1770	1863	1583	1863	1863	1583	1770	1863	1863
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		1111			1074			2672			3312	
Travel Time (s)		37.9			36.6			40.5			50.2	
Volume (vph)	0	0	0	24	0	73	0	951	13	26	794	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.92	0.95	0.90	0.90	0.95	0.90
Adj. Flow (vph)	0	0	0	27	0	81	0	1001	14	29	836	0
Lane Group Flow (vph)	0	0	0	27	0	81	0	1001	14	29	836	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 61.2% ICU Level of Service B
Analysis Period (min) 15

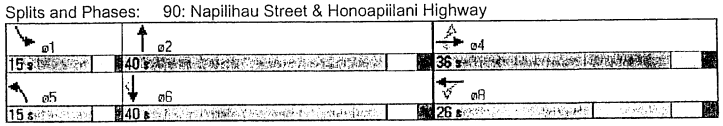
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		125	200		200
Storage Lanes	0		1	0		0	1		0	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850		0.946			0.994				0.850
Flt Protected		0.954			0.982		0.950			0.950		
Satd. Flow (prot)	0	1777	1583	0	1730	0	1770	1852	0	1770	1863	1583
Flt Permitted		0.724			0.911		0.950			0.950		
Satd. Flow (perm)	0	1349	1583	0	1605	0	1770	1852	0	1770	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			581		14			3				52
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		1254			1054			3312			5035	
Travel Time (s)		42.8			35.9			50.2			76.3	
Volume (vph)	115	4	577	12	7	13	356	487	19	7	289	47
Peak Hour Factor	0.90	0.90	0.95	0.90	0.90	0.90	0.95	0.95	0.90	0.90	0.95	0.90
Adj. Flow (vph)	128	4	607	13	8	14	375	513	21	8	304	52
Lane Group Flow (vph)	0	132	607	0	35	0	375	534	0	8	304	52
Turn Type	Perm		Perm	Perm			Prot			Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8								6
Detector Phases	4	4	4	8	8		5	2		1	6	6
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0		5.0	15.0		5.0	15.0	15.0
Minimum Split (s)	36.0	36.0	36.0	20.0	20.0		10.0	31.0		10.0	23.0	23.0
Total Split (s)	36.0	36.0	36.0	26.0	26.0	0.0	15.0	40.0	0.0	15.0	40.0	40.0
Total Split (%)	39.6%	39.6%	39.6%	28.6%	28.6%	0.0%	16.5%	44.0%	0.0%	16.5%	44.0%	44.0%
Maximum Green (s)	30.0	30.0	30.0	20.0	20.0		11.0	34.0		11.0	34.0	34.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		3.0	4.0		3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		1.0	2.0		1.0	2.0	2.0
Lead/Lag							Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		4.5	4.5		2.0	4.5	4.5
Recall Mode	None	None	None	None	None		None	Max		None	Max	Max
Walk Time (s)	5.0	5.0	5.0					5.0			5.0	5.0
Flash Dont Walk (s)	19.0	19.0	19.0					20.0			12.0	12.0
Pedestrian Calls (#/hr)	0	0	0					0			0	0
Act Effct Green (s)		17.0	17.0		17.0		12.1	50.7		6.2	37.3	37.3
Actuated g/C Ratio		0.23	0.23		0.23		0.16	0.67		0.07	0.49	0.49
v/c Ratio		0.43	0.75		0.09		1.32	0.43		0.06	0.33	0.06
Control Delay		25.7	6.4		15.2		197.5	9.6		37.7	14.4	4.6
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	0.0
Total Delay		25.7	6.4		15.2		197.5	9.6		37.7	14.4	4.6
LOS		C	A		B		F	A		D	B	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		9.8			15.2			87.1			13.5	
Approach LOS		A			B			F			B	
90th %ile Green (s)	26.8	26.8	26.8	26.8	26.8		11.0	39.1		5.9	34.0	34.0
90th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Gap	MaxR	MaxR
70th %ile Green (s)	16.3	16.3	16.3	16.3	16.3		11.0	49.0		0.0	34.0	34.0
70th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	MaxR	MaxR
50th %ile Green (s)	12.8	12.8	12.8	12.8	12.8		11.0	49.0		0.0	34.0	34.0
50th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	MaxR	MaxR
30th %ile Green (s)	10.4	10.4	10.4	10.4	10.4		11.0	49.0		0.0	34.0	34.0
30th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	MaxR	MaxR
10th %ile Green (s)	6.1	6.1	6.1	6.1	6.1		11.0	49.0		0.0	34.0	34.0
10th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	MaxR	MaxR

Intersection Summary

Area Type: Other
Cycle Length: 91
Actuated Cycle Length: 75.5
Natural Cycle: 80
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 1.32
Intersection Signal Delay: 44.9 Intersection LOS: D
Intersection Capacity Utilization 65.1% ICU Level of Service C
Analysis Period (min) 15
90th %ile Actuated Cycle: 87.8
70th %ile Actuated Cycle: 77.3
50th %ile Actuated Cycle: 73.8
30th %ile Actuated Cycle: 71.4
10th %ile Actuated Cycle: 67.1

Splits and Phases: 90: Napilihau Street & Honoapiilani Highway



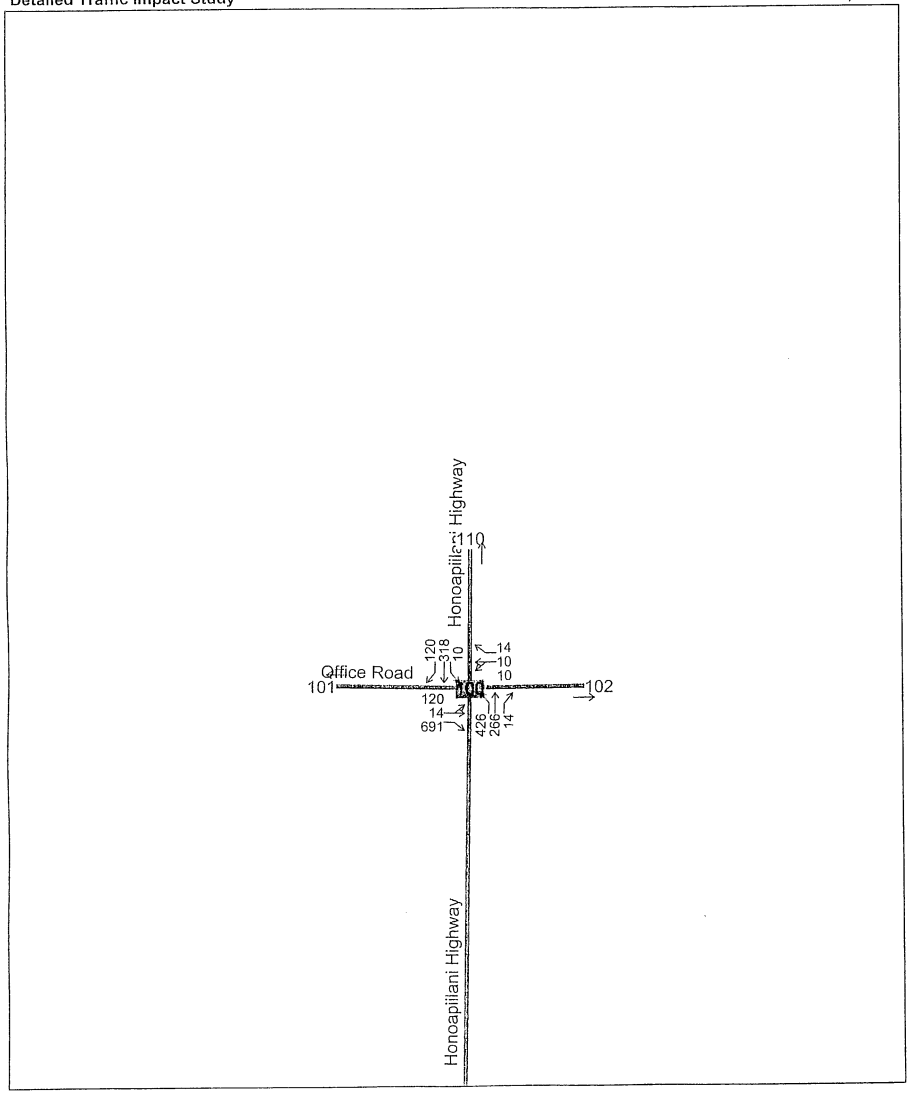
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		200	200		200
Storage Lanes	0		1	0		1	1		1	1		1
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850			0.850			0.850			0.850
Flt Protected		0.956			0.976		0.950			0.950		
Satd. Flow (prot)	0	1781	1583	0	1818	1583	1770	1863	1583	1770	1863	1583
Flt Permitted		0.956			0.976		0.950			0.950		
Satd. Flow (perm)	0	1781	1583	0	1818	1583	1770	1863	1583	1770	1863	1583
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		1268			1116			5035			1283	
Travel Time (s)		43.2			38.0			76.3			19.4	
Volume (vph)	86	8	248	8	8	8	559	273	13	8	123	199
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	96	9	276	9	9	9	621	303	14	9	137	221
Lane Group Flow (vph)	0	105	276	0	18	9	621	303	14	9	137	221
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

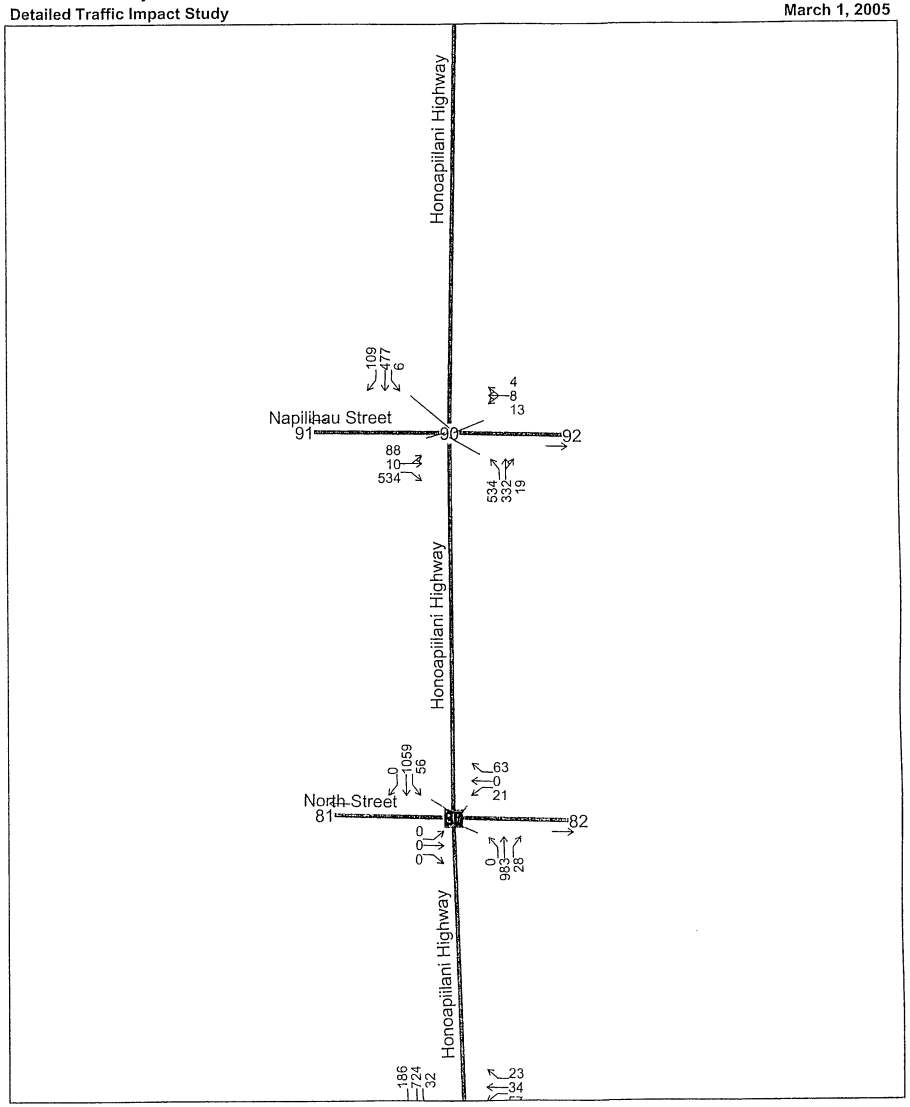
Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 59.3% ICU Level of Service B
Analysis Period (min) 15

APPENDIX I

Honoapiilani Highway Arterial Level of Service Analysis 2011 PM Peak Hour with Akahele Signal, Future Projects with Pulelehua (SYNCHRO)



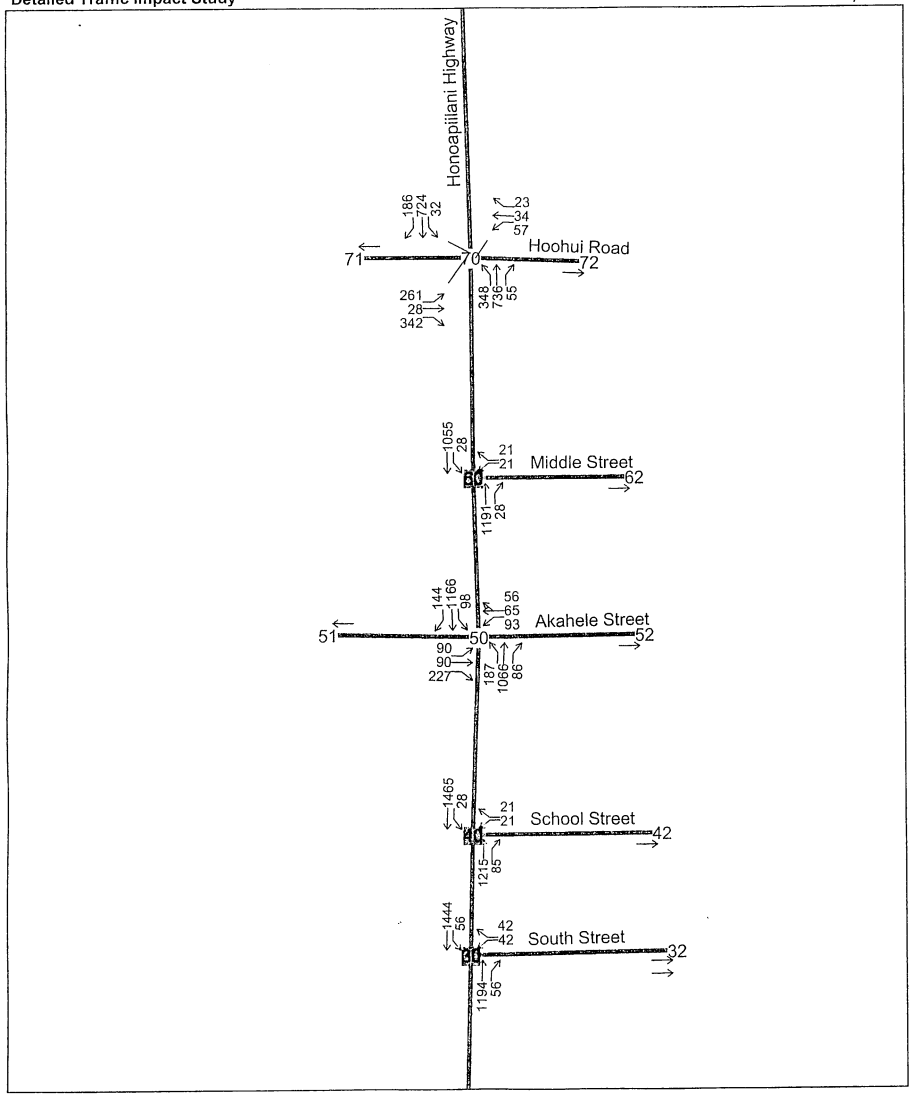
Arterial LOS Analysis
Detailed Traffic Impact Study
PM Pk Hr Future Projects w/Pulelehua and Signal 2011
March 1, 2005



Hall Planning & Engineering, Inc.

Arterial LOS Analysis
Detailed Traffic Impact Study

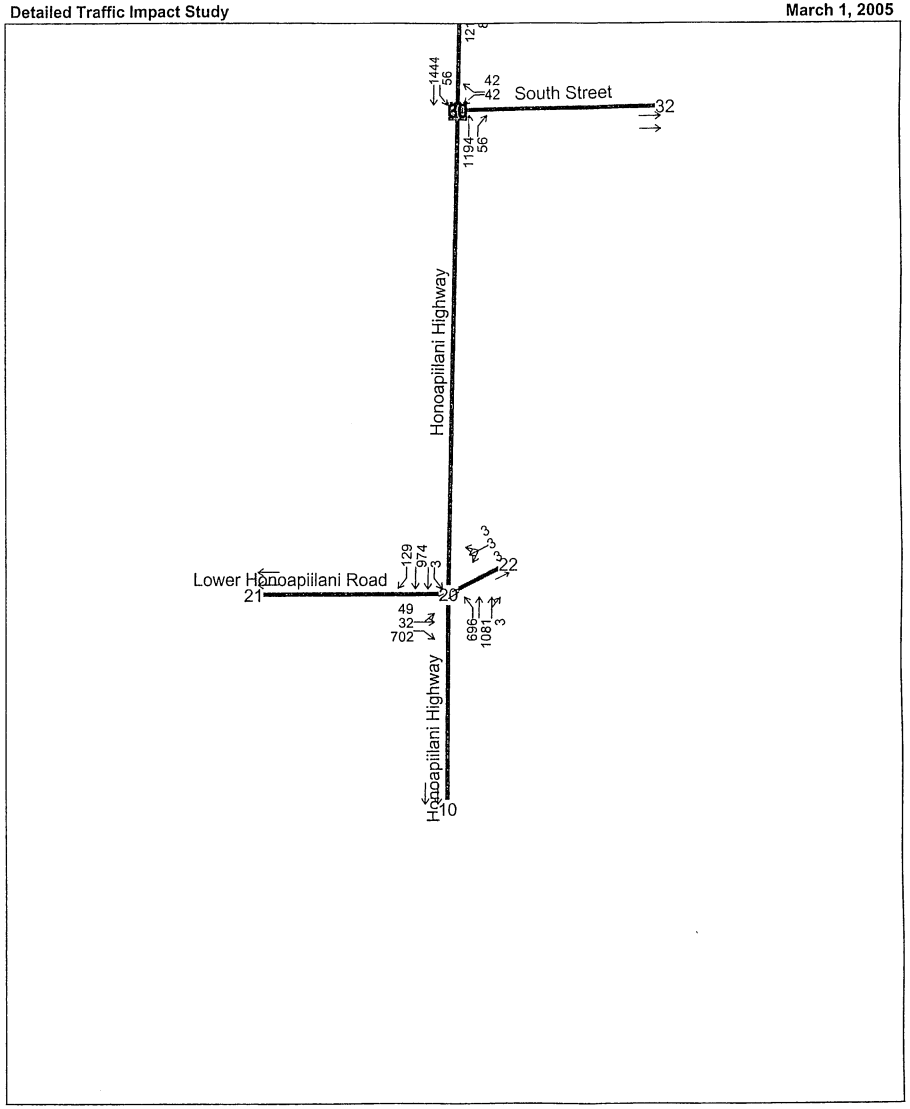
PM Pk Hr Future Projects w/Pulelehua and Signal 2011
March 1, 2005



Hall Planning & Engineering, Inc.

Arterial LOS Analysis
Detailed Traffic Impact Study

PM Pk Hr Future Projects w/Pulelehua and Signal 2011
March 1, 2005



Hall Planning & Engineering, Inc.

Arterial Level of Service: NB Honoapiilani Highway

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Lower Honoapiilani R	II	45	33.6	4.0	37.6	0.35	33.5	B
Akahele Street	II	45	103.9	29.6	133.5	1.30	35.0	A
Hoohui Road	II	45	49.1	17.4	66.5	0.61	33.3	B
Napilihau Street	II	45	90.7	8.8	99.5	1.13	41.0	A
Total	II		277.3	59.8	337.1	3.40	36.3	A

Arterial Level of Service: SB Honoapiilani Highway

Cross Street	Arterial Class	Flow Speed	Running Time	Signal Delay	Travel Time (s)	Dist (mi)	Arterial Speed	Arterial LOS
Napilihau Street	II	45	95.7	18.7	114.4	1.20	37.7	A
Hoohui Road	II	45	90.7	24.4	115.1	1.13	35.4	A
Akahele Street	II	45	49.1	67.2	116.3	0.61	19.0	D
Lower Honoapiilani R	II	45	103.9	35.8	139.7	1.30	33.5	B
Total	II		339.4	146.1	485.5	4.24	31.5	B

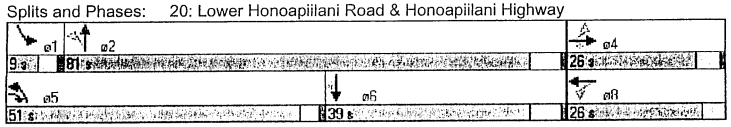
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	0		0	200		200	200		200
Storage Lanes	0		1	0		0	1		0	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00	0.95	1.00
Frt			0.850		0.955							0.850
Flt Protected		0.971			0.984		0.950			0.950		
Satd. Flow (prot)	0	1809	1583	0	1750	0	1770	3539	0	1770	3539	1583
Flt Permitted		0.837			0.949		0.103			0.950		
Satd. Flow (perm)	0	1559	1583	0	1688	0	192	3539	0	1770	3539	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			12		3							107
Headway 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
Link Speed (mph)		30			30			45			45	
Link Distance (ft)		1680			575			1848			4133	
Travel Time (s)		38.2			13.1			28.0			62.6	
Volume (vph)	49	32	702	3	3	3	696	1081	3	3	974	129
Peak Hour Factor	0.90	0.90	0.95	0.90	0.90	0.90	0.90	0.95	0.90	0.90	0.95	0.90
Adj. Flow (vph)	54	36	739	3	3	3	773	1138	3	3	1025	143
Lane Group Flow (vph)	0	90	739	0	9	0	773	1141	0	3	1025	143
Turn Type	Perm		pm+ov	Perm			pm+pt			Prot		Perm
Protected Phases		4	5		8		5	2		1	6	
Permitted Phases	4		4	8			2					6
Detector Phases	4	4	5	8	8		5	2		1	6	6
Minimum Initial (s)	5.0	5.0	3.0	5.0	5.0		3.0	15.0		3.0	15.0	15.0
Minimum Split (s)	26.0	26.0	9.0	20.0	20.0		9.0	29.0		9.0	36.0	36.0
Total Split (s)	26.0	26.0	51.0	26.0	26.0	0.0	51.0	81.0	0.0	9.0	39.0	39.0
Total Split (%)	22.4%	22.4%	44.0%	22.4%	22.4%	0.0%	44.0%	69.8%	0.0%	7.8%	33.6%	33.6%
Maximum Green (s)	21.0	21.0	47.0	22.0	22.0		47.0	75.0		5.0	33.0	33.0
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0		3.0	5.0		3.0	5.0	5.0
All-Red Time (s)	1.0	1.0	1.0	0.0	0.0		1.0	1.0		1.0	1.0	1.0
Lead/Lag			Lead				Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	3.0	3.0	2.0	3.0	3.0		2.0	5.0		2.0	5.0	5.0
Recall Mode	None	None	None	None	None		None	Max		None	Max	Max
Walk Time (s)	7.0	7.0						7.0			7.0	7.0
Flash Dont Walk (s)	14.0	14.0						16.0			23.0	23.0
Pedestrian Calls (#/hr)	0	0						0			0	0
Act Effct Green (s)		13.2	57.8		12.8		85.9	85.0		5.7	38.5	38.5
Actuated g/C Ratio		0.13	0.56		0.12		0.84	0.83		0.05	0.38	0.38
v/c Ratio		0.46	0.82		0.04		0.91	0.39		0.03	0.77	0.22
Control Delay		45.3	24.0		33.8		35.6	4.0		52.0	35.8	9.5
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	0.0
Total Delay		45.3	24.0		33.8		35.6	4.0		52.0	35.8	9.5
LOS		D	C		C		D	A		D	D	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		26.3			33.8			16.8			32.6	
Approach LOS		C			C			B			C	
90th %ile Green (s)	16.5	16.5	47.0	17.5	17.5		47.0	75.0		5.0	33.0	33.0
90th %ile Term Code	Gap	Gap	Max	Hold	Hold		Max	MaxR		Max	MaxR	MaxR
70th %ile Green (s)	13.5	13.5	47.0	14.5	14.5		47.0	84.0		0.0	33.0	33.0
70th %ile Term Code	Gap	Gap	Max	Hold	Hold		Max	Hold		Skip	MaxR	MaxR
50th %ile Green (s)	11.4	11.4	47.0	12.4	12.4		47.0	84.0		0.0	33.0	33.0
50th %ile Term Code	Gap	Gap	Max	Hold	Hold		Max	Hold		Skip	MaxR	MaxR
30th %ile Green (s)	9.4	9.4	47.0	10.4	10.4		47.0	84.0		0.0	33.0	33.0
30th %ile Term Code	Gap	Gap	Max	Hold	Hold		Max	Hold		Skip	MaxR	MaxR
10th %ile Green (s)	0.0	0.0	30.2	0.0	0.0		30.2	75.0		0.0	40.8	40.8
10th %ile Term Code	Skip	Skip	Gap	Skip	Skip		Gap	MaxR		Skip	Hold	Hold

Intersection Summary

Area Type: Other
Cycle Length: 116
Actuated Cycle Length: 102.4
Natural Cycle: 100
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.91
Intersection Signal Delay: 23.6 Intersection LOS: C
Intersection Capacity Utilization 84.6% ICU Level of Service E
Analysis Period (min) 15
90th %ile Actuated Cycle: 111.5
70th %ile Actuated Cycle: 108.5
50th %ile Actuated Cycle: 106.4
30th %ile Actuated Cycle: 104.4
10th %ile Actuated Cycle: 81

Splits and Phases: 20: Lower Honoapiilani Road & Honoapiilani Highway



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125	0		200	200	
Storage Lanes	1	1		1	1	
Turning Speed (mph)	15	9		9	15	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)	30		45			45
Link Distance (ft)	1775		4133			1028
Travel Time (s)	40.3		62.6			15.6
Volume (vph)	42	42	1194	56	56	1444
Peak Hour Factor	0.90	0.90	0.95	0.90	0.90	0.95
Adj. Flow (vph)	47	47	1257	62	62	1520
Lane Group Flow (vph)	47	47	1257	62	62	1520
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 86.0% ICU Level of Service E
Analysis Period (min) 15

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200	0		200	200	
Storage Lanes	1	1		1	1	
Turning Speed (mph)	15	9		9	15	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)	30		45			45
Link Distance (ft)	1628		1028			1695
Travel Time (s)	37.0		15.6			25.7
Volume (vph)	21	21	1215	85	28	1465
Peak Hour Factor	0.90	0.90	0.95	0.90	0.90	0.95
Adj. Flow (vph)	23	23	1279	94	31	1542
Lane Group Flow (vph)	23	23	1279	94	31	1542
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 87.1% ICU Level of Service E
Analysis Period (min) 15

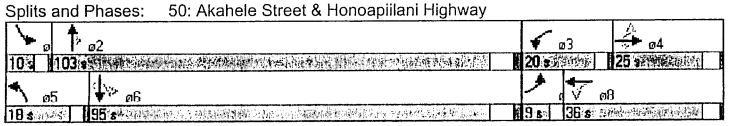
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	300		300	300		300	800		800	800		800
Storage Lanes	1		1	1		0	1		1	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50		50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0	0	0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850		0.931				0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1863	1583	1770	1734	0	1770	1863	1583	1770	1863	1583
Flt Permitted	0.671			0.485			0.950			0.043		
Satd. Flow (perm)	1250	1863	1583	903	1734	0	1770	1863	1583	80	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			213		25				96			152
Headway 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
Link Speed (mph)		30			30			45			45	
Link Distance (ft)		1291			1428			1695			1353	
Travel Time (s)		29.3			32.5			25.7			20.5	
Volume (vph)	90	90	227	93	65	56	187	1066	86	98	1166	144
Peak Hour Factor	0.95	0.95	0.95	0.90	0.90	0.90	0.95	0.95	0.90	0.90	0.95	0.95
Adj. Flow (vph)	95	95	239	103	72	62	197	1122	96	109	1227	152
Lane Group Flow (vph)	95	95	239	103	134	0	197	1122	96	109	1227	152
Turn Type	pm+pt		Perm	pm+pt			Prot		Perm	pm+pt		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases	4		4	8					2	6		6
Detector Phases	7	4	4	3	8		5	2	2	1	6	6
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0		5.0	10.0	10.0	5.0	15.0	15.0
Minimum Split (s)	9.0	25.0	25.0	20.0	20.0		10.0	25.0	25.0	10.0	35.0	35.0
Total Split (s)	9.0	25.0	25.0	20.0	36.0	0.0	18.0	103.0	103.0	10.0	95.0	95.0
Total Split (%)	5.7%	15.8%	15.8%	12.7%	22.8%	0.0%	11.4%	65.2%	65.2%	6.3%	60.1%	60.1%
Maximum Green (s)	6.0	20.0	20.0	16.0	31.0		14.0	96.0	96.0	6.0	88.0	88.0
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0		3.0	5.0	5.0	3.0	5.0	5.0
All-Red Time (s)	0.0	1.0	1.0	1.0	1.0		1.0	2.0	2.0	1.0	2.0	2.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0		2.0	5.0	5.0	2.0	5.0	5.0
Recall Mode	None	None	None	None	None		None	Max	Max	None	Max	Max
Walk Time (s)		7.0	7.0					7.0	7.0		7.0	7.0
Flash Dont Walk (s)		13.0	13.0					11.0	11.0		21.0	21.0
Pedestrian Calls (#/hr)		0	0					0	0		0	0
Act Effct Green (s)	20.9	14.9	14.9	30.1	21.3		15.0	100.2	100.2	99.2	92.2	92.2
Actuated g/C Ratio	0.14	0.10	0.10	0.21	0.15		0.10	0.68	0.68	0.68	0.63	0.63
v/c Ratio	0.48	0.50	0.68	0.40	0.49		1.09	0.88	0.09	0.81	1.05	0.14
Control Delay	59.3	66.6	17.3	52.0	48.4		151.0	29.6	2.0	71.1	67.2	2.2
Queue Delay	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	59.3	66.6	17.3	52.0	48.4		151.0	29.6	2.0	71.1	67.2	2.2
LOS	E	E	B	D	D		F	C	A	E	E	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		37.5			50.0			44.6			60.8	
Approach LOS		D			D			D			E	
90th %ile Green (s)	6.0	19.1	19.1	16.0	30.1		14.0	96.0	96.0	6.0	88.0	88.0
90th %ile Term Code	Max	Gap	Gap	Max	Hold		Max	MaxR	MaxR	Max	MaxR	MaxR
70th %ile Green (s)	6.0	15.0	15.0	13.6	23.6		14.0	96.0	96.0	6.0	88.0	88.0
70th %ile Term Code	Max	Gap	Gap	Gap	Hold		Max	MaxR	MaxR	Max	MaxR	MaxR
50th %ile Green (s)	6.0	12.8	12.8	11.6	19.4		14.0	96.0	96.0	6.0	88.0	88.0
50th %ile Term Code	Max	Gap	Gap	Gap	Hold		Max	MaxR	MaxR	Max	MaxR	MaxR
30th %ile Green (s)	6.0	10.6	10.6	9.7	15.3		14.0	96.0	96.0	6.0	88.0	88.0
30th %ile Term Code	Max	Gap	Gap	Gap	Hold		Max	MaxR	MaxR	Max	MaxR	MaxR
10th %ile Green (s)	6.0	7.7	7.7	6.9	9.6		14.0	96.0	96.0	6.0	88.0	88.0
10th %ile Term Code	Max	Gap	Gap	Gap	Hold		Max	MaxR	MaxR	Max	MaxR	MaxR

Intersection Summary

Area Type: Other
Cycle Length: 158
Actuated Cycle Length: 146.6
Natural Cycle: 180
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 1.09
Intersection Signal Delay: 50.9 Intersection LOS: D
Intersection Capacity Utilization 96.9% ICU Level of Service F
Analysis Period (min) 15
90th %ile Actuated Cycle: 157.1
70th %ile Actuated Cycle: 150.6
50th %ile Actuated Cycle: 146.4
30th %ile Actuated Cycle: 142.3
10th %ile Actuated Cycle: 136.6

Splits and Phases: 50: Akahele Street & Honoapiilani Highway



Lane Group	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200	0		200	200	
Storage Lanes	1	1		1	1	
Turning Speed (mph)	15	9		9	15	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.850		0.850		
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1770	1583	1863	1583	1770	1863
Flt Permitted	0.950				0.950	
Satd. Flow (perm)	1770	1583	1863	1583	1770	1863
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)	20		45			45
Link Distance (ft)	1386		1353			1890
Travel Time (s)	47.3		20.5			28.6
Volume (vph)	21	21	1191	28	28	1055
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	23	23	1323	31	31	1172
Lane Group Flow (vph)	23	23	1323	31	31	1172
Sign Control	Stop		Free			Free

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 72.7% ICU Level of Service C
Analysis Period (min) 15

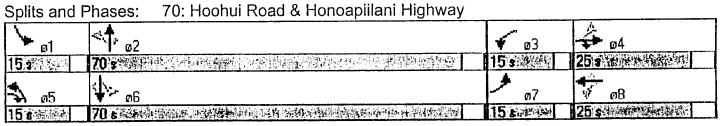
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		200	200		200
Storage Lanes	1		1	1		1	1		1	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50	50	50	50	50	50	50	50
Trailing Detector (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.732			0.737			0.125			0.116		
Satd. Flow (perm)	1364	1863	1583	1373	1863	1583	233	1863	1583	216	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			245			26			42			144
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		998			1017			1890			2672	
Travel Time (s)		34.0			34.7			28.6			40.5	
Volume (vph)	261	28	342	57	34	23	348	736	55	32	724	186
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	290	31	380	63	38	26	387	818	61	36	804	207
Lane Group Flow (vph)	290	31	380	63	38	26	387	818	61	36	804	207
Turn Type	pm+pt		pt+ov	pm+pt		Perm	pm+pt		Perm	pm+pt		Perm
Protected Phases	7	4	4 5	3	8		5	2		1	6	
Permitted Phases	4			8		8	2		2	6		6
Detector Phases	7	4	4 5	3	8	8	5	2	2	1	6	6
Minimum Initial (s)	5.0	5.0		5.0	5.0	5.0	5.0	15.0	15.0	5.0	15.0	15.0
Minimum Split (s)	9.5	20.0		9.0	20.0	20.0	10.0	21.0	21.0	10.0	21.0	21.0
Total Split (s)	15.0	25.0	40.0	15.0	25.0	25.0	15.0	70.0	70.0	15.0	70.0	70.0
Total Split (%)	12.0%	20.0%	32.0%	12.0%	20.0%	20.0%	12.0%	56.0%	56.0%	12.0%	56.0%	56.0%
Maximum Green (s)	11.5	20.5		11.5	20.5	20.5	11.5	65.5	65.5	11.5	65.5	65.5
Yellow Time (s)	3.0	4.0		3.0	4.0	4.0	3.0	4.0	4.0	3.0	4.0	4.0
All-Red Time (s)	0.5	0.5		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	2.0	4.0		2.0	4.0	4.0	2.0	4.0	4.0	2.0	4.0	4.0
Recall Mode	None	None		None	None	None	None	Min	Min	None	Max	Max
Act Effct Green (s)	26.1	17.3	32.4	20.5	14.1	14.1	82.5	77.2	77.2	73.1	67.4	67.4
Actuated g/C Ratio	0.23	0.15	0.28	0.18	0.12	0.12	0.72	0.67	0.67	0.62	0.59	0.59
v/c Ratio	0.83	0.11	0.61	0.23	0.17	0.12	1.18	0.65	0.06	0.17	0.74	0.21
Control Delay	60.4	43.5	16.4	35.5	46.0	16.3	129.6	17.4	4.8	8.1	24.4	5.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	60.4	43.5	16.4	35.5	46.0	16.3	129.6	17.4	4.8	8.1	24.4	5.1
LOS	E	D	B	D	D	B	F	B	A	A	C	A
Approach Delay		35.8			34.7			51.1			20.0	
Approach LOS		D			C			D			C	
90th %ile Green (s)	11.5	20.5		10.7	19.7	19.7	11.5	70.6	70.6	6.4	65.5	65.5

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
90th %ile Term Code	Max	Max		Gap	Hold	Hold	Max	Hold	Hold	Gap	MaxR	MaxR
70th %ile Green (s)	11.5	20.5		8.9	17.9	17.9	11.5	71.3	71.3	5.7	65.5	65.5
70th %ile Term Code	Max	Max		Gap	Hold	Hold	Max	Hold	Hold	Gap	MaxR	MaxR
50th %ile Green (s)	11.5	15.9		7.7	12.1	12.1	11.5	71.8	71.8	5.2	65.5	65.5
50th %ile Term Code	Max	Gap		Gap	Hold	Hold	Max	Hold	Hold	Gap	MaxR	MaxR
30th %ile Green (s)	11.5	12.7		6.4	7.6	7.6	11.5	80.5	80.5	0.0	65.5	65.5
30th %ile Term Code	Max	Hold		Gap	Gap	Gap	Max	Hold	Hold	Skip	MaxR	MaxR
10th %ile Green (s)	11.5	10.5		0.0	0.0	0.0	11.5	80.5	80.5	0.0	65.5	65.5
10th %ile Term Code	Max	Hold		Skip	Skip	Skip	Max	Hold	Hold	Skip	MaxR	MaxR

Intersection Summary

Area Type: Other
Cycle Length: 125
Actuated Cycle Length: 115.1
Natural Cycle: 90
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 1.18
Intersection Signal Delay: 36.7 Intersection LOS: D
Intersection Capacity Utilization 88.5% ICU Level of Service E
Analysis Period (min) 15
90th %ile Actuated Cycle: 124.2
70th %ile Actuated Cycle: 122.4
50th %ile Actuated Cycle: 116.6
30th %ile Actuated Cycle: 112.1
10th %ile Actuated Cycle: 100

Splits and Phases: 70: Hoohui Road & Honoapiilani Highway



Lane Group	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
Storage Length (ft)	125		125	125		125	200		200	200		200
Storage Lanes	1		1	1		1	1		1	1		1
Turning Speed (mph)	15		9	15		9	15		9	15		9
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						0.850			0.850			
Flt Protected				0.950						0.950		
Satd. Flow (prot)	1863	1863	1863	1770	1863	1583	1863	1863	1583	1770	1863	1863
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	1863	1863	1863	1770	1863	1583	1863	1863	1583	1770	1863	1863
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		1111			1074			2672			3312	
Travel Time (s)		37.9			36.6			40.5			50.2	
Volume (vph)	0	0	0	21	0	63	0	983	28	56	1059	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.92	0.95	0.90	0.90	0.95	0.90
Adj. Flow (vph)	0	0	0	23	0	70	0	1035	31	62	1115	0
Lane Group Flow (vph)	0	0	0	23	0	70	0	1035	31	62	1115	0
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 65.7% ICU Level of Service C
Analysis Period (min) 15

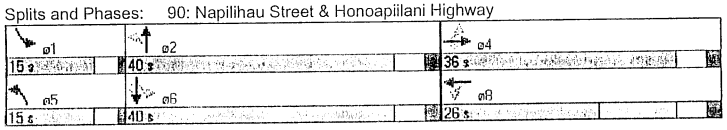
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	125		125	125		125	200		125	200		200
Storage Lanes	0		1	0		0	1		0	1		1
Total Lost Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Leading Detector (ft)	50	50	50	50	50		50	50		50	50	50
Trailing Detector (ft)	0	0	0	0	0		0	0		0	0	0
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850		0.980			0.991				0.850
Flt Protected		0.957			0.975		0.950			0.950		
Satd. Flow (prot)	0	1783	1583	0	1780	0	1770	1846	0	1770	1863	1583
Flt Permitted		0.757			0.888		0.248			0.381		
Satd. Flow (perm)	0	1410	1583	0	1621	0	462	1846	0	710	1863	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			431		4			4				121
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		1254			1054			3312			5035	
Travel Time (s)		42.8			35.9			50.2			76.3	
Volume (vph)	88	10	534	13	8	4	534	332	19	6	477	109
Peak Hour Factor	0.90	0.90	0.95	0.90	0.90	0.90	0.95	0.95	0.90	0.90	0.95	0.90
Adj. Flow (vph)	98	11	562	14	9	4	562	349	21	7	502	121
Lane Group Flow (vph)	0	109	562	0	27	0	562	370	0	7	502	121
Turn Type	Perm		Perm	Perm			pm+pt			pm+pt		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8			2			6		6
Detector Phases	4	4	4	8	8		5	2		1	6	6
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0		5.0	15.0		5.0	15.0	15.0
Minimum Split (s)	36.0	36.0	36.0	20.0	20.0		10.0	31.0		10.0	23.0	23.0
Total Split (s)	36.0	36.0	36.0	26.0	26.0	0.0	15.0	40.0	0.0	15.0	40.0	40.0
Total Split (%)	39.6%	39.6%	39.6%	28.6%	28.6%	0.0%	16.5%	44.0%	0.0%	16.5%	44.0%	44.0%
Maximum Green (s)	30.0	30.0	30.0	20.0	20.0		11.0	34.0		11.0	34.0	34.0
Yellow Time (s)	4.0	4.0	4.0	4.0	4.0		3.0	4.0		3.0	4.0	4.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		1.0	2.0		1.0	2.0	2.0
Lead/Lag							Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?												
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		2.0	4.5		2.0	4.5	4.5
Recall Mode	None	None	None	None	None		None	Max		None	Max	Max
Walk Time (s)	5.0	5.0	5.0					5.0			5.0	5.0
Flash Dont Walk (s)	19.0	19.0	19.0					20.0			12.0	12.0
Pedestrian Calls (#/hr)	0	0	0					0			0	0
Act Effct Green (s)		17.9	17.9		17.9		52.6	51.1		43.2	37.5	37.5
Actuated g/C Ratio		0.23	0.23		0.23		0.69	0.67		0.52	0.49	0.49
v/c Ratio		0.33	0.80		0.07		1.07	0.30		0.02	0.55	0.14
Control Delay		24.0	10.6		18.5		75.4	8.8		8.5	18.7	3.8
Queue Delay		0.0	0.0		0.0		0.0	0.0		0.0	0.0	0.0
Total Delay		24.0	10.6		18.5		75.4	8.8		8.5	18.7	3.8
LOS		C	B		B		E	A		A	B	A

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Approach Delay		12.7			18.5			49.0			15.7	
Approach LOS		B			B			D			B	
90th %ile Green (s)	30.0	30.0	30.0	30.0	30.0		11.0	39.9		5.1	34.0	34.0
90th %ile Term Code	Max	Max	Max	Hold	Hold		Max	Hold		Gap	MaxR	MaxR
70th %ile Green (s)	20.4	20.4	20.4	20.4	20.4		11.0	49.0		0.0	34.0	34.0
70th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	MaxR	MaxR
50th %ile Green (s)	14.1	14.1	14.1	14.1	14.1		11.0	49.0		0.0	34.0	34.0
50th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	MaxR	MaxR
30th %ile Green (s)	8.3	8.3	8.3	8.3	8.3		11.0	49.0		0.0	34.0	34.0
30th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	MaxR	MaxR
10th %ile Green (s)	5.4	5.4	5.4	5.4	5.4		11.0	49.0		0.0	34.0	34.0
10th %ile Term Code	Gap	Gap	Gap	Hold	Hold		Max	Hold		Skip	MaxR	MaxR

Intersection Summary

Area Type: Other
Cycle Length: 91
Actuated Cycle Length: 76.6
Natural Cycle: 90
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 1.07
Intersection Signal Delay: 28.6 Intersection LOS: C
Intersection Capacity Utilization 73.4% ICU Level of Service D
Analysis Period (min) 15
90th %ile Actuated Cycle: 91
70th %ile Actuated Cycle: 81.4
50th %ile Actuated Cycle: 75.1
30th %ile Actuated Cycle: 69.3
10th %ile Actuated Cycle: 66.4

Splits and Phases: 90: Napilihau Street & Honoapiilani Highway



Lane Group	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
Storage Length (ft)	125		125	125		125	200		200	200		200
Storage Lanes	0		1	0		1	1		1	1		1
Turning Speed (mph)	15		9	15		9	15		9	15		9
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			0.850			0.850			0.850			0.850
Flt Protected		0.957			0.976		0.950			0.950		
Satd. Flow (prot)	0	1783	1583	0	1818	1583	1770	1863	1583	1770	1863	1583
Flt Permitted		0.957			0.976		0.950			0.950		
Satd. Flow (perm)	0	1783	1583	0	1818	1583	1770	1863	1583	1770	1863	1583
Headway 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
Link Speed (mph)		20			20			45			45	
Link Distance (ft)		1268			1116			5035			1283	
Travel Time (s)		43.2			38.0			76.3			19.4	
Volume (vph)	120	14	691	10	10	14	426	266	14	10	318	120
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	133	16	768	11	11	16	473	296	16	11	353	133
Lane Group Flow (vph)	0	149	768	0	22	16	473	296	16	11	353	133
Sign Control		Stop			Stop			Free			Free	

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 72.9% ICU Level of Service C
Analysis Period (min) 15

APPENDIX J

Honoapiilani Highway Arterial Level of Service Analysis 2011 PM Peak Hour, Lahaina Section, Future Projects without Pulelehua (ARTPLAN)

ARTPLAN 2002 Conceptual Planning Analysis

Description/File Information

Filename	C:\Documents and Settings\Ted Mack\My Documents\My Files\Production\Production\Pulelehua\AP_Honoapiilani Hwy ArtPlan BEFORE PM Pk Hr 120304.xml	**Date Prepared**	12/3/2004		
Program	ARTPLAN	**Version**	5.2.0		
Analyst	HPE	**Agency**		**District**	
Arterial Name	Honoapiilani Highway	**Begin Intersection**	Kaanapali Parkway	**End Intersection**	Dickenson Street
Study Period	K5-6pm	**Peak Direction**	Northbound		
User Notes	Prepared for the Pulelehua project				

Facility Data

Roadway Variables		Traffic Variables		Control Variables		Multimodal Variables	
Area Type	Transitioning/Urban	**AADT**	34000	**Arrival Type**	3	**Paved Shoulder/Bike Lane**	No
Class	1	**K**	0.096	**Signals/Mile**	1.00	**Outside Lane Width**	Typical
Posted Speed	50	**D**	0.55	**Cycle Length**	120	**Pavement Condition**	Typical
# Thru Lanes	4	**PHF**	0.91	**Through g/C**	0.44	**Sidewalk**	Yes
Median Type	Restrictive	**% Turns Excl. Lanes**	12	**Control Type**	Actuated	**Sidewalk/Roadway Separation**	Typical
Left Turn Lanes	Yes	**% Heavy Vehicles**	3			**Sidewalk/Roadway Protective Barrier**	No
		Base Sat Flow Rate	1900			**Obstacle to Bus Stop**	No
		Local Adj. Factor	0.98			**Bus Freq**	1
		Adjusted Sat Flow Rate	1808			**Bus Span Of Service**	15

Automobile Segment Data

Segment #	Cycle Length	g/C	Arr. Type	% Turns	# Dir. Lanes	Length	AADT	Hourly Vol.	FFS	Median Type
1 (to Lealii Parkway)	120	0.65	3	12	2	1.07955	38788	1843	50	Restrictive
2 (to Fleming Road)	120	0.65	3	12	2	0.625	35379	1868	50	Restrictive
3 (to Kapuunakea Road)	120	0.65	3	12	2	0.44508	35379	1868	50	Restrictive
4 (to Lahainaluna Road)	120	0.65	3	12	2	0.83333	35587	1879	50	Restrictive
5 (to Dickenson Street)	120	0.65	3	12	2	0.16572	35587	1879	50	Restrictive

Automobile LOS

Segment #	Thru Mvmt Flow Rate	v/c	Control Delay	Int. Approach LOS	Speed (mph)	Segment LOS
1 (to Lealii Parkway)	1782	0.76	15.33	B	37.8	B
2 (to Fleming Road)	1806	0.77	15.6	B	32.6	C
3 (to Kapuunakea Road)	1806	0.77	15.57	B	28.8	C
4 (to Lahainaluna Road)	1817	0.77	15.69	B	35.4	B
5 (to Dickenson Street)	1817	0.77	15.68	B	19	E

Arterial Length	3.2	Auto Speed	33.0	Auto LOS	C

Automobile Service Volume Tables

	A	B	C	D	E
Lanes	**Hourly Volume In Peak Direction**				
1	**	830	1220	1300	1340
2	150	1700	2460	2600	2670
3	220	2580	3700	3910	4010
4	300	3450	4940	5210	5340
*	150	1700	2460	2600	2670
Lanes	**Hourly Volume In Both Directions**				
2	**	1500	2220	2360	2430
4	270	3090	4480	4730	4860
6	400	4680	6730	7110	7280
8	540	6280	8990	9480	9710
*	270	3090	4480	4730	4860
Lanes	**Annual Average Daily Traffic**				
2	**	15600	23100	24600	25300
4	2800	32200	46600	49300	50600
6	4200	48800	70100	74000	75900
8	5600	65400	93600	98700	101200
*	2800	32200	46600	49300	50600

APPENDIX K

Honoapiilani Highway Arterial Level of Service Analysis 2011 PM Peak Hour, Lahaina Section, Future Projects with Pulelehua (ARTPLAN)

ARTPLAN 2002 Conceptual Planning Analysis

Description/File Information

Filename	C:\Documents and Settings\Ted Mack\My Documents\My Files\Production\Production\Pulelehua\AP_Honoapiilani Hwy ArtPlan AFTER PM Pk Hr 120304.xml	**Date Prepared**	12/3/2004		
Program	ARTPLAN	**Version**	5.2.0		
Analyst	HPE	**Agency**		**District**	
Arterial Name	Honoapiilani Highway	**Begin Intersection**	Kaanapali Parkway	**End Intersection**	Dickenson Street
Study Period	K5-6pm	**Peak Direction**	Northbound		
User Notes	Prepared for the Pulelehua project				

Facility Data

Roadway Variables		Traffic Variables		Control Variables		Multimodal Variables	
Area Type	Transitioning/Urban	**AADT**	34000	**Arrival Type**	3	**Paved Shoulder/Bike Lane**	No
Class	1	**K**	0.096	**Signals/Mile**	1.00	**Outside Lane Width**	Typical
Posted Speed	50	**D**	0.55	**Cycle Length**	120	**Pavement Condition**	Typical
# Thru Lanes	4	**PHF**	0.91	**Through g/C**	0.44	**Sidewalk**	Yes
Median Type	Restrictive	**% Turns Excl. Lanes**	12	**Control Type**	Actuated	**Sidewalk/Roadway Separation**	Typical
Left Turn Lanes	Yes	**% Heavy Vehicles**	3			**Sidewalk/Roadway Protective Barrier**	No
		Base Sat Flow Rate	1900			**Obstacle to Bus Stop**	No
		Local Adj. Factor	0.98			**Bus Freq**	1
		Adjusted Sat Flow Rate	1808			**Bus Span Of Service**	15

Automobile Segment Data

Segment #	Cycle Length	g/C	Arr. Type	% Turns	# Dir. Lanes	Length	AADT	Hourly Vol.	FFS	Median Type
1 (to Lealii Parkway)	120	0.65	3	12	2	1.07955	38788	2068	50	Restrictive
2 (to Fleming Road)	120	0.65	3	12	2	0.625	39110	2065	50	Restrictive
3 (to Kapuunakea Road)	120	0.65	3	12	2	0.44508	39110	2065	50	Restrictive
4 (to Lahainaluna Road)	120	0.65	3	12	2	0.83333	38788	2048	50	Restrictive
5 (to Dickenson Street)	120	0.65	3	12	2	0.16572	38788	2048	50	Restrictive

Automobile LOS

Segment #	Thru Mvmt Flow Rate	v/c	Control Delay	Int. Approach LOS	Speed (mph)	Segment LOS
1 (to Lealii Parkway)	2000	0.85	17.79	B	36.6	B
2 (to Fleming Road)	1997	0.85	17.75	B	31.4	C
3 (to Kapuunakea Road)	1997	0.85	17.75	B	27.5	C
4 (to Lahainaluna Road)	1980	0.84	17.5	B	34.4	B
5 (to Dickenson Street)	1980	0.84	17.53	B	17.8	E

Arterial Length	3.2	Auto Speed	31.8	Auto LOS	C

Automobile Service Volume Tables

	A	B	C	D	E
Lanes	**Hourly Volume In Peak Direction**				
1	**	830	1220	1300	1340
2	150	1700	2460	2600	2670
3	220	2580	3700	3910	4010
4	300	3450	4940	5210	5340
*	150	1700	2460	2600	2670
Lanes	**Hourly Volume In Both Directions**				
2	**	1500	2220	2360	2430
4	270	3090	4480	4730	4860
6	400	4680	6730	7110	7280
8	540	6280	8990	9480	9710
*	270	3090	4480	4730	4860
Lanes	**Annual Average Daily Traffic**				
2	**	15600	23100	24600	25300
4	2800	32200	46600	49300	50600
6	4200	48800	70100	74000	75900
8	5600	65400	93600	98700	101200
*	2800	32200	46600	49300	50600

APPENDIX L

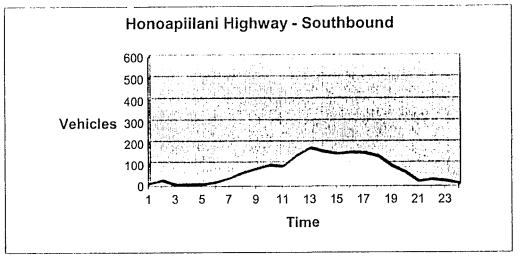
Existing Traffic Count Data

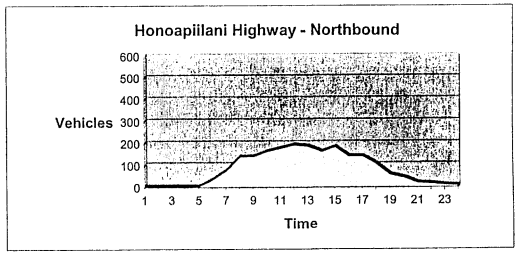
HONOAPIILANI HIGHWAY TRAFFIC COUNTS AND PROFILES

Counts Taken April 1, 2003, by HDOT

At Lower Honoapiilani Road (Northern Junction)

Time	Southbound	Northbound
12	6	4
1	21	2
2	0	2
3	2	1
4	2	4
5	12	35
6	31	75
7	58	138
8	76	139
9	93	163
10	88	177
11	138	193
12	175	187
13	158	162
14	148	184
15	154	141
16	152	140
17	136	106
18	90	57
19	61	43
20	16	20
21	25	16
22	18	10
23	7	7





1/2004 09:52 FAX 8082345501 FEDEX KINKOS 0337 002/002

HONOAPIILANI HIGHWAY APPROACH TRAFFIC COUNTS: HDOT (April 1, 2003)
Honoapiilani Highway (at Lower Honoapiilani Road - Northern Junction)

	Southbound AM [1]	Northbound AM [3]	Total
0:00	3	4	7
:15	0	0	0
:30	2	0	2
:45	1	0	1
TOTAL	6	4	10
1:00	0	0	0
:15	0	1	1
:30	0	1	1
:45	1	0	1
TOTAL	1	2	3
2:00	0	0	0
:15	0	1	1
:30	0	0	0
:45	0	1	1
TOTAL	0	2	2
3:00	0	1	1
:15	0	0	0
:30	1	0	1
:45	0	0	0
TOTAL	1	1	2
4:00	1	1	2
:15	0	1	1
:30	1	1	2
:45	0	1	1
TOTAL	2	4	6
5:00	2	7	9
:15	0	1	1
:30	0	1	1
:45	0	0	0
TOTAL	2	9	11
6:00	7	9	16
:15	6	17	23
:30	6	12	18
:45	12	29	41
TOTAL	31	77	108
7:00	16	30	46
:15	7	42	49
:30	13	38	51
:45	20	28	48
TOTAL	56	138	194
8:00	21	31	52
:15	22	29	51
:30	17	31	48
:45	18	45	63
TOTAL	78	136	214
9:00	23	42	65
:15	28	39	67
:30	21	37	58
:45	21	45	66
TOTAL	93	163	256
10:00	18	46	64
:15	26	37	63
:30	19	57	76
:45	25	37	62
TOTAL	88	177	265
11:00	32	42	74
:15	30	54	84
:30	39	47	86
:45	37	50	87
TOTAL	138	193	331
	1,645		1,438
	2,005		
	3,650		

AM Peak Hour
"D" Factor (NB) 0.5831
"K" Factor 0.0529
Total AM

24-hr Southbound
24-hr Northbound
24-hr Total

	Southbound PM [1]	Northbound PM [3]	Total
12:00	63	57	120
:15	26	46	72
:30	37	46	83
:45	49	35	84
TOTAL	175	187	362
13:00	45	38	83
:15	30	58	88
:30	37	31	68
:45	38	37	75
TOTAL	150	162	320
14:00	30	41	71
:15	33	56	89
:30	54	38	92
:45	31	49	80
TOTAL	148	184	332
15:00	35	33	68
:15	31	37	68
:30	47	30	77
:45	41	41	82
TOTAL	154	141	295
16:00	52	37	89
:15	40	39	79
:30	30	21	51
:45	30	44	74
TOTAL	152	140	292
17:00	38	30	68
:15	35	38	73
:30	34	20	54
:45	29	15	44
TOTAL	136	108	242
18:00	21	18	39
:15	31	13	44
:30	17	21	38
:45	21	7	28
TOTAL	90	57	147
19:00	21	16	37
:15	15	9	24
:30	16	14	30
:45	9	4	13
TOTAL	61	43	104
20:00	3	5	8
:15	4	4	8
:30	5	5	10
:45	4	6	10
TOTAL	16	20	36
21:00	7	4	11
:15	5	4	9
:30	10	6	16
:45	3	1	4
TOTAL	25	15	40
22:00	4	3	7
:15	3	2	5
:30	4	3	7
:45	7	2	9
TOTAL	18	10	28
23:00	1	2	3
:15	1	1	2
:30	1	2	3
:45	7	2	9
TOTAL		7	14
			2,272

PM Peak Hour
"D" Factor (NB) 0.5666
"K" Factor 0.0992
Total PM

4/8/2003

State of Hawaii, Department of Transportation, Highways Division

ISLAND : Maui
STATION NO : C-12-F
AUX NO :
FUND SYSTEM :
FILE : Leg 4

STATION DESCRIPTION : Honoapiilani Highway at Napilihau Street Maui

TC NO : C-12-F
ID NO : 7, 150

COUNT GROUP ID :
ROUTE NO : MP. :
HWY ST NAME : Napilihau St
MOV (6), DIR : To Honoapiilani Hwy D-01 REG SURVEY DATE : 04/01/03 START TIME : 09:00 AM
MOV (8), DIR : To Maui Land and Pineapple D-02 REG SURVEY DATE : 04/01/03 START TIME : 09:00 AM

MOV (6), TYPE :
MOV (8), TYPE :

TIME-AM	MOV 6	MOV 8	TOTAL	TIME-AM	MOV 6	MOV 8	TOTAL	TIME-PM	MOV 6	MOV 8	TOTAL	TIME-PM	MOV 6	MOV 8	TOTAL
12:00-12:15	2	2	4	6:00- 6:15	15	9	24	12:00-12:15	6	1	7	6:00- 6:15	3	0	3
12:15-12:30	0	0	0	6:15- 6:30	9	12	21	12:15-12:30	2	7	9	6:15- 6:30	2	0	2
12:30-12:45	2	0	2	6:30- 6:45	6	4	10	12:30-12:45	3	2	5	6:30- 6:45	2	0	2
12:45- 1:00	0	0	0	6:45- 7:00	8	6	14	12:45- 1:00	13	1	14	6:45- 7:00	2	0	2
1:00- 1:15	2	0	2	7:00- 7:15	5	0	5	1:00- 1:15	13	5	18	7:00- 7:15	7	0	7
1:15- 1:30	0	0	0	7:15- 7:30	7	3	10	1:15- 1:30	6	1	7	7:15- 7:30	5	0	5
1:30- 1:45	0	0	0	7:30- 7:45	8	1	9	1:30- 1:45	7	2	9	7:30- 7:45	2	1	3
1:45- 2:00	1	0	1	7:45- 8:00	8	7	15	1:45- 2:00	6	6	12	7:45- 8:00	4	0	4
2:00- 2:15	0	0	0	8:00- 8:15	6	6	12	2:00- 2:15	3	1	4	8:00- 8:15	0	0	0
2:15- 2:30	0	0	0	8:15- 8:30	2	7	9	2:15- 2:30	13	5	18	8:15- 8:30	2	2	4
2:30- 2:45	3	0	3	8:30- 8:45	3	10	13	2:30- 2:45	3	2	5	8:30- 8:45	0	2	2
2:45- 3:00	1	0	1	8:45- 9:00	1	0	1	2:45- 3:00	7	6	13	8:45- 9:00	4	1	5
3:00- 3:15	0	0	0	9:00- 9:15	3	6	9	3:00- 3:15	11	4	15	9:00- 9:15	0	1	1
3:15- 3:30	0	0	0	9:15- 9:30	2	1	3	3:15- 3:30	6	5	11	9:15- 9:30	0	0	0
3:30- 3:45	0	0	0	9:30- 9:45	8	9	17	3:30- 3:45	51	7	58	9:30- 9:45	0	0	0
3:45- 4:00	0	0	0	9:45-10:00	5	4	9	3:45- 4:00	5	0	5	9:45-10:00	0	0	0
4:00- 4:15	0	0	0	10:00-10:15	7	4	11	4:00- 4:15	4	2	6	10:00-10:15	4	0	4
4:15- 4:30	0	0	0	10:15-10:30	3	6	9	4:15- 4:30	4	4	8	10:15-10:30	1	2	3
4:30- 4:45	2	1	3	10:30-10:45	1	0	1	4:30- 4:45	6	0	6	10:30-10:45	1	0	1
4:45- 5:00	3	3	6	10:45-11:00	9	6	15	4:45- 5:00	6	2	8	10:45-11:00	0	0	0
5:00- 5:15	0	2	2	11:00-11:15	5	2	7	5:00- 5:15	6	0	6	11:00-11:15	4	0	4
5:15- 5:30	0	2	2	11:15-11:30	1	5	6	5:15- 5:30	8	2	10	11:15-11:30	0	0	0
5:30- 5:45	4	3	7	11:30-11:45	11	4	15	5:30- 5:45	16	3	19	11:30-11:45	0	0	0
5:45- 6:00	6	7	13	11:45-12:00	2	2	4	5:45- 6:00	3	0	3	11:45-12:00	0	0	0

AM COMMUTER PERIOD (06:00 - 09:00)	MOV 6	MOV 8	TOTAL
TWO-DIRECTIONAL PEAK :	-------	-------	6:00 AM - 7:00 AM
AM - PEAK HR TIME	28	31	59
AM - PEAK HR VOLUME			11.06
AM - K FACTOR (%)	54.05	44.93	100.00
AM - D %			
DIRECTIONAL PEAK :			
AM PEAK - HR TIME	6:00 AM - 7:00 AM	8:45 AM - 9:45 AM	
AM PEAK - HR VOLUME	28	32	

PM COMMUTER PERIOD (15:00 - 19:00)	MOV 6	MOV 8	TOTAL
TWO-DIRECTIONAL PEAK :	-------	-------	3:30 PM - 4:30 PM
PM - PEAK HR TIME	72	26	98
PM - PEAK HR VOLUME			14.29
PM - K FACTOR (%)	82.02	17.98	100.00
PM - D %			
DIRECTIONAL PEAK :			
PM PEAK - HR TIME	3:00 PM - 4:00 PM	3:00 PM - 4:00 PM	
PM PEAK - HR VOLUME	72	26	

AM PERIOD (06:00 - 12:00)			
TWO-DIRECTIONAL PEAK :			
AM - PEAK HR TIME			6:00 AM - 7:00 AM
AM - PEAK HR VOLUME	28	31	59
AM - K FACTOR (%)			81.04
AM - D %	53.07	46.93	100.00

PM PERIOD (12:00 - 24:00)			
TWO-DIRECTIONAL PEAK :			
PM - PEAK HR TIME			2:45 PM - 3:45 PM
PM - PEAK HR VOLUME	75	22	97
PM - K FACTOR (%)			85.57
PM - D %	77.32	22.68	100.00

NON-COMMUTER PERIOD (09:00 - 15:00)			
TWO-DIRECTIONAL PEAK :			
PEAK HR TIME			12:45 PM - 1:45 PM
PEAK HR VOLUME	39	9	48
DIRECTIONAL PEAK :			
PEAK HR TIME	12:45 PM - 1:45 PM	9:30 AM - 10:30 AM	
PEAK HR VOLUME	39	23	

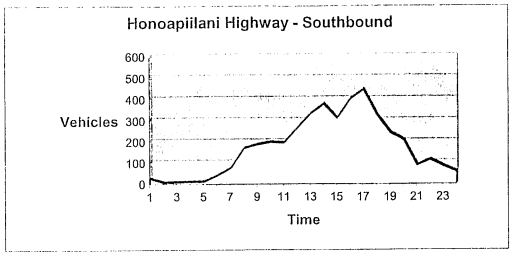
6 - HR, 12 - HR, 24 - HR PERIODS			
AM 6 - HR PERIOD (06:00 - 12:00)	135	114	249
AM 12 - HR PERIOD (00:00 - 12:00)	161	134	295
PM 6 - HR PERIOD (12:00 - 18:00)	158	68	226
PM 12 - HR PERIOD (12:00 - 24:00)	241	75	316
24 HOUR PERIOD	402	310	712
D %	56.35	43.65	100.00

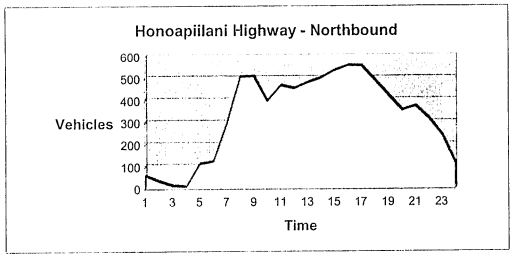
HONOAPIILANI HIGHWAY TRAFFIC COUNTS AND PROFILES

Counts Taken April 1, 2003, by HDOT

At Napilihau Street

Time	Southbound	Northbound
12	22	56
1	3	31
2	5	11
3	6	7
4	9	109
5	37	121
6	72	292
7	166	505
8	184	507
9	195	394
10	192	466
11	262	452
12	330	480
13	373	500
14	307	533
15	397	556
16	440	554
17	323	488
18	239	420
19	206	354
20	86	372
21	112	316
22	82	240
23	54	107





HONOAPIILANI HIGHWAY APPROACH TRAFFIC COUNTS: HDOT (April 1, 2003)

Honoapiilani Highway (at Napilihau Street)

	Southbound AM [1]	Northbound AM [3]	Total
0:00	14	23	37
:15	3	14	17
:30	2	11	13
:45	3	8	11
TOTAL	22	56	78
1:00	1	9	10
:15	1	10	11
:30	0	7	7
:45	1	5	6
TOTAL	3	31	34
2:00	3	5	8
:15	0	2	2
:30	0	3	3
:45	2	1	3
TOTAL	5	11	16
3:00	1	2	3
:15	2	2	4
:30	2	0	2
:45	1	3	4
TOTAL	6	7	13
4:00	0	18	18
:15	1	18	19
:30	3	34	37
:45	5	39	44
TOTAL	9	109	118
5:00	10	17	27
:15	6	18	24
:30	7	38	45
:45	14	48	62
TOTAL	37	121	158
6:00	16	48	64
:15	20	57	77
:30	16	83	99
:45	20	104	124
TOTAL	72	292	364
7:00	44	106	150
:15	36	146	182
:30	45	122	167
:45	41	131	172
TOTAL	166	505	671
8:00	55	131	186
:15	47	153	200
:30	41	105	146
:45	41	118	159
TOTAL	184	507	691
9:00	46	96	142
:15	50	97	147
:30	52	86	138
:45	47	115	162
TOTAL	195	394	589
10:00	57	104	161
:15	63	112	175
:30	65	127	192
:45	7	123	130
TOTAL	192	466	658
11:00	62	112	174
10	61	120	181
6	62	100	162
:45	77	120	197
TOTAL	262	452	714
			4,104

AM Peak Hour
"D" Factor (NB) 0.7337
"K" Factor 0.0423

Total AM

4,102	24-hr Southbound	
7,871	24-hr Northbound	
11,973	24-hr Total	

	Southbound PM [1]	Northbound PM [3]	Total
12:00	93	124	217
:15	63	139	202
:30	96	108	204
:45	78	109	187
TOTAL	330	480	810
13:00	76	121	197
:15	86	136	222
:30	118	124	242
:45	93	119	212
TOTAL	373	500	873
14:00	83	119	202
:15	65	130	195
:30	79	148	227
:45	80	136	216
TOTAL	307	533	840
15:00	105	138	243
:15	107	142	249
:30	89	133	222
:45	96	143	239
TOTAL	397	556	953
16:00	154	137	291
:15	100	143	243
:30	112	135	247
:45	74	139	213
TOTAL	440	554	994
17:00	88	119	207
:15	75	136	211
:30	80	120	200
:45	80	113	193
TOTAL	323	488	811
18:00	52	108	160
:15	70	106	176
:30	66	96	162
:45	51	110	161
TOTAL	239	420	659
19:00	67	95	162
:15	51	99	150
:30	45	79	124
:45	43	81	124
TOTAL	206	354	560
20:00	23	83	106
:15	27	86	113
:30	19	96	115
:45	17	107	124
TOTAL	86	372	459
21:00	36	90	126
:15	22	69	91
:30	33	89	122
:45	21	68	89
TOTAL	112	316	428
22:00	19	62	81
:15	21	76	97
:30	27	61	88
:45	15	41	56
TOTAL	82	240	322
23:00	23	45	68
:15	18	18	36
:30	9	20	29
:45	4	24	28
TOTAL	54	107	161
			7,869

PM Peak Hour
"D" Factor (NB) 0.5573
"K" Factor 0.0630

Total PM

TRAFFIC COUNT SUMMARY WORKSHEET

PROJECT: Kaanapali
INTERSECTION: Honoapiilani Hwy at Akahele St
DAY/DATE: Fri, 14 May 04
START TIME: 15:30 PM
END TIME: 18:00 PM

Cumulative Counter Readings at:

Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
15:30	0	0	0	0	0	0	0	0	0	0	0	0	0
15:45	0	0	0	0	0	0	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0	0	0	0	0
16:15	0	0	0	0	0	0	0	0	0	0	0	0	0
16:30	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15	0	0	0	0	0	0	0	0	0	0	0	0	0
17:30	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45	0	0	0	0	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0	0	0	0

15-Minute Volumes Beginning at:

	Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Interval	Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	15:30	10	172	14	13	1	5	9	184	8	7	0	14	437
2	15:45	15	160	3	1	0	3	2	155	29	22	0	16	406
3	16:00	12	215	0	2	0	4	0	174	13	24	3	18	465
4	16:15	24	202	10	3	0	3	1	226	45	41	0	14	569
5	16:30	19	221	4	1	1	9	12	215	32	34	2	19	569
6	16:45	12	217	5	3	1	3	5	158	20	33	0	19	476
7	17:00	27	215	9	3	0	5	3	201	29	44	1	9	546
8	17:15	15	209	5	2	0	0	8	206	23	22	2	29	521
9	17:30	10	115	2	5	8	8	2	141	17	13	1	19	341
10	17:45	13	93	4	1	0	6	5	138	20	12	0	11	303
	Max	27	221	14	13	8	9	12	226	45	44	3	29	569

Maximum Hourly Volume of Each Movement

15:30	16:30	61	749	27	19	1	15	12	739	95	94	3	62	1877
15:45	16:45	70	798	17	7	1	19	15	770	119	121	5	67	2009
16:00	17:00	67	855	19	9	2	19	18	773	110	132	5	70	2079
16:15	17:15	82	855	28	10	2	20	21	800	126	152	3	61	2160
16:30	17:30	73	862	23	9	2	17	28	780	104	133	5	76	2112
16:45	17:45	64	756	21	13	9	16	18	706	89	112	4	76	1884
17:00	18:00	65	632	20	11	8	19	18	686	89	91	4	68	1711

Maximum Hourly Volume of Each Movement

Volume	82	862	28	19	9	20	28	800	126	152	5	76	2160
Per Cent	8%	89%	3%	40%	19%	42%	3%	84%	13%	65%	2%	33%	
PHF	0.76	0.98	0.50	0.37	0.28	0.56	0.58	0.88	0.70	0.86	0.42	0.66	0.95
Total Arrivals		972			48			954			233		2207
Total Departures		895			61			1034			217		2207
Total		1867			109			1988			450		

TRAFFIC COUNT SUMMARY WORKSHEET

PROJECT: Kaanapali
INTERSECTION: Honoapiilani Hwy at Akahele St
DAY/DATE: Mon, 17 May 04
START TIME: 6:30 am
END TIME: 9:00 am

Cumulative Counter Readings at:

Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
6:30	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45	0	0	0	0	0	0	0	0	0	0	0	0	0
9:00	0	0	0	0	0	0	0	0	0	0	0	0	0

15-Minute Volumes Beginning at:

	Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Interval	Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	6:30	3	56	2	1	0	1	1	59	3	5	0	9	140
2	6:45	2	74	2	0	1	3	1	89	3	12	2	18	207
3	7:00	10	121	7	1	0	0	4	97	10	20	0	11	281
4	7:15	5	175	1	1	0	5	4	93	8	33	0	11	336
5	7:30	5	223	2	2	1	2	9	136	15	32	3	16	446
6	7:45	6	134	5	3	2	4	10	110	15	24	0	13	326
7	8:00	10	144	3	2	4	11	9	133	18	32	3	19	388
8	8:15	11	123	4	4	2	21	9	138	23	24	2	16	377
9	8:30	8	138	3	1	1	6	1	100	16	20	0	9	303
10	8:45	10	155	0	1	0	4	1	111	10	32	0	9	333
	Max	11	223	7	4	4	21	10	138	23	33	3	19	446

Maximum Hourly Volume of Each Movement

6:30	7:30	20	426	12	3	1	9	10	338	24	70	2	49	964
6:45	7:45	22	593	12	4	2	10	18	415	36	97	5	56	1270
7:00	8:00	26	653	15	7	3	11	27	436	48	109	3	51	1389
7:15	8:15	26	676	11	8	7	22	32	472	56	121	6	59	1496
7:30	8:30	32	624	14	11	9	38	37	517	71	112	8	64	1537
7:45	8:45	35	539	15	10	9	42	29	481	72	100	5	57	1394
8:00	9:00	39	560	10	8	7	42	20	482	67	108	5	53	1401

Maximum Hourly Volume of Each Movement

Volume	39	676	15	11	9	42	37	517	72	121	8	64	1537
Per Cent	5%	93%	2%	18%	15%	68%	6%	83%	12%	63%	4%	33%	
PHF	0.89	0.76	0.54	0.69	0.56	0.50	0.93	0.94	0.78	0.92	0.67	0.84	0.86
Total Arrivals		730			62			626			193		1611
Total Departures		592			60			839			120		1611
Total		1322			122			1465			313		

TRAFFIC COUNT SUMMARY WORKSHEET

PROJECT: Kaanapali
INTERSECTION: Honoapiilani Hwy at Hoohui Rd
DAY/DATE: Monday, 17 May 04
START TIME: 15:30 PM
END TIME: 18:00 PM

Cumulative Counter Readings at:

Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
15:30	0	0	0	0	0	0	0	0	0	0	0	0	0
15:45	0	0	0	0	0	0	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0	0	0	0	0
16:15	0	0	0	0	0	0	0	0	0	0	0	0	0
16:30	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15	0	0	0	0	0	0	0	0	0	0	0	0	0
17:30	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45	0	0	0	0	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0	0	0	0

15-Minute Volumes Beginning at:

	Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Interval	Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	15:30	15	121	4	2	10	21	10	133	45	35	2	25	423
2	15:45	23	144	6	4	10	9	23	140	59	62	6	45	531
3	16:00	17	121	3	5	4	11	11	122	43	57	4	33	431
4	16:15	23	111	3	5	6	7	14	101	51	53	5	41	420
5	16:30	28	105	2	6	3	5	8	94	39	49	2	37	378
6	16:45	42	109	5	1	1	9	9	151	75	54	6	42	504
7	17:00	33	165	12	3	14	17	6	152	70	75	6	57	610
8	17:15	30	130	8	4	6	13	8	128	57	61	4	43	492
9	17:30	31	131	2	1	6	14	11	126	60	69	8	40	499
10	17:45	27	91	3	0	6	3	2	97	34	28	3	29	323
	Max	42	165	12	6	14	21	23	152	75	75	8	57	610

Maximum Hourly Volume of Each Movement

15:30	16:30	78	497	16	16	30	48	58	496	198	207	17	144	1805
15:45	16:45	91	481	14	20	23	32	56	457	192	221	17	156	1760
16:00	17:00	110	446	13	17	14	32	42	468	208	213	17	153	1733
16:15	17:15	126	490	22	15	24	38	37	498	235	231	19	177	1912
16:30	17:30	133	509	27	14	24	44	31	525	241	239	18	179	1984
16:45	17:45	136	535	27	9	27	53	34	557	262	259	24	182	2105
17:00	18:00	121	517	25	8	32	47	27	503	221	233	21	169	1924

Maximum Hourly Volume of Each Movement

Volume		136	535	27	20	32	53	58	557	262	259	24	182	2105
Per Cent		19%	77%	4%	19%	30%	50%	7%	64%	30%	56%	5%	39%	
PHF		0.81	0.81	0.56	0.83	0.57	0.63	0.63	0.92	0.87	0.86	0.75	0.80	0.86
Total Arrivals			698			105			877			465		2145
Total Departures			759			109			847			430		2145
Total			1457			214			1724			895		

TRAFFIC COUNT SUMMARY WORKSHEET

PROJECT: Kaanapali
INTERSECTION: Honoapiilani Hwy at Hoohui Rd
DAY/DATE: Wednesday, 19 May 04
START TIME: 6:30 am
END TIME: 9:00 am

Cumulative Counter Readings at:

Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
6:30	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45	0	0	0	0	0	0	0	0	0	0	0	0	0
9:00	0	0	0	0	0	0	0	0	0	0	0	0	0

15-Minute Volumes Beginning at:

	Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Interval	Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	6:30	10	165	2	1	3	11	7	65	17	21	0	7	309
2	6:45	13	83	3	0	4	6	10	83	20	31	3	18	274
3	7:00	14	107	1	1	2	18	2	89	22	57	1	12	326
4	7:15	15	136	1	0	1	22	1	119	25	64	0	15	399
5	7:30	17	92	2	0	0	10	4	97	31	55	1	19	328
6	7:45	15	96	1	3	8	9	4	109	46	43	10	28	372
7	8:00	14	74	1	0	2	15	1	122	37	42	1	19	328
8	8:15	14	98	1	1	4	7	2	125	38	44	2	24	360
9	8:30	18	90	1	1	1	5	6	109	32	65	0	21	349
10	8:45	17	105	1	1	2	9	4	98	34	43	1	25	340
	Max	18	165	3	3	8	22	10	125	46	65	10	28	399

Maximum Hourly Volume of Each Movement

6:30	7:30	52	491	7	2	10	57	20	356	84	173	4	52	1308
6:45	7:45	59	418	7	1	7	56	17	388	98	207	5	64	1327
7:00	8:00	61	431	5	4	11	59	11	414	124	219	12	74	1425
7:15	8:15	61	398	5	3	11	56	10	447	139	204	12	81	1427
7:30	8:30	60	360	5	4	14	41	11	453	152	184	14	90	1388
7:45	8:45	61	358	4	5	15	36	13	465	153	194	13	92	1409
8:00	9:00	63	367	4	3	9	36	13	454	141	194	4	89	1377

Maximum Hourly Volume of Each Movement

Volume		63	491	7	5	15	59	20	465	153	219	14	92	1427
Per Cent		11%	88%	1%	6%	19%	75%	3%	73%	24%	67%	4%	28%	
PHF		0.88	0.74	0.58	0.42	0.47	0.67	0.50	0.93	0.83	0.84	0.35	0.82	0.89
Total Arrivals			561			79			638			325		1603
Total Departures			562			41			769			231		1603
Total			1123			120			1407			556		

TRAFFIC COUNT SUMMARY WORKSHEET

PROJECT: Kaanapali
INTERSECTION: Honoapiilani Hwy at Napilihau St
DAY/DATE: Monday, 17 May 04
START TIME: 15:30 PM
END TIME: 18:00 PM

Cumulative Counter Readings at:

Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
15:30	0	0	0	0	0	0	0	0	0	0	0	0	0
15:45	0	0	0	0	0	0	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0	0	0	0	0
16:15	0	0	0	0	0	0	0	0	0	0	0	0	0
16:30	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15	0	0	0	0	0	0	0	0	0	0	0	0	0
17:30	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45	0	0	0	0	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0	0	0	0

15-Minute Volumes Beginning at:

	Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Interval	Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	15:30	19	74	1	1	4	1	3	64	104	95	4	12	382
2	15:45	11	65	0	0	2	3	4	52	85	111	1	18	352
3	16:00	22	94	0	0	3	0	0	66	94	104	1	17	401
4	16:15	18	95	2	1	1	1	4	65	96	84	1	16	384
5	16:30	28	75	1	1	1	1	2	51	83	96	0	15	354
6	16:45	14	84	1	1	1	3	4	40	93	66	5	7	319
7	17:00	11	58	0	0	2	4	2	62	78	112	0	19	348
8	17:15	16	55	0	2	1	3	0	58	74	79	0	12	300
9	17:30	14	56	0	0	2	0	0	41	76	75	2	15	281
10	17:45	18	59	0	0	0	0	1	45	63	70	3	10	269
	Max	28	95	2	2	4	4	4	66	104	112	5	19	401

Maximum Hourly Volume of Each Movement

15:30	16:30	70	328	3	2	10	5	11	247	379	394	7	63	1519
15:45	16:45	79	329	3	2	7	5	10	234	358	395	3	66	1491
16:00	17:00	82	348	4	3	6	5	10	222	366	350	7	55	1458
16:15	17:15	71	312	4	3	5	9	12	218	350	358	6	57	1405
16:30	17:30	69	272	2	4	5	11	8	211	328	353	5	53	1321
16:45	17:45	55	253	1	3	6	10	6	201	321	332	7	53	1248
17:00	18:00	59	228	0	2	5	7	3	206	291	336	5	56	1198

Maximum Hourly Volume of Each Movement

Volume	82	348	4	4	10	11	12	247	379	395	7	66	1519
Per Cent	19%	80%	1%	16%	40%	44%	2%	39%	59%	84%	1%	14%	
PHF	0.73	0.92	0.50	0.50	0.63	0.69	0.75	0.94	0.91	0.88	0.35	0.87	0.95
Total Arrivals		434			25			638			468		1565
Total Departures		317			23			754			471		1565
Total		751			48			1392			939		

TRAFFIC COUNT SUMMARY WORKSHEET

PROJECT: Kaanapali
INTERSECTION: Honoapiilani Hwy at Akahele St
DAY/DATE: Fri, 14 May 04
START TIME: 15:30 PM
END TIME: 18:00 PM

Cumulative Counter Readings at:

Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
15:30	0	0	0	0	0	0	0	0	0	0	0	0	0
15:45	0	0	0	0	0	0	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0	0	0	0	0
16:15	0	0	0	0	0	0	0	0	0	0	0	0	0
16:30	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15	0	0	0	0	0	0	0	0	0	0	0	0	0
17:30	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45	0	0	0	0	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0	0	0	0

15-Minute Volumes Beginning at:

	Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Interval	Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	15:30	10	172	14	13	1	5	9	184	8	7	0	14	437
2	15:45	15	160	3	1	0	3	2	155	29	22	0	16	406
3	16:00	12	215	0	2	0	4	0	174	13	24	3	18	465
4	16:15	24	202	10	3	0	3	1	226	45	41	0	14	569
5	16:30	19	221	4	1	1	9	12	215	32	34	2	19	569
6	16:45	12	217	5	3	1	3	5	158	20	33	0	19	476
7	17:00	27	215	9	3	0	5	3	201	29	44	1	9	546
8	17:15	15	209	5	2	0	0	8	206	23	22	2	29	521
9	17:30	10	115	2	5	8	8	2	141	17	13	1	19	341
10	17:45	13	93	4	1	0	6	5	138	20	12	0	11	303
	Max	27	221	14	13	8	9	12	226	45	44	3	29	569

Maximum Hourly Volume of Each Movement

15:30	16:30	61	749	27	19	1	15	12	739	95	94	3	62	1877
15:45	16:45	70	798	17	7	1	19	15	770	119	121	5	67	2009
16:00	17:00	67	855	19	9	2	19	18	773	110	132	5	70	2079
16:15	17:15	82	855	28	10	2	20	21	800	126	152	3	61	2160
16:30	17:30	73	862	23	9	2	17	28	780	104	133	5	76	2112
16:45	17:45	64	756	21	13	9	16	18	706	89	112	4	76	1884
17:00	18:00	65	632	20	11	8	19	18	686	89	91	4	68	1711

Maximum Hourly Volume of Each Movement

Volume	82	862	28	19	9	20	28	800	126	152	5	76	2160
Per Cent	8%	89%	3%	40%	19%	42%	3%	84%	13%	65%	2%	33%	
PHF	0.76	0.98	0.50	0.37	0.28	0.56	0.58	0.88	0.70	0.86	0.42	0.66	0.95
Total Arrivals		972			48			954			233		2207
Total Departures		895			61			1034			217		2207
Total		1867			109			1988			450		

TRAFFIC COUNT SUMMARY WORKSHEET

PROJECT: Kaanapali
INTERSECTION: Honoapiilani Hwy at Akahele St
DAY/DATE: Mon, 17 May 04
START TIME: 6:30 am
END TIME: 9:00 am

Cumulative Counter Readings at:

Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
6:30	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45	0	0	0	0	0	0	0	0	0	0	0	0	0
9:00	0	0	0	0	0	0	0	0	0	0	0	0	0

15-Minute Volumes Beginning at:

	Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Interval	Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	6:30	3	56	2	1	0	1	1	59	3	5	0	9	140
2	6:45	2	74	2	0	1	3	1	89	3	12	2	18	207
3	7:00	10	121	7	1	0	0	4	97	10	20	0	11	281
4	7:15	5	175	1	1	0	5	4	93	8	33	0	11	336
5	7:30	5	223	2	2	1	2	9	136	15	32	3	16	446
6	7:45	6	134	5	3	2	4	10	110	15	24	0	13	326
7	8:00	10	144	3	2	4	11	9	133	18	32	3	19	388
8	8:15	11	123	4	4	2	21	9	138	23	24	2	16	377
9	8:30	8	138	3	1	1	6	1	100	16	20	0	9	303
10	8:45	10	155	0	1	0	4	1	111	10	32	0	9	333
	Max	11	223	7	4	4	21	10	138	23	33	3	19	446

Maximum Hourly Volume of Each Movement

6:30	7:30	20	426	12	3	1	9	10	338	24	70	2	49	964
6:45	7:45	22	593	12	4	2	10	18	415	36	97	5	56	1270
7:00	8:00	26	653	15	7	3	11	27	436	48	109	3	51	1389
7:15	8:15	26	676	11	8	7	22	32	472	56	121	6	59	1496
7:30	8:30	32	624	14	11	9	38	37	517	71	112	8	64	1537
7:45	8:45	35	539	15	10	9	42	29	481	72	100	5	57	1394
8:00	9:00	39	560	10	8	7	42	20	482	67	108	5	53	1401

Maximum Hourly Volume of Each Movement

Volume	39	676	15	11	9	42	37	517	72	121	8	64	1537
Per Cent	5%	93%	2%	18%	15%	68%	6%	83%	12%	63%	4%	33%	
PHF	0.89	0.76	0.54	0.69	0.56	0.50	0.93	0.94	0.78	0.92	0.67	0.84	0.86
Total Arrivals		730			62			626			193		1611
Total Departures		592			60			839			120		1611
Total		1322			122			1465			313		

TRAFFIC COUNT SUMMARY WORKSHEET

PROJECT: Kaanapali
INTERSECTION: Honoapiilani Hwy at Hoohui Rd
DAY/DATE: Monday, 17 May 04
START TIME: 15:30 PM
END TIME: 18:00 PM

Cumulative Counter Readings at:

Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
15:30	0	0	0	0	0	0	0	0	0	0	0	0	0
15:45	0	0	0	0	0	0	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0	0	0	0	0
16:15	0	0	0	0	0	0	0	0	0	0	0	0	0
16:30	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15	0	0	0	0	0	0	0	0	0	0	0	0	0
17:30	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45	0	0	0	0	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0	0	0	0

15-Minute Volumes Beginning at:

	Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Interval	Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	15:30	15	121	4	2	10	21	10	133	45	35	2	25	423
2	15:45	23	144	6	4	10	9	23	140	59	62	6	45	531
3	16:00	17	121	3	5	4	11	11	122	43	57	4	33	431
4	16:15	23	111	3	5	6	7	14	101	51	53	5	41	420
5	16:30	28	105	2	6	3	5	8	94	39	49	2	37	378
6	16:45	42	109	5	1	1	9	9	151	75	54	6	42	504
7	17:00	33	165	12	3	14	17	6	152	70	75	6	57	610
8	17:15	30	130	8	4	6	13	8	128	57	61	4	43	492
9	17:30	31	131	2	1	6	14	11	126	60	69	8	40	499
10	17:45	27	91	3	0	6	3	2	97	34	28	3	29	323
	Max	42	165	12	6	14	21	23	152	75	75	8	57	610

Maximum Hourly Volume of Each Movement

15:30	16:30	78	497	16	16	30	48	58	496	198	207	17	144	1805
15:45	16:45	91	481	14	20	23	32	56	457	192	221	17	156	1760
16:00	17:00	110	446	13	17	14	32	42	468	208	213	17	153	1733
16:15	17:15	126	490	22	15	24	38	37	498	235	231	19	177	1912
16:30	17:30	133	509	27	14	24	44	31	525	241	239	18	179	1984
16:45	17:45	136	535	27	9	27	53	34	557	262	259	24	182	2105
17:00	18:00	121	517	25	8	32	47	27	503	221	233	21	169	1924

Maximum Hourly Volume of Each Movement

Volume	136	535	27	20	32	53	58	557	262	259	24	182	2105
Per Cent	19%	77%	4%	19%	30%	50%	7%	64%	30%	56%	5%	39%	
PHF	0.81	0.81	0.56	0.83	0.57	0.63	0.63	0.92	0.87	0.86	0.75	0.80	0.86
Total Arrivals		698			105			877			465		2145
Total Departures		759			109			847			430		2145
Total		1457			214			1724			895		

TRAFFIC COUNT SUMMARY WORKSHEET

PROJECT: Kaanapali
INTERSECTION: Honoapiilani Hwy at Hoohui Rd
DAY/DATE: Wednesday, 19 May 04
START TIME: 6:30 am
END TIME: 9:00 am

Cumulative Counter Readings at:

Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
6:30	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45	0	0	0	0	0	0	0	0	0	0	0	0	0
9:00	0	0	0	0	0	0	0	0	0	0	0	0	0

15-Minute Volumes Beginning at:

	Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Interval	Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	6:30	10	165	2	1	3	11	7	65	17	21	0	7	309
2	6:45	13	83	3	0	4	6	10	83	20	31	3	18	274
3	7:00	14	107	1	1	2	18	2	89	22	57	1	12	326
4	7:15	15	136	1	0	1	22	1	119	25	64	0	15	399
5	7:30	17	92	2	0	0	10	4	97	31	55	1	19	328
6	7:45	15	96	1	3	8	9	4	109	46	43	10	28	372
7	8:00	14	74	1	0	2	15	1	122	37	42	1	19	328
8	8:15	14	98	1	1	4	7	2	125	38	44	2	24	360
9	8:30	18	90	1	1	1	5	6	109	32	65	0	21	349
10	8:45	17	105	1	1	2	9	4	98	34	43	1	25	340
	Max	18	165	3	3	8	22	10	125	46	65	10	28	399

Maximum Hourly Volume of Each Movement

6:30	7:30	52	491	7	2	10	57	20	356	84	173	4	52	1308
6:45	7:45	59	418	7	1	7	56	17	388	98	207	5	64	1327
7:00	8:00	61	431	5	4	11	59	11	414	124	219	12	74	1425
7:15	8:15	61	398	5	3	11	56	10	447	139	204	12	81	1427
7:30	8:30	60	360	5	4	14	41	11	453	152	184	14	90	1388
7:45	8:45	61	358	4	5	15	36	13	465	153	194	13	92	1409
8:00	9:00	63	367	4	3	9	36	13	454	141	194	4	89	1377

Maximum Hourly Volume of Each Movement

Volume	63	491	7	5	15	59	20	465	153	219	14	92	1427
Per Cent	11%	88%	1%	6%	19%	75%	3%	73%	24%	67%	4%	28%	
PHF	0.88	0.74	0.58	0.42	0.47	0.67	0.50	0.93	0.83	0.84	0.35	0.82	0.89
Total Arrivals		561			79			638			325		1603
Total Departures		562			41			769			231		1603
Total		1123			120			1407			556		

TRAFFIC COUNT SUMMARY WORKSHEET

PROJECT: Kaanapali
INTERSECTION: Honoapiilani Hwy at Kaanapali Prkwy
DAY/DATE: Wednesday, 19 May 04
START TIME: 6:30 am
END TIME: 9:00 am

Cumulative Counter Readings at:

Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
6:30	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45	20	137	1	1	2	1	0	0	0	0	0	0	162
7:00	36	311	2	2	2	1	0	0	0	0	0	0	354
7:15	51	472	3	2	3	3	0	0	0	0	0	0	534
7:30	79	826	5	3	5	6	0	0	0	0	0	0	924
7:45	103	1105	9	6	7	9	0	0	0	0	0	0	1239
8:00	135	1367	17	10	10	10	0	0	0	0	0	0	1549
8:15	172	1573	21	11	13	10	0	0	0	0	0	0	1800
8:30	201	1757	25	13	15	11	0	0	0	0	0	0	2022
8:45	232	1971	29	15	17	12	0	0	0	0	0	0	2276
9:00	252	2232	37	16	18	13	0	0	0	0	0	0	2568

15-Minute Volumes Beginning at:

	Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Interval	Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	6:30	20	137	1	1	2	1	2	146	99	29	0	9	447
2	6:45	16	174	1	1	0	0	2	196	93	48	1	16	548
3	7:00	15	161	1	0	1	2	1	175	108	55	0	26	545
4	7:15	28	354	2	1	2	3	2	202	113	68	0	28	803
5	7:30	24	279	4	3	2	3	2	242	114	63	2	34	772
6	7:45	32	262	8	4	3	1	1	276	107	57	0	28	779
7	8:00	37	206	4	1	3	0	2	241	92	67	3	23	679
8	8:15	29	184	4	2	2	1	1	235	71	49	1	33	612
9	8:30	31	214	4	2	2	1	3	168	79	55	0	32	591
10	8:45	20	261	8	1	1	1	0	192	83	47	0	42	656
	Max	37	354	8	4	3	3	3	276	114	68	3	42	803

Maximum Hourly Volume of Each Movement

6:30	7:30	79	826	5	3	5	6	7	719	413	200	1	79	2343
6:45	7:45	83	968	8	5	5	8	7	815	428	234	3	104	2668
7:00	8:00	99	1056	15	8	8	9	6	895	442	243	2	116	2899
7:15	8:15	121	1101	18	9	10	7	7	961	426	255	5	113	3033
7:30	8:30	122	931	20	10	10	5	6	994	384	236	6	118	2842
7:45	8:45	129	866	20	9	10	3	7	920	349	228	4	116	2661
8:00	9:00	117	865	20	6	8	3	6	836	325	218	4	130	2538

Maximum Hourly Volume of Each Movement

Volume	129	1101	20	10	10	9	7	994	442	255	6	130	3033
Per Cent	10%	88%	2%	34%	34%	31%	0%	69%	31%	65%	2%	33%	
PHF	0.87	0.78	0.63	0.63	0.83	0.75	0.58	0.90	0.97	0.94	0.50	0.77	0.94
Total Arrivals		1250			29			1443			391		3113
Total Departures		1134			33			1365			581		3113
Total		2384			62			2808			972		

TRAFFIC COUNT SUMMARY WORKSHEET

PROJECT: Kaanapali
INTERSECTION: Honoapiilani Hwy at Kaanapali Prkwy
DAY/DATE: Wednesday, 19 May 04
START TIME: 6:30 am
END TIME: 9:00 am

Cumulative Counter Readings at:

Start	North Approach			East Approach			South Approach			West Approach			Intersection
Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
6:30	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45	20	137	1	1	2	1	0	0	0	0	0	0	162
7:00	36	311	2	2	2	1	0	0	0	0	0	0	354
7:15	51	472	3	2	3	3	0	0	0	0	0	0	534
7:30	79	826	5	3	5	6	0	0	0	0	0	0	924
7:45	103	1105	9	6	7	9	0	0	0	0	0	0	1239
8:00	135	1367	17	10	10	10	0	0	0	0	0	0	1549
8:15	172	1573	21	11	13	10	0	0	0	0	0	0	1800
8:30	201	1757	25	13	15	11	0	0	0	0	0	0	2022
8:45	232	1971	29	15	17	12	0	0	0	0	0	0	2276
9:00	252	2232	37	16	18	13	0	0	0	0	0	0	2568

15-Minute Volumes Beginning at:

	Start	North Approach			East Approach			South Approach			West Approach			Intersection
Interval	Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	6:30	20	137	1	1	2	1	2	146	99	29	0	9	447
2	6:45	16	174	1	1	0	0	2	196	93	48	1	16	548
3	7:00	15	161	1	0	1	2	1	175	108	55	0	26	545
4	7:15	28	354	2	1	2	3	2	202	113	68	0	28	803
5	7:30	24	279	4	3	2	3	2	242	114	63	2	34	772
6	7:45	32	262	8	4	3	1	1	276	107	57	0	28	779
7	8:00	37	206	4	1	3	0	2	241	92	67	3	23	679
8	8:15	29	184	4	2	2	1	1	235	71	49	1	33	612
9	8:30	31	214	4	2	2	1	3	168	79	55	0	32	591
10	8:45	20	261	8	1	1	1	0	192	83	47	0	42	656
	Max	37	354	8	4	3	3	3	276	114	68	3	42	803

Maximum Hourly Volume of Each Movement

6:30	7:30	79	826	5	3	5	6	7	719	413	200	1	79	2343
6:45	7:45	83	968	8	5	5	8	7	815	428	234	3	104	2668
7:00	8:00	99	1056	15	8	8	9	6	895	442	243	2	116	2899
7:15	8:15	121	1101	18	9	10	7	7	961	426	255	5	113	3033
7:30	8:30	122	931	20	10	10	5	6	994	384	236	6	118	2842
7:45	8:45	129	866	20	9	10	3	7	920	349	228	4	116	2661
8:00	9:00	117	865	20	6	8	3	6	836	325	218	4	130	2538

Maximum Hourly Volume of Each Movement

Volume		129	1101	20	10	10	9	7	994	442	255	6	130	3033
Per Cent		10%	88%	2%	34%	34%	31%	0%	69%	31%	65%	2%	33%	
PHF		0.87	0.78	0.63	0.63	0.83	0.75	0.58	0.90	0.97	0.94	0.50	0.77	0.94
Total Arrivals			1250			29			1443			391		3113
Total Departures			1134			33			1365			581		3113
Total			2384			62			2808			972		

TRAFFIC COUNT SUMMARY WORKSHEET

PROJECT: Kaanapali
INTERSECTION: Honoapiilani Hwy at Kaanapali Prkwy
DAY/DATE: Wednesday, 19 May 04
START TIME: 15:30 PM
END TIME: 18:00 PM

Cumulative Counter Readings at:

Start	North Approach			East Approach			South Approach			West Approach			Intersection
Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
15:30	0	0	0	0	0	0	0	0	0	0	0	0	0
15:45	0	0	0	0	0	0	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0	0	0	0	0
16:15	0	0	0	0	0	0	0	0	0	0	0	0	0
16:30	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15	0	0	0	0	0	0	0	0	0	0	0	0	0
17:30	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45	0	0	0	0	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0	0	0	0

15-Minute Volumes Beginning at:

	Start	North Approach			East Approach			South Approach			West Approach			Intersection
Interval	Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	15:30	60	311	10	1	4	4	19	228	132	108	5	49	931
2	15:45	47	301	22	5	0	6	0	292	131	131	3	73	1011
3	16:00	63	321	10	4	0	2	1	203	113	173	0	80	970
4	16:15	73	406	11	4	3	2	1	264	162	179	1	71	1177
5	16:30	87	340	2	2	1	0	1	259	124	141	2	78	1037
6	16:45	72	359	16	1	0	3	4	289	157	136	2	63	1102
7	17:00	44	337	9	0	2	4	2	271	96	117	0	70	952
8	17:15	52	331	6	1	0	1	2	276	89	143	2	62	965
9	17:30	38	286	17	0	8	2	2	224	82	143	2	67	871
10	17:45	40	307	6	4	2	1	5	211	63	117	3	60	819
	Max	87	406	22	5	8	6	19	292	162	179	5	80	1177

Maximum Hourly Volume of Each Movement

15:30	16:30	243	1339	53	14	7	14	21	987	538	591	9	273	4089
15:45	16:45	270	1368	45	15	4	10	3	1018	530	624	6	302	4195
16:00	17:00	295	1426	39	11	4	7	7	1015	556	629	5	292	4286
16:15	17:15	276	1442	38	7	6	9	8	1083	539	573	5	282	4268
16:30	17:30	255	1367	33	4	3	8	9	1095	466	537	6	273	4056
16:45	17:45	206	1313	48	2	10	10	10	1060	424	539	6	262	3890
17:00	18:00	174	1261	38	5	12	8	11	982	330	520	7	259	3607

Maximum Hourly Volume of Each Movement

Volume		295	1442	53	15	12	14	21	1095	556	629	9	302	4286
Per Cent		16%	81%	3%	37%	29%	34%	1%	65%	33%	67%	1%	32%	
PHF		0.85	0.89	0.60	0.75	0.38	0.58	0.28	0.94	0.86	0.88	0.45	0.94	0.91
Total Arrivals			1790			41			1672			940		4443
Total Departures			1412			83			2085			863		4443
Total			3202			124			3757			1803		

TRAFFIC COUNT SUMMARY WORKSHEET

PROJECT: Kaanapali
INTERSECTION: Honoapiilani Hwy at Kaanapali Prkwy
DAY/DATE: Wednesday, 19 May 04
START TIME: 15:30 PM
END TIME: 18:00 PM

Cumulative Counter Readings at:

Start	North Approach			East Approach			South Approach			West Approach			Intersection
Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
15:30	0	0	0	0	0	0	0	0	0	0	0	0	0
15:45	0	0	0	0	0	0	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0	0	0	0	0
16:15	0	0	0	0	0	0	0	0	0	0	0	0	0
16:30	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15	0	0	0	0	0	0	0	0	0	0	0	0	0
17:30	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45	0	0	0	0	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0	0	0	0

15-Minute Volumes Beginning at:

	Start	North Approach			East Approach			South Approach			West Approach			Intersection
Interval	Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	15:30	60	311	10	1	4	4	19	228	132	108	5	49	931
2	15:45	47	301	22	5	0	6	0	292	131	131	3	73	1011
3	16:00	63	321	10	4	0	2	1	203	113	173	0	80	970
4	16:15	73	406	11	4	3	2	1	264	162	179	1	71	1177
5	16:30	87	340	2	2	1	0	1	259	124	141	2	78	1037
6	16:45	72	359	16	1	0	3	4	289	157	136	2	63	1102
7	17:00	44	337	9	0	2	4	2	271	96	117	0	70	952
8	17:15	52	331	6	1	0	1	2	276	89	143	2	62	965
9	17:30	38	286	17	0	8	2	2	224	82	143	2	67	871
10	17:45	40	307	6	4	2	1	5	211	63	117	3	60	819
	Max	87	406	22	5	8	6	19	292	162	179	5	80	1177

Maximum Hourly Volume of Each Movement

15:30	16:30	243	1339	53	14	7	14	21	987	538	591	9	273	4089
15:45	16:45	270	1368	45	15	4	10	3	1018	530	624	6	302	4195
16:00	17:00	295	1426	39	11	4	7	7	1015	556	629	5	292	4286
16:15	17:15	276	1442	38	7	6	9	8	1083	539	573	5	282	4268
16:30	17:30	255	1367	33	4	3	8	9	1095	466	537	6	273	4056
16:45	17:45	206	1313	48	2	10	10	10	1060	424	539	6	262	3890
17:00	18:00	174	1261	38	5	12	8	11	982	330	520	7	259	3607

Maximum Hourly Volume of Each Movement

Volume		295	1442	53	15	12	14	21	1095	556	629	9	302	4286
Per Cent		16%	81%	3%	37%	29%	34%	1%	65%	33%	67%	1%	32%	
PHF		0.85	0.89	0.60	0.75	0.38	0.58	0.28	0.94	0.86	0.88	0.45	0.94	0.91
Total Arrivals			1790			41			1672			940		4443
Total Departures			1412			83			2085			863		4443
Total			3202			124			3757			1803		

TRAFFIC COUNT SUMMARY WORKSHEET

PROJECT: Kaanapali
INTERSECTION: Honoapiilani Hwy at Leialii Pkwy
DAY/DATE: Fri, 14 May 04
START TIME: 6:30 am
END TIME: 9:00 am

Cumulative Counter Readings at:

Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
6:30	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45	0	0	0	0	0	0	0	0	0	0	0	0	0
9:00	0	0	0	0	0	0	0	0	0	0	0	0	0

15-Minute Volumes Beginning at:

	Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Interval	Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	6:30	0	218	4	5	1	4	6	274	0	0	0	0	512
2	6:45	0	315	6	4	0	6	15	267	0	0	0	0	613
3	7:00	1	411	9	9	0	6	20	322	1	1	1	0	781
4	7:15	1	310	7	5	0	12	18	410	1	0	0	0	764
5	7:30	1	306	7	7	0	8	15	350	1	2	0	0	697
6	7:45	0	287	10	10	0	8	28	299	3	2	0	0	647
7	8:00	0	312	11	5	0	9	21	263	1	0	0	0	622
8	8:15	1	274	14	15	0	23	19	295	3	4	0	3	651
9	8:30	0	289	10	7	0	19	14	289	1	2	0	0	631
10	8:45	0	303	11	13	0	20	16	240	6	1	0	0	610
	Max	1	411	14	15	1	23	28	410	6	4	1	3	781

Maximum Hourly Volume of Each Movement

6:30	7:30	2	1254	26	23	1	28	59	1273	2	1	1	0	2670
6:45	7:45	3	1342	29	25	0	32	68	1349	3	3	1	0	2855
7:00	8:00	3	1314	33	31	0	34	81	1381	6	5	1	0	2889
7:15	8:15	2	1215	35	27	0	37	82	1322	6	4	0	0	2730
7:30	8:30	2	1179	42	37	0	48	83	1207	8	8	0	3	2617
7:45	8:45	1	1162	45	37	0	59	82	1146	8	8	0	3	2551
8:00	9:00	1	1178	46	40	0	71	70	1087	11	7	0	3	2514

Maximum Hourly Volume of Each Movement

Volume		3	1342	46	40	1	71	83	1381	11	8	1	3	2889
Per Cent		0%	96%	3%	36%	1%	63%	6%	94%	1%	67%	8%	25%	
PHF		0.75	0.82	0.82	0.67	0.25	0.77	0.74	0.84	0.46	0.50	0.25	0.25	0.92
Total Arrivals			1391			112			1475			12		2990
Total Departures			1424			130			1421			15		2990
Total			2815			242			2896			27		

TRAFFIC COUNT SUMMARY WORKSHEET

PROJECT: Kaanapali
INTERSECTION: Honoapiilani Hwy at Leialii Pkwy
DAY/DATE: Fri, 14 May 04
START TIME: 6:30 am
END TIME: 9:00 am

Cumulative Counter Readings at:

Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
6:30	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45	0	0	0	0	0	0	0	0	0	0	0	0	0
9:00	0	0	0	0	0	0	0	0	0	0	0	0	0

15-Minute Volumes Beginning at:

	Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Interval	Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	6:30	0	218	4	5	1	4	6	274	0	0	0	0	512
2	6:45	0	315	6	4	0	6	15	267	0	0	0	0	613
3	7:00	1	411	9	9	0	6	20	322	1	1	1	0	781
4	7:15	1	310	7	5	0	12	18	410	1	0	0	0	764
5	7:30	1	306	7	7	0	8	15	350	1	2	0	0	697
6	7:45	0	287	10	10	0	8	28	299	3	2	0	0	647
7	8:00	0	312	11	5	0	9	21	263	1	0	0	0	622
8	8:15	1	274	14	15	0	23	19	295	3	4	0	3	651
9	8:30	0	289	10	7	0	19	14	289	1	2	0	0	631
10	8:45	0	303	11	13	0	20	16	240	6	1	0	0	610
	Max	1	411	14	15	1	23	28	410	6	4	1	3	781

Maximum Hourly Volume of Each Movement

6:30	7:30	2	1254	26	23	1	28	59	1273	2	1	1	0	2670
6:45	7:45	3	1342	29	25	0	32	68	1349	3	3	1	0	2855
7:00	8:00	3	1314	33	31	0	34	81	1381	6	5	1	0	2889
7:15	8:15	2	1215	35	27	0	37	82	1322	6	4	0	0	2730
7:30	8:30	2	1179	42	37	0	48	83	1207	8	8	0	3	2617
7:45	8:45	1	1162	45	37	0	59	82	1146	8	8	0	3	2551
8:00	9:00	1	1178	46	40	0	71	70	1087	11	7	0	3	2514

Maximum Hourly Volume of Each Movement

Volume	3	1342	46	40	1	71	83	1381	11	8	1	3	2889
Per Cent	0%	96%	3%	36%	1%	63%	6%	94%	1%	67%	8%	25%	
PHF	0.75	0.82	0.82	0.67	0.25	0.77	0.74	0.84	0.46	0.50	0.25	0.25	0.92
Total Arrivals		1391			112			1475			12		2990
Total Departures		1424			130			1421			15		2990
Total		2815			242			2896			27		

TRAFFIC COUNT SUMMARY WORKSHEET

PROJECT: Kaanapali
INTERSECTION: Honoapiilani Hwy at Leialii Pkwy
DAY/DATE: Fri, 14 May 04
START TIME: 15:30 PM
END TIME: 18:00 PM

Cumulative Counter Readings at:

Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
15:30	0	0	0	0	0	0	0	0	0	0	0	0	0
15:45	0	0	0	0	0	0	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0	0	0	0	0
16:15	0	0	0	0	0	0	0	0	0	0	0	0	0
16:30	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15	0	0	0	0	0	0	0	0	0	0	0	0	0
17:30	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45	0	0	0	0	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0	0	0	0

15-Minute Volumes Beginning at:

	Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Interval	Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	15:30	0	405	17	15	0	28	26	413	0	0	0	0	904
2	15:45	2	464	17	16	0	27	30	422	5	0	1	1	985
3	16:00	0	392	23	24	0	38	32	431	2	2	0	3	947
4	16:15	1	514	15	13	0	23	25	417	3	3	0	0	1014
5	16:30	0	418	17	12	0	22	16	389	1	2	0	0	877
6	16:45	1	403	17	20	1	17	27	416	1	2	0	0	905
7	17:00	1	402	21	16	0	19	24	388	1	1	0	0	873
8	17:15	2	434	14	14	0	9	36	350	2	1	0	2	864
9	17:30	0	392	13	8	0	9	27	349	1	1	0	1	801
10	17:45	1	395	12	13	0	18	25	310	1	1	0	0	776
	Max	2	514	23	24	1	38	36	431	5	3	1	3	1014

Maximum Hourly Volume of Each Movement

15:30	16:30	3	1775	72	68	0	116	113	1683	10	5	1	4	3850
15:45	16:45	3	1788	72	65	0	110	103	1659	11	7	1	4	3823
16:00	17:00	2	1727	72	69	1	100	100	1653	7	9	0	3	3743
16:15	17:15	3	1737	70	61	1	81	92	1610	6	8	0	0	3669
16:30	17:30	4	1657	69	62	1	67	103	1543	5	6	0	2	3519
16:45	17:45	4	1631	65	58	1	54	114	1503	5	5	0	3	3443
17:00	18:00	4	1623	60	51	0	55	112	1397	5	4	0	3	3314

Maximum Hourly Volume of Each Movement

Volume	4	1788	72	69	1	116	114	1683	11	9	1	4	3850
Per Cent	0%	96%	4%	37%	1%	62%	6%	93%	1%	64%	7%	29%	
PHF	0.50	0.87	0.78	0.72	0.25	0.76	0.79	0.98	0.55	0.75	0.25	0.33	0.95
Total Arrivals		1864			186			1808			14		3872
Total Departures		1756			187			1913			16		3872
Total		3620			373			3721			30		

TRAFFIC COUNT SUMMARY WORKSHEET

PROJECT: Kaanapali
INTERSECTION: Honoapiilani Hwy at Lelalii Pkwy
DAY/DATE: Fri, 14 May 04
START TIME: 15:30 PM
END TIME: 18:00 PM

Cumulative Counter Readings at:

Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
15:30	0	0	0	0	0	0	0	0	0	0	0	0	0
15:45	0	0	0	0	0	0	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0	0	0	0	0
16:15	0	0	0	0	0	0	0	0	0	0	0	0	0
16:30	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15	0	0	0	0	0	0	0	0	0	0	0	0	0
17:30	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45	0	0	0	0	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0	0	0	0

15-Minute Volumes Beginning at:

	Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Interval	Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	15:30	0	405	17	15	0	28	26	413	0	0	0	0	904
2	15:45	2	464	17	16	0	27	30	422	5	0	1	1	985
3	16:00	0	392	23	24	0	38	32	431	2	2	0	3	947
4	16:15	1	514	15	13	0	23	25	417	3	3	0	0	1014
5	16:30	0	418	17	12	0	22	16	389	1	2	0	0	877
6	16:45	1	403	17	20	1	17	27	416	1	2	0	0	905
7	17:00	1	402	21	16	0	19	24	388	1	1	0	0	873
8	17:15	2	434	14	14	0	9	36	350	2	1	0	2	864
9	17:30	0	392	13	8	0	9	27	349	1	1	0	1	801
10	17:45	1	395	12	13	0	18	25	310	1	1	0	0	776
	Max	2	514	23	24	1	38	36	431	5	3	1	3	1014

Maximum Hourly Volume of Each Movement

15:30	16:30	3	1775	72	68	0	116	113	1683	10	5	1	4	3850
15:45	16:45	3	1788	72	65	0	110	103	1659	11	7	1	4	3823
16:00	17:00	2	1727	72	69	1	100	100	1653	7	9	0	3	3743
16:15	17:15	3	1737	70	61	1	81	92	1610	6	8	0	0	3669
16:30	17:30	4	1657	69	62	1	67	103	1543	5	6	0	2	3519
16:45	17:45	4	1631	65	58	1	54	114	1503	5	5	0	3	3443
17:00	18:00	4	1623	60	51	0	55	112	1397	5	4	0	3	3314

Maximum Hourly Volume of Each Movement

Volume	4	1788	72	69	1	116	114	1683	11	9	1	4	3850
Per Cent	0%	96%	4%	37%	1%	62%	6%	93%	1%	64%	7%	29%	
PHF	0.50	0.87	0.78	0.72	0.25	0.76	0.79	0.98	0.55	0.75	0.25	0.33	0.95
Total Arrivals		1864			186			1808			14		3872
Total Departures		1756			187			1913			16		3872
Total		3620			373			3721			30		

TRAFFIC COUNT SUMMARY WORKSHEET

PROJECT: Kaanapali
INTERSECTION: Honoapiilani Hwy at Napilihau St
DAY/DATE: Monday, 17 May 04
START TIME: 6:30 am
END TIME: 9:00 am

Cumulative Counter Readings at:

Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
6:30	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45	0	0	0	0	0	0	0	0	0	0	0	0	0
9:00	0	0	0	0	0	0	0	0	0	0	0	0	0

15-Minute Volumes Beginning at:

	Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Interval	Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	6:30	5	17	0	2	1	1	1	58	31	55	0	12	183
2	6:45	8	27	0	0	0	4	1	55	30	75	0	12	212
3	7:00	8	47	0	1	1	2	1	54	48	83	3	11	259
4	7:15	8	33	0	3	0	2	5	89	60	98	0	14	312
5	7:30	8	35	1	2	0	2	3	73	44	79	0	14	261
6	7:45	2	49	1	3	1	1	1	66	49	74	0	16	263
7	8:00	11	32	1	2	2	3	1	66	66	83	2	20	289
8	8:15	4	39	1	0	1	0	5	56	31	73	0	12	222
9	8:30	10	36	5	1	0	4	6	59	34	79	0	5	239
10	8:45	8	35	1	1	1	5	2	73	55	75	3	14	273
	Max	11	49	5	3	2	5	6	89	66	98	3	20	312

Maximum Hourly Volume of Each Movement

6:30	7:30	29	124	0	6	2	9	8	256	169	311	3	49	966
6:45	7:45	32	142	1	6	1	10	10	271	182	335	3	51	1044
7:00	8:00	26	164	2	9	2	7	10	282	201	334	3	55	1095
7:15	8:15	29	149	3	10	3	8	10	294	219	334	2	64	1125
7:30	8:30	25	155	4	7	4	6	10	261	190	309	2	62	1035
7:45	8:45	27	156	8	6	4	8	13	247	180	309	2	53	1013
8:00	9:00	33	142	8	4	4	12	14	254	186	310	5	51	1023

Maximum Hourly Volume of Each Movement

Volume	33	164	8	10	4	12	14	294	219	335	5	64	1125
Per Cent	16%	80%	4%	38%	15%	46%	3%	56%	42%	83%	1%	16%	
PHF	0.75	0.84	0.40	0.83	0.50	0.60	0.58	0.83	0.83	0.85	0.42	0.80	0.90
Total Arrivals		205			26			527			404		1162
Total Departures		368			27			511			256		1162
Total		573			53			1038			660		

TRAFFIC COUNT SUMMARY WORKSHEET

PROJECT: Kaanapali
INTERSECTION: Honoapiilani Hwy at Napilihau St
DAY/DATE: Monday, 17 May 04
START TIME: 6:30 am
END TIME: 9:00 am

Cumulative Counter Readings at:

Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
6:30	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45	0	0	0	0	0	0	0	0	0	0	0	0	0
9:00	0	0	0	0	0	0	0	0	0	0	0	0	0

15-Minute Volumes Beginning at:

	Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Interval	Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	6:30	5	17	0	2	1	1	1	58	31	55	0	12	183
2	6:45	8	27	0	0	0	4	1	55	30	75	0	12	212
3	7:00	8	47	0	1	1	2	1	54	48	83	3	11	259
4	7:15	8	33	0	3	0	2	5	89	60	98	0	14	312
5	7:30	8	35	1	2	0	2	3	73	44	79	0	14	261
6	7:45	2	49	1	3	1	1	1	66	49	74	0	16	263
7	8:00	11	32	1	2	2	3	1	66	66	83	2	20	289
8	8:15	4	39	1	0	1	0	5	56	31	73	0	12	222
9	8:30	10	36	5	1	0	4	6	59	34	79	0	5	239
10	8:45	8	35	1	1	1	5	2	73	55	75	3	14	273
	Max	11	49	5	3	2	5	6	89	66	98	3	20	312

Maximum Hourly Volume of Each Movement

6:30	7:30	29	124	0	6	2	9	8	256	169	311	3	49	966
6:45	7:45	32	142	1	6	1	10	10	271	182	335	3	51	1044
7:00	8:00	26	164	2	9	2	7	10	282	201	334	3	55	1095
7:15	8:15	29	149	3	10	3	8	10	294	219	334	2	64	1125
7:30	8:30	25	155	4	7	4	6	10	261	190	309	2	62	1035
7:45	8:45	27	156	8	6	4	8	13	247	180	309	2	53	1013
8:00	9:00	33	142	8	4	4	12	14	254	186	310	5	51	1023

Maximum Hourly Volume of Each Movement

Volume		33	164	8	10	4	12	14	294	219	335	5	64	1125
Per Cent		16%	80%	4%	38%	15%	46%	3%	56%	42%	83%	1%	16%	
PHF		0.75	0.84	0.40	0.83	0.50	0.60	0.58	0.83	0.83	0.85	0.42	0.80	0.90
Total Arrivals			205			26			527			404		1162
Total Departures			368			27			511			256		1162
Total			573			53			1038			660		

TRAFFIC COUNT SUMMARY WORKSHEET

PROJECT: Kaanapali
INTERSECTION: Honoapiilani Hwy at Napilihau St
DAY/DATE: Monday, 17 May 04
START TIME: 15:30 PM
END TIME: 18:00 PM

Cumulative Counter Readings at:

Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
15:30	0	0	0	0	0	0	0	0	0	0	0	0	0
15:45	0	0	0	0	0	0	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0	0	0	0	0
16:15	0	0	0	0	0	0	0	0	0	0	0	0	0
16:30	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15	0	0	0	0	0	0	0	0	0	0	0	0	0
17:30	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45	0	0	0	0	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0	0	0	0

15-Minute Volumes Beginning at:

	Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Interval	Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	15:30	19	74	1	1	4	1	3	64	104	95	4	12	382
2	15:45	11	65	0	0	2	3	4	52	85	111	1	18	352
3	16:00	22	94	0	0	3	0	0	66	94	104	1	17	401
4	16:15	18	95	2	1	1	1	4	65	96	84	1	16	384
5	16:30	28	75	1	1	1	1	2	51	83	96	0	15	354
6	16:45	14	84	1	1	1	3	4	40	93	66	5	7	319
7	17:00	11	58	0	0	2	4	2	62	78	112	0	19	348
8	17:15	16	55	0	2	1	3	0	58	74	79	0	12	300
9	17:30	14	56	0	0	2	0	0	41	76	75	2	15	281
10	17:45	18	59	0	0	0	0	1	45	63	70	3	10	269
	Max	28	95	2	2	4	4	4	66	104	112	5	19	401

Maximum Hourly Volume of Each Movement

15:30	16:30	70	328	3	2	10	5	11	247	379	394	7	63	1519
15:45	16:45	79	329	3	2	7	5	10	234	358	395	3	66	1491
16:00	17:00	82	348	4	3	6	5	10	222	366	350	7	55	1458
16:15	17:15	71	312	4	3	5	9	12	218	350	358	6	57	1405
16:30	17:30	69	272	2	4	5	11	8	211	328	353	5	53	1321
16:45	17:45	55	253	1	3	6	10	6	201	321	332	7	53	1248
17:00	18:00	59	228	0	2	5	7	3	206	291	336	5	56	1198

Maximum Hourly Volume of Each Movement

Volume		82	348	4	4	10	11	12	247	379	395	7	66	1519
Per Cent		19%	80%	1%	16%	40%	44%	2%	39%	59%	84%	1%	14%	
PHF		0.73	0.92	0.50	0.50	0.63	0.69	0.75	0.94	0.91	0.88	0.35	0.87	0.95
Total Arrivals			434			25			638			468		1565
Total Departures			317			23			754			471		1565
Total			751			48			1392			939		

TRAFFIC COUNT SUMMARY WORKSHEET

PROJECT: Kaanapali
INTERSECTION: Honoapiilani Hwy at Napilihau St
DAY/DATE: Monday, 17 May 04
START TIME: 15:30 PM
END TIME: 18:00 PM

Cumulative Counter Readings at:

Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
15:30	0	0	0	0	0	0	0	0	0	0	0	0	0
15:45	0	0	0	0	0	0	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	0	0	0	0	0	0
16:15	0	0	0	0	0	0	0	0	0	0	0	0	0
16:30	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15	0	0	0	0	0	0	0	0	0	0	0	0	0
17:30	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45	0	0	0	0	0	0	0	0	0	0	0	0	0
18:00	0	0	0	0	0	0	0	0	0	0	0	0	0

15-Minute Volumes Beginning at:

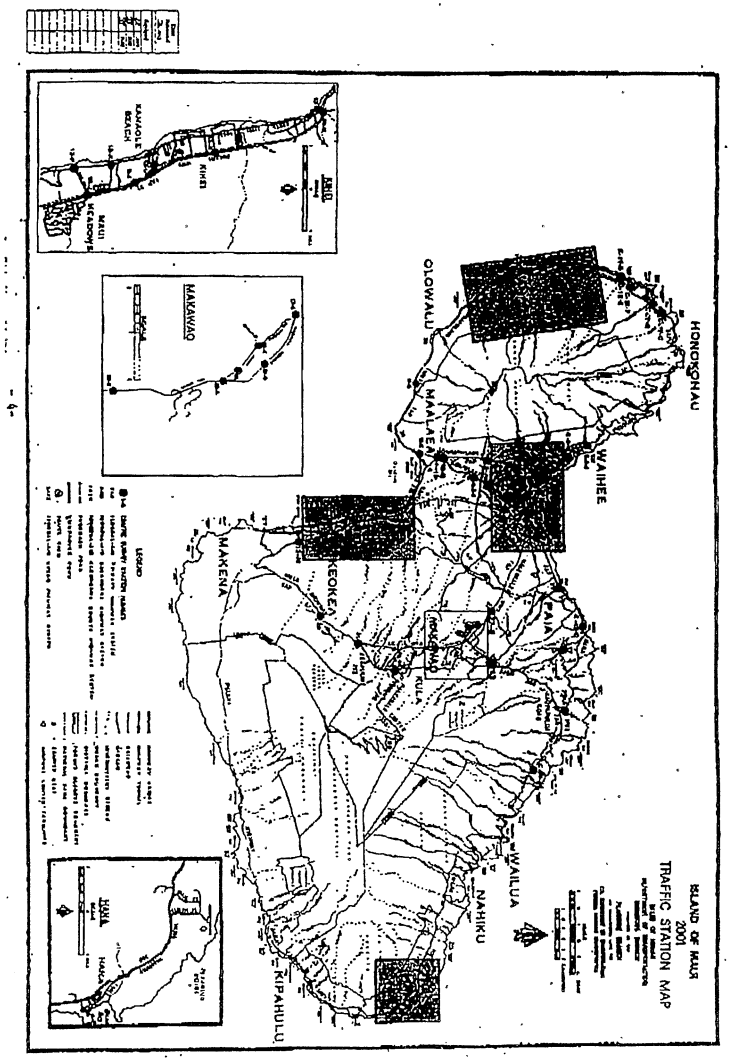
	Start	North Approach			East Approach			South Approach			West Approach			Intersectior
Interval	Time	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	15:30	19	74	1	1	4	1	3	64	104	95	4	12	382
2	15:45	11	65	0	0	2	3	4	52	85	111	1	18	352
3	16:00	22	94	0	0	3	0	0	66	94	104	1	17	401
4	16:15	18	95	2	1	1	1	4	65	96	84	1	16	384
5	16:30	28	75	1	1	1	1	2	51	83	96	0	15	354
6	16:45	14	84	1	1	1	3	4	40	93	66	5	7	319
7	17:00	11	58	0	0	2	4	2	62	78	112	0	19	348
8	17:15	16	55	0	2	1	3	0	58	74	79	0	12	300
9	17:30	14	56	0	0	2	0	0	41	76	75	2	15	281
10	17:45	18	59	0	0	0	0	1	45	63	70	3	10	269
	Max	28	95	2	2	4	4	4	66	104	112	5	19	401

Maximum Hourly Volume of Each Movement

15:30	16:30	70	328	3	2	10	5	11	247	379	394	7	63	1519
15:45	16:45	79	329	3	2	7	5	10	234	358	395	3	66	1491
16:00	17:00	82	348	4	3	6	5	10	222	366	350	7	55	1458
16:15	17:15	71	312	4	3	5	9	12	218	350	358	6	57	1405
16:30	17:30	69	272	2	4	5	11	8	211	328	353	5	53	1321
16:45	17:45	55	253	1	3	6	10	6	201	321	332	7	53	1248
17:00	18:00	59	228	0	2	5	7	3	206	291	336	5	56	1198

Maximum Hourly Volume of Each Movement

Volume	82	348	4	4	10	11	12	247	379	395	7	66	1519
Per Cent	19%	80%	1%	16%	40%	44%	2%	39%	59%	84%	1%	14%	
PHF	0.73	0.92	0.50	0.50	0.63	0.69	0.75	0.94	0.91	0.88	0.35	0.87	0.95
Total Arrivals		434			25			638			468		1565
Total Departures		317			23			754			471		1565
Total		751			48			1392			939		



24-HOUR TRAFFIC COUNT STATION SUMMARY

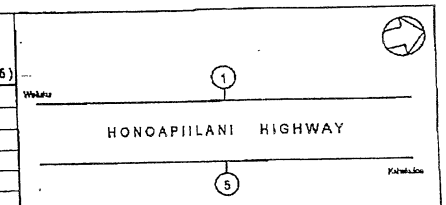
HAWAII STATE DEPARTMENT OF TRANSPORTATION
HIGHWAY PLANNING BRANCH

Station No : C-12-E
Highway/Street : Honoapiilani Highway
Location : at Kahana Kai Bridge
Fund System : Route No : M.P. : Island : Maui
Rte Dir (D-1)=Mov (5)

	ROAD SECTION	
	D-1	D-2
Number of Lanes		
Lane Width (Ft)		
Lateral Clearance (Ft) Left/Right		
Detection Method (Loops/Hoses)		

Special Conditions :

Highway Divided : No___ Yes___ Type :



FILE : SEG (1)

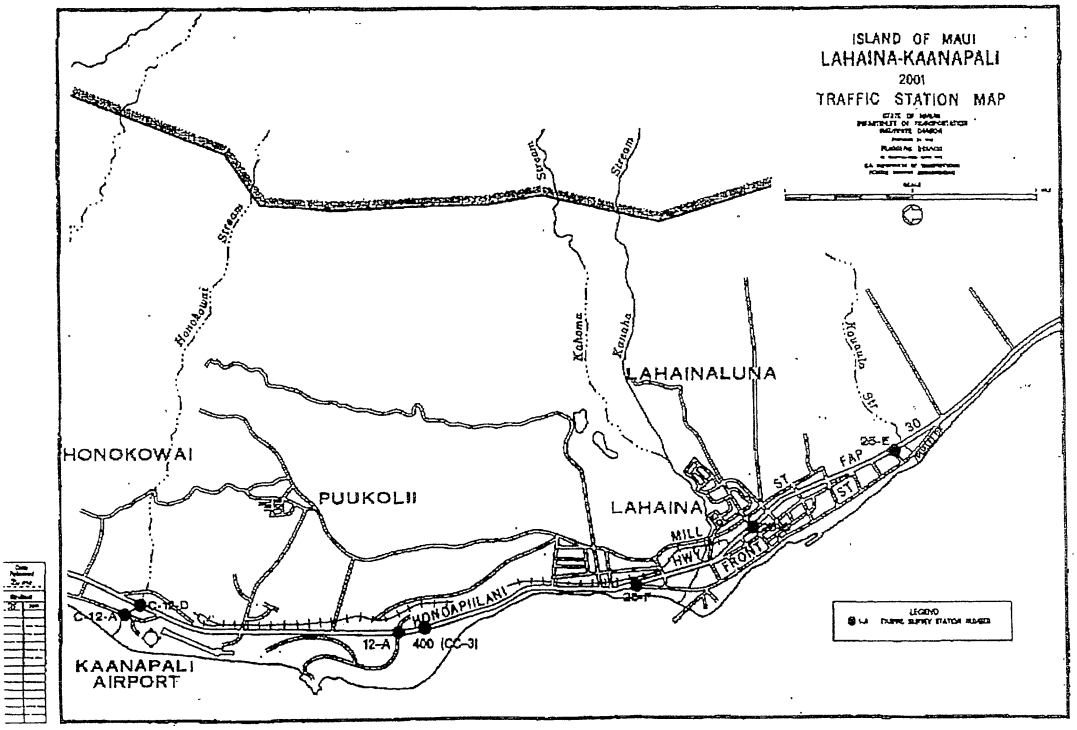
M1 = 12 Hrs Manual/24 Hrs Data Estimated
M2 = 24 Hrs Manual
M3 = 12 Hrs Manual/Truck & Cycle Count Only
A = 24 Hrs ATR
I = 24 Hrs IRD, Piezo Cables
I2 = 24 Hrs IRD, Piezo Cables/Truck & Cycle Count Only

DATE	SURVEY TYPE	A.M. PEAK HOUR						P.M. PEAK HOUR						24-HOUR PERIOD					
		VOLUME (VEH)			TRUCK (T) %			VOLUME (VEH)			TRUCK (T) %			VOLUME (VEH)			TRUCK (T) %		
		TRAFFIC DIRECTION			TRAFFIC DIRECTION			TRAFFIC DIRECTION			TRAFFIC DIRECTION			TRAFFIC DIRECTION			TRAFFIC DIRECTION		
		MOV 1	MOV 5	TOTAL	MOV 1	MOV 5	TOTAL	MOV 1	MOV 5	TOTAL	MOV 1	MOV 5	TOTAL	MOV 1	MOV 5	TOTAL	MOV 1	MOV 5	TOTAL
08/22-23/95	A	451	428	879	2.4	3.3	2.8	617	470	1087	1.5	1.9	1.7	6958	6744	13702	2.9	2.6	2.7
04/22-23/97	A	454	424	878	3.7	3.5	3.6	639	567	1206	2.0	1.9	2.0	7469	7228	14697	3.2	2.8	3.0
04/27-28/99	A	446	458	904	2.7	2.2	2.4	650	507	1157	2.2	1.6	1.9	7198	7107	14305	2.3	2.5	2.4
04/16-17/01	A	541	474	1015	4.6	3.2	3.9	786	503	1289	1.9	1.6	1.6	7829	7612	15441	2.9	2.8	2.8
04/01-02/03*	A	491	515	1006	2.9	3.3	3.1	763	545	1308	2.5	1.7	2.1	7886	7776	15662	2.6	1.9	2.2

STATION NO : C-12-E

Hwyst_01E\Maui\Vizeg

*March 19, 2003 Start of Operation Iraqi Freedom



018/032
FEDEX KINKOS 0937
5501

ISLAND : Maui
STATION NO : C-12-E
AUX NO :
FUND SYSTEM :
FILE: Seg (VTC)

STATION DESCRIPTION : Honoapiilani Highway at Kahana Kai Bridge Maui

COUNT GROUP ID :
ROUTE NO : M.P. :
HWY ST NAME : Honoapiilani Hwy
MOV (3 -) DIR : To Wailuku
MOV (5) DIR : To Kahakuloa

MOV (1) TYPE :
MOV (5) TYPE :

D-02 BEG SURVEY DATE : 04/01/03
D-01 BEG SURVEY DATE : 04/01/03

TCNO : C-12-E
ID NO : 12.48

START TIME : 09:00 AM
START TIME : 09:00 AM

TIME-AM	MOV 3	MOV 5	TOTAL	TIME-AM	MOV 1	MOV 5	TOTAL	TIME-PM	MOV 1	MOV 5	TOTAL	TIME-PM	MOV 1	MOV 5	TOTAL
12:00-12:15	16	23	39	6:00- 6:15	48	45	93	12:00-12:15	133	127	260	6:00- 6:15	109	108	217
12:15-12:30	6	15	21	6:15- 6:30	40	60	100	12:15-12:30	121	134	255	6:15- 6:30	132	102	234
12:30-12:45	8	10	18	6:30- 6:45	78	88	166	12:30-12:45	142	103	245	6:30- 6:45	107	91	198
12:45- 1:00	8	10	18	6:45- 7:00	72	104	176	12:45- 1:00	132	114	246	6:45- 7:00	107	117	224
1:00- 1:15	6	10	16	7:00- 7:15	123	106	229	1:00- 1:15	137	120	257	7:00- 7:15	118	88	206
1:15- 1:30	3	9	12	7:15- 7:30	143	134	279	1:15- 1:30	142	128	270	7:15- 7:30	100	99	199
1:30- 1:45	2	6	8	7:30- 7:45	122	121	243	1:30- 1:45	176	117	293	7:30- 7:45	89	74	163
1:45- 2:00	3	6	9	7:45- 8:00	102	134	236	1:45- 2:00	163	126	289	7:45- 8:00	73	83	156
2:00- 2:15	4	4	8	8:00- 8:15	122	126	248	2:00- 2:15	136	128	264	8:00- 8:15	63	83	146
2:15- 2:30	2	3	5	8:15- 8:30	105	143	248	2:15- 2:30	127	128	255	8:15- 8:30	48	88	136
2:30- 2:45	3	3	6	8:30- 8:45	109	109	218	2:30- 2:45	146	142	288	8:30- 8:45	37	75	112
2:45- 3:00	5	1	6	8:45- 9:00	100	116	216	2:45- 3:00	129	137	266	8:45- 9:00	42	106	148
3:00- 3:15	6	2	8	9:00- 9:15	111	94	205	3:00- 3:15	155	139	294	9:00- 9:15	55	93	148
3:15- 3:30	3	2	5	9:15- 9:30	106	92	198	3:15- 3:30	170	138	308	9:15- 9:30	47	66	113
3:30- 3:45	3	0	3	9:30- 9:45	117	96	213	3:30- 3:45	205	138	343	9:30- 9:45	57	89	146
3:45- 4:00	2	3	5	9:45-10:00	102	106	208	3:45- 4:00	178	131	309	9:45-10:00	64	62	106
4:00- 4:15	1	19	20	10:00-10:15	121	100	221	4:00- 4:15	210	138	348	10:00-10:15	39	67	106
4:15- 4:30	9	18	27	10:15-10:30	118	110	228	4:15- 4:30	164	137	301	10:15-10:30	32	72	104
4:30- 4:45	7	37	44	10:30-10:45	126	128	254	4:30- 4:45	155	143	298	10:30-10:45	45	57	102
4:45- 5:00	17	37	54	10:45-11:00	86	115	201	4:45- 5:00	131	131	262	10:45-11:00	38	47	85
5:00- 5:15	19	16	35	11:00-11:15	118	117	235	5:00- 5:15	130	130	260	11:00-11:15	41	44	85
5:15- 5:30	19	19	38	11:15-11:30	112	121	233	5:15- 5:30	156	123	279	11:15-11:30	30	17	47
5:30- 5:45	33	33	66	11:30-11:45	127	98	225	5:30- 5:45	144	115	259	11:30-11:45	18	23	41
5:45- 6:00	38	51	89	11:45-12:00	124	122	246	5:45- 6:00	130	112	242	11:45-12:00	7	22	29

AM COMMUTER PERIOD (06:00 - 09:00)	MOV 1	MOV 5	TOTAL
TWO-DIRECTIONAL PEAK :	-------	-------	7:15 AM - 8:15 AM
AM - PEAK HR TIME			
AM - PEAK HR VOLUME	491	515	1,006
AM - K FACTOR (%)			6.42
AM - D %	48.81	51.19	100.00
DIRECTIONAL PEAK :			
AM PEAK - HR TIME	7:00 AM - 8:00 AM	7:30 AM - 8:30 AM	
AM PEAK - HR VOLUME	497	524	

PM COMMUTER PERIOD (15:00 - 19:00)	MOV 1	MOV 5	TOTAL
TWO-DIRECTIONAL PEAK :	-------	-------	3:15 PM - 4:15 PM
PM - PEAK HR TIME			
PM - PEAK HR VOLUME	763	545	1,308
PM - K FACTOR (%)			8.35
PM - D %	58.33	41.67	100.00
DIRECTIONAL PEAK :			
PM PEAK - HR TIME	3:15 PM - 4:15 PM	3:45 PM - 4:45 PM	
PM PEAK - HR VOLUME	763	549	

AM PERIOD (06:00 - 12:00)			
TWO-DIRECTIONAL PEAK :			
AM - PEAK HR TIME			7:15 AM - 8:15 AM
AM - PEAK HR VOLUME	491	515	1,006
AM - K FACTOR (%)			6.42
AM - D %	48.81	51.19	100.00

PM PERIOD (12:00 - 24:00)			
TWO-DIRECTIONAL PEAK :			
PM - PEAK HR TIME			3:15 PM - 4:15 PM
PM - PEAK HR VOLUME	763	545	1,308
PM - K FACTOR (%)			8.35
PM - D %	58.33	41.67	100.00

NON-COMMUTER PERIOD (09:00 - 15:00)			
TWO-DIRECTIONAL PEAK :			
PEAK HR TIME			1:15 PM - 2:15 PM
PEAK HR VOLUME	517	497	1,014
DIRECTIONAL PEAK :			
PEAK HR TIME	2:00 PM - 3:00 PM	2:00 PM - 3:00 PM	
PEAK HR VOLUME	519	524	

6 - HR, 12 - HR, 24 - HR PERIODS			
AM 6 - HR PERIOD (06:00 - 12:00)	2,354	2,583	5,115
AM 12 - HR PERIOD (00:00 - 12:00)	2,754	2,934	5,642
PM 6 - HR PERIOD (12:00 - 18:00)	3,452	3,077	6,729
PM 12 - HR PERIOD (12:00 - 24:00)	3,130	4,550	8,980
24 HOUR PERIOD	7,186	7,776	15,642
D %	52.25	44.55	100.00

017/032
FEDEX KINKOS 0937
15501

VEHICLE TYPE CLASSIFICATION (TCOMP - 13 CATEGORIES)

HAWAII STATE DEPARTMENT OF TRANSPORTATION
HIGHWAY PLANNING BRANCH

Island : Maui
Station No : C-12-E
Hwy/St : Honoapiilani Highway
Location : at Kahana Kai Bridge
Route System :
Route No :
M.P. :
Route Direction (D-1) = MOV (5)
Survey Date : 04/01-02/03
Survey Period : 09:00 AM - 09:00 AM
File : Seg
Hwy/St :
Route No :
M.P. :

VEHICLE TYPE		A.M. PEAK (7:15 - 8:15) DIRECTION MOV 1	MOV 5	TOTAL	P.M. PEAK (3:15 - 4:15) DIRECTION MOV 1	MOV 5	TOTAL	24-HOUR VOLUME (09:00 AM - 09:00 AM) DIRECTION MOV 1	MOV 5	TOTAL	VERTICAL %
PASSENGER CARS											
1	MTC	4	3	7	5	7	12	45	45	90	0.57
2	Car	383	431	814	569	458	1027	6201	6714	12915	82.46
3	PU/Van	84	61	145	165	68	233	1393	843	2236	14.28
15	Unclassified	6	3	9	5	3	8	40	30	70	0.45
Sub-Total		477	498	975	744	536	1280	7679	7632	15311	97.76
TRUCKS & BUSES											
4	Bus	2	2	4	4	4	8	48	37	85	0.54
5	2X, 6 Tires	6	8	14	14	3	17	118	69	187	1.19
6	3X, SUT	5	3	8	1	1	2	27	27	54	0.35
7	4X, SUT										
8	2S1,3S1,2S2		3	3		1	1	9	8	17	0.11
9	3S2,3-2,2-3		1	1				4	3	7	0.04
10	6/8+X S-Tlr	1		1				1		1	0.01
11	5X M-Tlr										
12	6X M-Tlr										
13	7X M-Tlr										
Sub - Total		14	17	31	19	9	28	207	144	351	2.24
TOTAL		491	515	1006	763	545	1308	7886	7776	15662	100%
Distribution (D) %		48.8	51.2	100%	58.3	41.7	100%	50.4	49.6	100%	
Trucks (T) %		2.9	3.3	3.1	2.5	1.7	2.1	2.6	1.9	100%	
K %				6.4			8.4				

Hwypt_01\E:\Maui\seg\12vtc

STATION NO : C-12-E

020/032
FEDEX KINKOS 0937
5501

4/8/2003 State of Hawaii, Department of Transportation, Highways Division

ISLAND : Maui
STATION NO : C-12-F
AUX NO :
FUND SYSTEM :
FILE : Leg 1

STATION DESCRIPTION : Honoapiilani Highway at Napilihau Street Maui

TC NO : C-12-F
ID NO : 31, 40

COUNT GROUP ID :
ROUTE NO :
HWY ST NAME : Honoapiilani Hwy
MOV (1), DIR : To Wailuku
MOV (5), DIR : To Kahului

M.P. :

MOV (1), TYPE :
MOV (5), TYPE :

D-02
D-01

BEG SURVEY DATE : 04/01/03
BEG SURVEY DATE : 04/01/03

START TIME : 09:00 AM
START TIME : 09:00 AM

TIME-AM	MOV 1	MOV 5	TOTAL	TIME-AM	MOV 1	MOV 5	TOTAL	TIME-PM	MOV 1	MOV 5	TOTAL	TIME-PM	MOV 1	MOV 5	TOTAL
12:00-12:15	14	3	17	6:00- 6:15	16	18	34	12:00-12:15	93	69	162	6:00- 6:15	52	43	95
12:15-12:30	3	1	4	6:15- 6:30	20	42	62	12:15-12:30	65	79	144	6:15- 6:30	70	37	107
12:30-12:45	2	1	3	6:30- 6:45	16	53	69	12:30-12:45	90	62	152	6:30- 6:45	66	48	114
12:45- 1:00	3	1	4	6:45- 7:00	20	74	94	12:45- 1:00	78	59	137	6:45- 7:00	31	36	67
1:00- 1:15	1	0	1	7:00- 7:15	64	55	119	1:00- 1:15	76	68	144	7:00- 7:15	67	34	101
1:15- 1:30	1	2	3	7:15- 7:30	36	118	154	1:15- 1:30	86	89	175	7:15- 7:30	51	41	92
1:30- 1:45	0	1	1	7:30- 7:45	45	85	130	1:30- 1:45	118	73	191	7:30- 7:45	45	34	79
1:45- 2:00	1	2	3	7:45- 8:00	41	87	128	1:45- 2:00	93	67	160	7:45- 8:00	43	29	72
2:00- 2:15	3	0	3	8:00- 8:15	55	83	138	2:00- 2:15	83	83	166	8:00- 8:15	23	34	57
2:15- 2:30	0	0	0	8:15- 8:30	47	105	152	2:15- 2:30	65	72	137	8:15- 8:30	27	39	66
2:30- 2:45	0	2	2	8:30- 8:45	41	79	120	2:30- 2:45	79	93	172	8:30- 8:45	19	28	47
2:45- 3:00	2	0	2	8:45- 9:00	41	77	118	2:45- 3:00	80	73	153	8:45- 9:00	17	43	60
3:00- 3:15	1	1	2	9:00- 9:15	46	62	108	3:00- 3:15	105	57	162	9:00- 9:15	36	41	77
3:15- 3:30	2	0	2	9:15- 9:30	50	64	114	3:15- 3:30	107	74	181	9:15- 9:30	22	40	62
3:30- 3:45	2	0	2	9:30- 9:45	52	68	120	3:30- 3:45	89	84	173	9:30- 9:45	33	38	71
3:45- 4:00	1	2	3	9:45-10:00	47	73	120	3:45- 4:00	96	77	173	9:45-10:00	21	30	51
4:00- 4:15	0	13	13	10:00-10:15	37	71	108	4:00- 4:15	154	66	220	10:00-10:15	19	16	35
4:15- 4:30	1	18	19	10:15-10:30	61	61	122	4:15- 4:30	100	85	185	10:15-10:30	21	29	50
4:30- 4:45	2	27	29	10:30-10:45	65	87	152	4:30- 4:45	118	54	172	10:30-10:45	27	22	49
4:45- 5:00	5	38	43	10:45-11:00	54	76	130	4:45- 5:00	74	80	154	10:45-11:00	15	19	34
5:00- 5:15	10	15	25	11:00-11:15	82	54	136	5:00- 5:15	88	50	138	11:00-11:15	23	9	32
5:15- 5:30	6	18	24	11:15-11:30	51	69	120	5:15- 5:30	75	58	133	11:15-11:30	18	5	23
5:30- 5:45	7	28	35	11:30-11:45	62	55	117	5:30- 5:45	80	66	146	11:30-11:45	9	5	14
5:45- 6:00	14	34	48	11:45-12:00	77	84	161	5:45- 6:00	80	48	128	11:45-12:00	4	4	8

AM COMMUTER PERIOD (05:00 - 09:00)	MOV 1	MOV 5	TOTAL
TWO-DIRECTIONAL PEAK :			7:15 AM - 8:15 AM
AM - PEAK HR TIME	-------	-------	550
AM - PEAK HR VOLUME	177	373	0.69
AM - K FACTOR (%)			100.00
AM - D %	32.18	67.82	
DIRECTIONAL PEAK :			
AM PEAK - HR TIME	7:30 AM - 8:30 AM	7:15 AM - 8:15 AM	
AM PEAK - HR VOLUME	388	373	

PM COMMUTER PERIOD (15:00 - 19:00)	MOV 1	MOV 5	TOTAL
TWO-DIRECTIONAL PEAK :			3:30 PM - 4:30 PM
PM - PEAK HR TIME	-------	-------	751
PM - PEAK HR VOLUME	439	312	0.86
PM - K FACTOR (%)			100.00
PM - D %	58.46	41.54	
DIRECTIONAL PEAK :			
PM PEAK - HR TIME	3:45 PM - 4:45 PM	3:30 PM - 4:30 PM	
PM PEAK - HR VOLUME	488	312	

AM PERIOD (05:00 - 12:00)			
TWO-DIRECTIONAL PEAK :			
AM - PEAK HR TIME			7:15 AM - 8:15 AM
AM - PEAK HR VOLUME	177	373	550
AM - K FACTOR (%)			0.69
AM - D %	32.18	67.82	100.00

PM PERIOD (12:00 - 24:00)			
TWO-DIRECTIONAL PEAK :			
PM - PEAK HR TIME			3:30 PM - 4:30 PM
PM - PEAK HR VOLUME	439	312	751
PM - K FACTOR (%)			0.86
PM - D %	58.46	41.54	100.00

NON-COMMUTER PERIOD (09:00 - 15:00)			
TWO-DIRECTIONAL PEAK :			
PEAK HR TIME			1:15 PM - 2:15 PM
PEAK HR VOLUME	310	312	622
DIRECTIONAL PEAK :			
PEAK HR TIME	1:15 PM - 2:15 PM	2:00 PM - 3:00 PM	
PEAK HR VOLUME	340	321	

6 - HR, 12 - HR, 24 - HR PERIODS		
AM 6 - HR PERIOD (06:00 - 12:00)	1,118	1,720
AM 12 - HR PERIOD (00:00 - 12:00)	1,159	1,927
PM 6 - HR PERIOD (12:00 - 18:00)	2,172	1,666
PM 12 - HR PERIOD (12:00 - 24:00)	2,651	2,390
24 HOUR PERIOD	4,150	4,317
D %	48.04	51.04

		2,848
		3,136
		3,838
		5,341
		8,477
		100.00

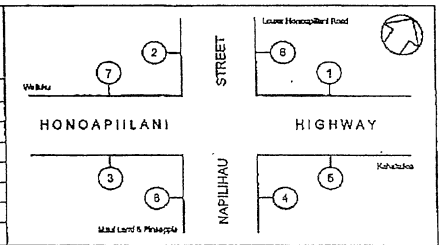
019/032
FEDEX KINKOS 0937
05/21/2004 09:52 FAX 8082345501

24-HOUR TRAFFIC COUNT - STATION SUMMARY

HAWAII STATE DEPARTMENT OF TRANSPORTATION
HIGHWAY PLANNING BRANCH

Station No : C-12-F

Location : Honoapiilani Highway at Napilihau Street



STATION CHARACTERISTICS	INTERSECTION APPROACHES				
	LEG 1	LEG 2	LEG 3	LEG 4	
Traffic Control					
Width of Approach (Ft)					
Number of Lanes at Approach					
Separate Turning Lane (Lt, Rt, Lt/Rt)					
Parking (AM, PM, All Day, None)					
Bus Stop (NS: Near Side, FS: Far Side)					

DATE	24-HOUR TRAFFIC VOLUMES												Vehicles Entering Intersection
	MOV 1	MOV 5	TOTAL	MOV 2	MOV 6	TOTAL	MOV 3	MOV 7	TOTAL	MOV 4	MOV 8	TOTAL	
04/29-30/99	3967	4162	8119	5468	5009	10477	7456	7419	14875	524	1226	1750	18405
05/06-07/99	3791	4033	7824	5538	4947	10485	-	-	-	362	393	745	-
04/16-17/01	4172	4363	8535	-	-	-	7739	7857	15596	293	841	1134	-
04/19-20/01	-	-	-	5215	4598	10813	-	-	-	-	-	-	-
04/30-05/01/01	-	-	-	-	-	-	-	-	-	552	267	819	-
04/01-02/03*	4150	4327	8477	5618	3896	9512	7845	5751	13596	412	211	623	18023

Honapii_C12F_WeekdayWk1

*March 19, 2003 Start of Operation Iraqi Freedom

STATION NO : C-12-F

1999 3957 + 7456 11,413

1999
2000
2001
2002
2003
2004
2005

2003 4150 + 7645 11795

FEDEX KINKOS 0837 3501 022/032

4/9/2003 State of Hawaii, Department of Transportation, Highways Division

ISLAND : Maui
STATION NO : C-12-F
AUX NO :
FUND SYSTEM :
FILE : Leg 3

STATION DESCRIPTION : Honoapiilani Highway at Napilihau Street Maui

TC NO: C-12-F
ID NO: 35, 198

COUNT GROUP ID :
ROUTE NO :
HWY ST NAME : Honoapiilani Hwy
MOV (3), DIR : To Kahului
MOV (7), DIR : To Wailuku
M.P. :

MOV (3), TYPE :
MOV (7), TYPE :

D-01 BEG SURVEY DATE : 04/01/03
D-02 BEG SURVEY DATE : 04/01/03

START TIME : 09:00 AM
START TIME : 09:00 AM

TIME-AM	MOV 3	MOV 7	TOTAL	TIME-AM	MOV 3	MOV 7	TOTAL	TIME-PM	MOV 3	MOV 7	TOTAL	TIME-PM	MOV 3	MOV 7	TOTAL
12:00-12:15	23	17	40	6:00- 6:15	48	50	98	12:00-12:15	134	11	145	6:00- 6:15	108	106	214
12:15-12:30	14	7	21	6:15- 6:30	57	31	88	12:15-12:30	139	1	140	6:15- 6:30	106	127	233
12:30-12:45	11	6	17	6:30- 6:45	83	74	157	12:30-12:45	108	2	110	6:30- 6:45	90	96	186
12:45- 1:00	8	7	15	6:45- 7:00	104	65	169	12:45- 1:00	109	19	128	6:45- 7:00	110	107	217
1:00- 1:15	9	4	13	7:00- 7:15	106	126	232	1:00- 1:15	121	5	126	7:00- 7:15	95	119	214
1:15- 1:30	10	3	13	7:15- 7:30	146	128	274	1:15- 1:30	136	23	159	7:15- 7:30	99	97	196
1:30- 1:45	7	2	9	7:30- 7:45	122	112	234	1:30- 1:45	124	120	244	7:30- 7:45	79	90	169
1:45- 2:00	5	3	8	7:45- 8:00	131	97	228	1:45- 2:00	119	47	166	7:45- 8:00	81	77	158
2:00- 2:15	5	5	10	8:00- 8:15	131	120	251	2:00- 2:15	119	124	243	8:00- 8:15	83	55	138
2:15- 2:30	2	1	3	8:15- 8:30	153	97	250	2:15- 2:30	130	93	223	8:15- 8:30	86	43	129
2:30- 2:45	3	3	6	8:30- 8:45	105	101	206	2:30- 2:45	148	113	261	8:30- 8:45	76	37	113
2:45- 3:00	1	4	5	8:45- 9:00	118	85	203	2:45- 3:00	136	21	157	8:45- 9:00	107	38	145
3:00- 3:15	2	6	8	9:00- 9:15	96	98	194	3:00- 3:15	138	75	213	9:00- 9:15	90	54	144
3:15- 3:30	2	3	5	9:15- 9:30	97	103	200	3:15- 3:30	142	88	230	9:15- 9:30	69	47	116
3:30- 3:45	0	4	4	9:30- 9:45	86	90	176	3:30- 3:45	133	40	173	9:30- 9:45	89	52	141
3:45- 4:00	3	1	4	9:45-10:00	115	40	155	3:45- 4:00	143	159	302	9:45-10:00	68	47	115
4:00- 4:15	18	3	21	10:00-10:15	104	61	165	4:00- 4:15	137	212	349	10:00-10:15	62	35	97
4:15- 4:30	18	5	23	10:15-10:30	112	112	224	4:15- 4:30	143	148	291	10:15-10:30	76	31	107
4:30- 4:45	34	9	43	10:30-10:45	127	112	239	4:30- 4:45	125	153	278	10:30-10:45	61	44	105
4:45- 5:00	39	13	52	10:45-11:00	123	61	184	4:45- 5:00	139	123	262	10:45-11:00	41	35	76
5:00- 5:15	17	19	36	11:00-11:15	112	70	182	5:00- 5:15	119	171	290	11:00-11:15	45	37	82
5:15- 5:30	18	17	35	11:15-11:30	120	60	180	5:15- 5:30	126	137	263	11:15-11:30	18	29	47
5:30- 5:45	28	31	59	11:30-11:45	100	53	153	5:30- 5:45	120	142	262	11:30-11:45	20	14	34
5:45- 6:00	48	35	83	11:45-12:00	120	20	140	5:45- 6:00	113	128	241	11:45-12:00	24	5	29

AM COMMUTER PERIOD (01:00 - 09:00)	MOV 3	MOV 7	TOTAL	PM COMMUTER PERIOD (15:00 - 19:00)	MOV 7	MOV 7	TOTAL
TWO-DIRECTIONAL PEAK :	-------	-------	7:15 AM - 8:15 AM	TWO-DIRECTIONAL PEAK :	-------	-------	3:45 PM - 4:45 PM
AM - PEAK HR TIME	530	487	987	PM - PEAK HR TIME	358	672	1,230
AM - PEAK HR VOLUME			7.26	PM - PEAK HR VOLUME			9.05
AM - K FACTOR (%)	53.70	46.30	100.00	PM - K FACTOR (%)	45.37	54.63	100.00
AM - D %				PM - D %			
DIRECTIONAL PEAK :	7:00 AM - 8:00 AM	7:00 AM - 8:00 AM		DIRECTIONAL PEAK :	3:45 PM - 4:45 PM	3:45 PM - 4:45 PM	
AM PEAK - HR TIME	537	465		PM PEAK - HR VOLUME	358	672	
AM PEAK - HR VOLUME							

AM PERIOD (01:00 - 12:00)				PM PERIOD (12:00 - 24:00)			
TWO-DIRECTIONAL PEAK :			7:15 AM - 8:15 AM	TWO-DIRECTIONAL PEAK :			3:45 PM - 4:45 PM
AM - PEAK HR TIME	530	487	987	PM - PEAK HR TIME	358	672	1,230
AM - PEAK HR VOLUME			7.26	PM - PEAK HR VOLUME			9.05
AM - K FACTOR (%)	53.70	46.30	100.00	PM - K FACTOR (%)	45.37	54.63	100.00
AM - D %				PM - D %			

NON-COMMUTER PERIOD (09:00 - 15:00)				6 - HR, 12 - HR, 24 - HR PERIODS			
TWO-DIRECTIONAL PEAK :			1:45 PM - 2:45 PM	AM 6 - HR PERIOD (04:00 - 10:00)	2,616	1,966	4,582
PEAK HR TIME	316	377	693	AM 12 - HR PERIOD (00:00 - 12:00)	3,931	3,134	5,725
PEAK HR VOLUME				PM 6 - HR PERIOD (12:00 - 18:00)	3,181	2,115	5,296
DIRECTIONAL PEAK :	2:00 PM - 3:00 PM	1:30 PM - 2:30 PM		PM 12 - HR PERIOD (12:00 - 24:00)	4,894	3,577	8,471
PEAK HR TIME	393	384		24 HOUR PERIOD	7,845	5,731	13,576
PEAK HR VOLUME				D %	57.79	42.20	100.00

4/8/2003 State of Hawaii, Department of Transportation, Highways Division

FEDEX KINKOS 0837 1/2004 09:52 FAX 8082345501 021/032

ISLAND : Maui
STATION NO : C-12-F
AUX NO :
FUND SYSTEM :
FILE : Leg 2

STATION DESCRIPTION : Honoapiilani Highway at Napilihau Street Maui

TC NO: C-12-F
ID NO: 50, 188

COUNT GROUP ID :
ROUTE NO :
HWY ST NAME : Napilihau St
MOV (2), DIR : To Honoapiilani Hwy
MOV (6), DIR : To Lower Honoapiilani Rd
M.P. :

MOV (2), TYPE :
MOV (6), TYPE :

D-01 BEG SURVEY DATE : 04/01/03
D-02 BEG SURVEY DATE : 04/01/03

START TIME : 09:00 AM
START TIME : 09:00 AM

TIME-AM	MOV 2	MOV 6	TOTAL	TIME-AM	MOV 2	MOV 6	TOTAL	TIME-PM	MOV 2	MOV 6	TOTAL	TIME-PM	MOV 2	MOV 6	TOTAL
12:00-12:15	6	14	20	6:00- 6:15	55	15	70	12:00-12:15	86	78	164	6:00- 6:15	81	62	143
12:15-12:30	3	6	9	6:15- 6:30	39	15	54	12:15-12:30	95	66	161	6:15- 6:30	90	72	162
12:30-12:45	2	10	12	6:30- 6:45	76	17	93	12:30-12:45	105	70	175	6:30- 6:45	72	49	121
12:45- 1:00	7	5	12	6:45- 7:00	75	32	107	12:45- 1:00	87	61	148	6:45- 7:00	82	68	150
1:00- 1:15	4	6	10	7:00- 7:15	128	45	165	1:00- 1:15	82	50	132	7:00- 7:15	75	62	137
1:15- 1:30	3	6	9	7:15- 7:30	147	49	196	1:15- 1:30	99	53	152	7:15- 7:30	68	61	129
1:30- 1:45	2	3	5	7:30- 7:45	92	52	144	1:30- 1:45	105	75	180	7:30- 7:45	65	47	112
1:45- 2:00	2	3	5	7:45- 8:00	88	49	137	1:45- 2:00	93	52	145	7:45- 8:00	47	53	100
2:00- 2:15	2	3	5	8:00- 8:15	105	61	166	2:00- 2:15	93	45	138	8:00- 8:15	47	45	92
2:15- 2:30	1	0	1	8:15- 8:30	81	49	130	2:15- 2:30	92	69	161	8:15- 8:30	28	44	72
2:30- 2:45	4	2	6	8:30- 8:45	91	35	126	2:30- 2:45	114	73	187	8:30- 8:45	24	39	63
2:45- 3:00	5	1	6	8:45- 9:00	70	40	110	2:45- 3:00	81	60	141	8:45- 9:00	32	62	94
3:00- 3:15	9	1	10	9:00- 9:15	72	35	107	3:00- 3:15	83	79	162	9:00- 9:15	40	43	83
3:15- 3:30	2	0	2	9:15- 9:30	95	46	141	3:15- 3:30	110	77	187	9:15- 9:30	41	36	77
3:30- 3:45	2	0	2	9:30- 9:45	105	35	140	3:30- 3:45	128	78	206	9:30- 9:45	33	46	79
3:45- 4:00	0	0	0	9:45-10:00	90	49	139	3:45- 4:00	119	80	199	9:45-10:00	35	33	68
4:00- 4:15	4	2	6	10:00-10:15	87	41	128	4:00- 4:15	120	89	209	10:00-10:15	26	38	64
4:15- 4:30	10	2	12	10:15-10:30	79	50	129	4:15- 4:30	87	82	169	10:15-10:30	19	44	63
4:30- 4:45	13	8	21	10:30-10:45	89	58	147	4:30- 4:45	83	91	174	10:30-10:45	27	30	57
4:45- 5:00	22	7	29	10:45-11:00	74	54	128	4:45- 5:00	105	77	182	10:45-11:00	21	20	41
5:00- 5:15	17	4	21	11:00-11:15	82	77	159	5:00- 5:15	127	78	205	11:00-11:15	24	27	48
5:15- 5:30	16	0	16	11:15-11:30	70	56	126	5:15- 5:30	90	72	162	11:15-11:30	15	8	23
5:30- 5:45	27	9	36	11:30-11:45	80	52	132	5:30- 5:45	103	73	176	11:30-11:45	13	12	25
5:45- 6:00	33	13	46	11:45-12:00	90	55	145	5:45- 6:00	75	74	149	11:45-12:00	4	19	23

AM COMMUTER PERIOD (01:00 - 09:00)	MOV 2	MOV 6	TOTAL	PM COMMUTER PERIOD (15:00 - 19:00)	MOV 2	MOV 6	TOTAL
TWO-DIRECTIONAL PEAK :	-------	-------	7:15 AM - 8:15 AM	TWO-DIRECTIONAL PEAK :	-------	-------	3:15 PM - 4:15 PM
AM - PEAK HR TIME	433	211	643	PM - PEAK HR TIME	477	224	701
AM - PEAK HR VOLUME			6.75	PM - PEAK HR VOLUME			8.43
AM - K FACTOR (%)	67.19	32.81	100.00	PM - K FACTOR (%)	59.55	40.45	100.00
AM - D %				PM - D %			
DIRECTIONAL PEAK :	7:00 AM - 8:00 AM	7:15 AM - 8:15 AM		DIRECTIONAL PEAK :	3:15 PM - 4:15 PM	3:45 PM - 4:45 PM	
AM PEAK - HR TIME	442	218		PM PEAK - HR TIME	477	342	
AM PEAK - HR VOLUME				PM PEAK - HR VOLUME			

AM PERIOD (00:00 - 12:00)				PM PERIOD (12:00 - 24:00)			
TWO-DIRECTIONAL PEAK :			7:15 AM - 8:15 AM	TWO-DIRECTIONAL PEAK :			3:15 PM - 4:15 PM
AM - PEAK HR TIME	433	211	643	PM - PEAK HR TIME	477	224	701
AM - PEAK HR VOLUME			6.75	PM - PEAK HR VOLUME			8.43
AM - K FACTOR (%)	67.19	32.81	100.00	PM - K FACTOR (%)	59.55	40.45	100.00
AM - D %				PM - D %			

NON-COMMUTER PERIOD (09:00 - 15:00)				6 - HR, 12 - HR, 24 - HR PERIODS			
TWO-DIRECTIONAL PEAK :			12:00 PM - 1:00 PM	AM 6 - HR PERIOD (04:00 - 10:00)	2,012	1,067	3,119
PEAK HR TIME	373	275	648	AM 12 - HR PERIOD (00:00 - 12:00)	2,748	1,172	3,920
PEAK HR VOLUME				PM 6 - HR PERIOD (12:00- 18:00)	2,314	1,792	4,046
DIRECTIONAL PEAK :	1:45 PM - 2:45 PM	12:00 PM - 1:00 PM		PM 12 - HR PERIOD (12:00 - 24:00)	3,344	2,724	6,093
PEAK HR TIME	393	275		24 HOUR PERIOD	5,515	3,896	9,372
PEAK HR VOLUME				D %	59.04	40.96	100.00

025/032
FEDEX KINKOS 0937
5501

4/8/2003 State of Hawaii, Department of Transportation, Highways Division

ISLAND : Maui
STATION NO : C-12-G
AUX NO :
FUND SYSTEM :
FILE : Leg 1

STATION DESCRIPTION : Honoapiilani Highway at North Junction with Lower Honoapiilani Road Maui

TC NO : C-12-G
ID NO : 176, 136

COUNT GROUP ID :
ROUTE NO :
HWY ST NAME : Honoapiilani Hwy
MOV (1): DIR : To Wahiawa
MOV (5): DIR : To Kahului

M.P. :

MOV (1) TYPE :
MOV (5) TYPE :

D-02 BEG SURVEY DATE : 04/01/03
D-01 BEG SURVEY DATE : 04/01/03

START TIME : 09:00 AM
START TIME : 09:00 AM

TIME-AM	MOV 1	MOV 5	TOTAL	TIME-AM	MOV 1	MOV 5	TOTAL	TIME-PM	MOV 1	MOV 5	TOTAL	TIME-PM	MOV 1	MOV 5	TOTAL
12:00-12:15	3	2	5	6:00- 6:15	7	6	13	12:00-12:15	63	45	108	6:00- 6:15	21	14	35
12:15-12:30	0	0	0	6:15- 6:30	6	10	16	12:15-12:30	26	37	63	6:15- 6:30	31	12	43
12:30-12:45	2	0	2	6:30- 6:45	6	24	30	12:30-12:45	37	43	80	6:30- 6:45	17	18	35
12:45- 1:00	1	0	1	6:45- 7:00	13	26	39	12:45- 1:00	69	31	80	6:45- 7:00	21	7	28
1:00- 1:15	0	0	0	7:00- 7:15	16	26	42	1:00- 1:15	45	34	79	7:00- 7:15	21	16	37
1:15- 1:30	0	0	0	7:15- 7:30	7	39	46	1:15- 1:30	38	43	81	7:15- 7:30	15	9	24
1:30- 1:45	0	1	1	7:30- 7:45	13	28	41	1:30- 1:45	37	28	65	7:30- 7:45	16	12	28
1:45- 2:00	1	0	1	7:45- 8:00	20	23	43	1:45- 2:00	38	34	72	7:45- 8:00	9	4	13
2:00- 2:15	0	0	0	8:00- 8:15	21	25	46	2:00- 2:15	30	33	63	8:00- 8:15	3	6	9
2:15- 2:30	0	1	1	8:15- 8:30	22	23	45	2:15- 2:30	33	46	79	8:15- 8:30	4	4	8
2:30- 2:45	0	0	0	8:30- 8:45	17	29	46	2:30- 2:45	54	28	82	8:30- 8:45	5	5	10
2:45- 3:00	0	1	1	8:45- 9:00	16	43	59	2:45- 3:00	31	38	69	8:45- 9:00	4	4	8
3:00- 3:15	0	0	0	9:00- 9:15	23	31	54	3:00- 3:15	35	27	62	9:00- 9:15	7	4	11
3:15- 3:30	0	0	0	9:15- 9:30	28	39	67	3:15- 3:30	31	31	62	9:15- 9:30	5	4	9
3:30- 3:45	1	0	1	9:30- 9:45	21	31	52	3:30- 3:45	47	22	69	9:30- 9:45	10	4	14
3:45- 4:00	1	0	1	9:45-10:00	21	35	56	3:45- 4:00	41	31	72	9:45-10:00	3	1	4
4:00- 4:15	1	1	2	10:00-10:15	18	42	60	4:00- 4:15	52	29	81	10:00-10:15	4	2	6
4:15- 4:30	0	1	1	10:15-10:30	26	32	58	4:15- 4:30	40	34	74	10:15-10:30	3	1	4
4:30- 4:45	1	1	2	10:30-10:45	19	49	68	4:30- 4:45	30	18	48	10:30-10:45	4	2	6
4:45- 5:00	0	1	1	10:45-11:00	25	38	63	4:45- 5:00	20	36	56	10:45-11:00	7	2	9
5:00- 5:15	2	7	9	11:00-11:15	32	33	65	5:00- 5:15	38	24	62	11:00-11:15	1	1	2
5:15- 5:30	0	5	5	11:15-11:30	30	46	76	5:15- 5:30	35	28	63	11:15-11:30	4	1	5
5:30- 5:45	6	7	13	11:30-11:45	39	35	74	5:30- 5:45	34	18	52	11:30-11:45	1	2	3
5:45- 6:00	4	11	15	11:45-12:00	37	46	83	5:45- 6:00	29	18	47	11:45-12:00	1	3	4

AM COMMUTER PERIOD (06:00 - 09:00)	MOV 1	MOV 5	TOTAL
TWO-DIRECTIONAL PEAK :	-------	-------	8:00 AM - 9:00 AM
AM - PEAK HR TIME	28	120	196
AM - PEAK HR VOLUME			5.87
AM - K FACTOR (%)	38.78	61.22	100.00
AM - D %			
DIRECTIONAL PEAK :	7:45 AM - 8:45 AM	8:00 AM - 9:00 AM	
AM PEAK - HR TIME	69	120	
AM PEAK - HR VOLUME			

PM COMMUTER PERIOD (15:00 - 18:00)	MOV 1	MOV 5	TOTAL
TWO-DIRECTIONAL PEAK :	-------	-------	3:00 PM - 4:00 PM
PM - PEAK HR TIME	180	116	296
PM - PEAK HR VOLUME			8.87
PM - K FACTOR (%)	60.81	39.19	100.00
PM - D %			
DIRECTIONAL PEAK :	3:00 PM - 4:00 PM	4:00 PM - 5:00 PM	
PM PEAK - HR TIME	180	112	
PM PEAK - HR VOLUME			

AM PERIOD (00:00 - 12:00)			
TWO-DIRECTIONAL PEAK :			11:00 AM - 12:00 PM
AM - PEAK HR TIME	171	160	331
AM - PEAK HR VOLUME			9.92
AM - K FACTOR (%)	48.33	51.69	100.00
AM - D %			

PM PERIOD (12:00 - 24:00)			
TWO-DIRECTIONAL PEAK :			12:00 PM - 1:00 PM
PM - PEAK HR TIME	171	156	331
PM - PEAK HR VOLUME			9.92
PM - K FACTOR (%)	52.87	47.13	100.00
PM - D %			

NON-COMMUTER PERIOD (09:00 - 15:00)			
TWO-DIRECTIONAL PEAK :			10:15 AM - 11:15 AM
PEAK HR TIME	169	172	341
PEAK HR VOLUME			
DIRECTIONAL PEAK :	12:00 PM - 1:00 PM	11:15 AM - 12:15 PM	
PEAK HR TIME	171	172	
PEAK HR VOLUME			

6 - HR, 12 - HR, 24 - HR PERIODS			
AM 6 - HR PERIOD (06:00 - 12:00)	683	759	1,342
AM 12 - HR PERIOD (00:00 - 12:00)	806	798	1,604
PM 6 - HR PERIOD (12:00 - 18:00)	923	756	1,679
PM 12 - HR PERIOD (12:00 - 24:00)	1,140	894	2,034
24 HOUR PERIOD	1,946 -	1,652 -	3,598
D %	69.31	30.69	100.00

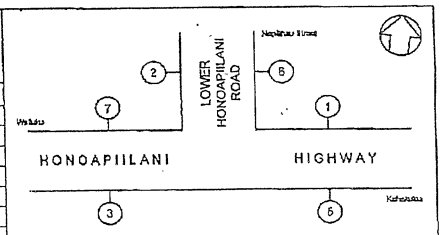
24-HOUR TRAFFIC COUNT - STATION SUMMARY

HAWAII STATE DEPARTMENT OF TRANSPORTATION
HIGHWAY PLANNING BRANCH

Station No : C-12-G

Location : Honoapiilani Highway at North Junction with Lower Honoapiilani Road

STATION CHARACTERISTICS	INTERSECTION APPROACHES				
	LEG 1	LEG 2	LEG 3	LEG 4	
Traffic Control					
Width of Approach (Ft)					
Number of Lanes at Approach					
Separate Turning Lane (Lt, Rt, LVRt)					
Parking (AM, PM, All Day, None)					
Bus Stop (NS: Near Side, FS: Far Side)					



DATE	24-HOUR TRAFFIC VOLUMES												Vehicles Entering Intersection
	MOV 1	MOV 5	TOTAL	MOV 2	MOV 6	TOTAL	MOV 3	MOV 7	TOTAL	MOV 4	MOV 8	TOTAL	
04/28-29/99	1622	1582	3104	891	950	1841	1890	1676	3565				4303
04/16-17/01	1757	1739	3496	725	558	1283	-	-	-				-
04/24-25/01	-	-	-	-	-	-	1857	1740	3597				-
04/01-02/03*	1848	1692	3338	569	497	1066	2006	1903	3909				4221

Hawaii_State\Maui\c12g

*March 19, 2003 Start of Operation Iraqi Freedom

STATION NO : C-12-G

024/032
FEDEX KINKOS 0937
5501

027/032
FEDEX KINKOS 0937
45501

4/8/2003

State of Hawaii, Department of Transportation, Highways Division

ISLAND : Maui
STATION NO : C-12-G
AUX NO :
FUND SYSTEM :
FILE : Leg 3

STATION DESCRIPTION : Honoapiilani Highway
at North Junction with Lower Honoapiilani Road
Maui

TC NO : C-12-G
ID NO : 171, 203

COUNT GROUP ID :
ROUTE NO :
HWY ST NAME : Honoapiilani Hwy
MOV (3 -) DIR : To Kahekuloa
MOV (7) DIR : To Wailuku

M.P. :

MOV (3) TYPE :
MOV (7) TYPE :

D-01 BEG SURVEY DATE : 04/01/03
D-02 BEG SURVEY DATE : 04/01/03

START TIME : 09:00 AM
START TIME : 09:00 AM

TIME-AM	MOV 3	MOV 7	TOTAL	TIME-AM	MOV 3	MOV 7	TOTAL	TIME-PM	MOV 3	MOV 7	TOTAL	TIME-PM	MOV 3	MOV 7	TOTAL
12:00-12:15	4	1	5	6:00- 6:15	9	9	18	12:00-12:15	57	76	133	6:00- 6:15	18	23	41
12:15-12:30	0	0	0	6:15- 6:30	11	5	16	12:15-12:30	46	26	72	6:15- 6:30	13	33	46
12:30-12:45	0	1	1	6:30- 6:45	26	7	33	12:30-12:45	49	39	88	6:30- 6:45	19	24	43
12:45- 1:00	0	1	1	6:45- 7:00	29	15	44	12:45- 1:00	35	54	89	6:45- 7:00	7	21	28
1:00- 1:15	0	0	0	7:00- 7:15	30	16	46	1:00- 1:15	38	50	88	7:00- 7:15	16	23	39
1:15- 1:30	1	0	1	7:15- 7:30	42	11	53	1:15- 1:30	56	38	94	7:15- 7:30	9	14	23
1:30- 1:45	1	0	1	7:30- 7:45	38	16	54	1:30- 1:45	31	44	75	7:30- 7:45	14	21	35
1:45- 2:00	0	1	1	7:45- 8:00	28	22	50	1:45- 2:00	37	46	83	7:45- 8:00	4	8	12
2:00- 2:15	0	1	1	8:00- 8:15	31	21	52	2:00- 2:15	41	39	80	8:00- 8:15	5	9	14
2:15- 2:30	1	0	1	8:15- 8:30	29	26	55	2:15- 2:30	56	44	100	8:15- 8:30	4	4	8
2:30- 2:45	0	0	0	8:30- 8:45	31	23	54	2:30- 2:45	38	63	101	8:30- 8:45	5	4	9
2:45- 3:00	1	0	1	8:45- 9:00	48	17	65	2:45- 3:00	49	35	84	8:45- 9:00	5	5	10
3:00- 3:15	1	1	2	9:00- 9:15	42	28	70	3:00- 3:15	33	43	76	9:00- 9:15	4	8	12
3:15- 3:30	0	0	0	9:15- 9:30	39	25	64	3:15- 3:30	37	41	78	9:15- 9:30	4	10	14
3:30- 3:45	0	1	1	9:30- 9:45	37	29	66	3:30- 3:45	30	57	87	9:30- 9:45	6	10	16
3:45- 4:00	0	1	1	9:45-10:00	45	23	68	3:45- 4:00	41	55	96	9:45-10:00	1	4	5
4:00- 4:15	1	1	2	10:00-10:15	46	21	67	4:00- 4:15	37	54	91	10:00-10:15	3	4	7
4:15- 4:30	1	0	1	10:15-10:30	37	29	66	4:15- 4:30	39	39	77	10:15-10:30	2	6	8
4:30- 4:45	1	1	2	10:30-10:45	57	21	78	4:30- 4:45	21	47	68	10:30-10:45	3	5	8
4:45- 5:00	1	0	1	10:45-11:00	37	26	63	4:45- 5:00	44	41	85	10:45-11:00	2	8	10
5:00- 5:15	7	2	9	11:00-11:15	42	35	77	5:00- 5:15	10	34	44	11:00-11:15	2	1	3
5:15- 5:30	7	1	8	11:15-11:30	54	36	90	5:15- 5:30	34	43	81	11:15-11:30	1	5	6
5:30- 5:45	10	6	16	11:30-11:45	47	44	91	5:30- 5:45	20	38	58	11:30-11:45	2	1	3
5:45- 6:00	11	4	15	11:45-12:00	50	39	89	5:45- 6:00	18	29	47	11:45-12:00	2	1	3

AM COMMUTER PERIOD (05:00 - 09:00)	MOV 3	MOV 7	TOTAL
TWO-DIRECTIONAL PEAK :	-------	-------	8:00 AM - 9:00 AM
AM - PEAK HR TIME	339	87	226
AM - PEAK HR VOLUME			5.78
AM - K FACTOR (%)	61.50	38.50	100.00
AM - D %			
DIRECTIONAL PEAK :	6:45 AM - 7:45 AM	7:45 AM - 8:45 AM	
AM PEAK - HR TIME	139	87	
AM PEAK - HR VOLUME			

PM COMMUTER PERIOD (15:00 - 19:00)	MOV 3	MOV 7	TOTAL
TWO-DIRECTIONAL PEAK :	-------	-------	3:15 PM - 4:15 PM
PM - PEAK HR TIME	145	297	332
PM - PEAK HR VOLUME			9.09
PM - K FACTOR (%)	41.39	58.81	100.00
PM - D %			
DIRECTIONAL PEAK :	3:30 PM - 4:30 PM	3:15 PM - 4:15 PM	
PM PEAK - HR TIME	144	297	
PM PEAK - HR VOLUME			

AM PERIOD (05:00 - 12:00)			
TWO-DIRECTIONAL PEAK :			11:00 AM - 12:00 PM
AM - PEAK HR TIME	189	134	367
AM - PEAK HR VOLUME			8.86
AM - K FACTOR (%)	58.62	44.28	100.00
AM - D %			

PM PERIOD (12:00 - 18:00)			
TWO-DIRECTIONAL PEAK :			12:00 PM - 1:00 PM
PM - PEAK HR TIME	187	193	182
PM - PEAK HR VOLUME			9.77
PM - K FACTOR (%)	48.63	51.04	100.00
PM - D %			

NON-COMMUTER PERIOD (09:00 - 15:00)			
TWO-DIRECTIONAL PEAK :			11:15 AM - 12:15 PM
PEAK HR TIME	208	195	403
PEAK HR VOLUME			
DIRECTIONAL PEAK :	11:15 AM - 12:15 PM	12:15 AM - 12:15 PM	
PEAK HR TIME	208	195	
PEAK HR VOLUME			

6 - HR, 12 - HR, 24 - HR PERIODS			
AM 6 - HR PERIOD (06:00 - 12:00)	853	566	1,419
AM 12 - HR PERIOD (00:00 - 12:00)	935	567	1,502
PM 6 - HR PERIOD (12:00- 18:00)	930	1,085	2,015
PM 12 - HR PERIOD (12:00 - 24:00)	1,073	1,326	2,399
24 HOUR PERIOD	2,006	1,502	3,508
D %	57.17	42.83	100.00

026/032
FEDEX KINKOS 0937
5501

4/25/2003

State of Hawaii, Department of Transportation, Highways Division

ISLAND : Maui
STATION NO : C-12-G
AUX NO :
FUND SYSTEM :
FILE : Leg 2

STATION DESCRIPTION : Honoapiilani Highway
at North Junction with Lower Honoapiilani Road
Maui

TC NO : C-12-G
ID NO : 193, 197

COUNT GROUP ID :
ROUTE NO :
HWY ST NAME : Lower Honoapiilani Rd
MOV (2), DIR : To Honoapiilani Hwy
MOV (6), DIR : To Napilihau St

M.P. :

MOV (2), TYPE :
MOV (6), TYPE :

D-01 BEG SURVEY DATE : 04/01/03
D-02 BEG SURVEY DATE : 04/01/03

START TIME : 09:00 AM
START TIME : 09:00 AM

TIME-AM	MOV 2	MOV 6	TOTAL	TIME-AM	MOV 2	MOV 6	TOTAL	TIME-PM	MOV 2	MOV 6	TOTAL	TIME-PM	MOV 2	MOV 6	TOTAL
12:00-12:15	0	0	0	6:00- 6:15	0	1	1	12:00-12:15	32	22	54	6:00- 6:15	6	5	11
12:15-12:30	0	0	0	6:15- 6:30	0	0	0	12:15-12:30	9	16	25	6:15- 6:30	5	2	7
12:30-12:45	0	0	0	6:30- 6:45	2	2	4	12:30-12:45	10	13	23	6:30- 6:45	5	0	5
12:45- 1:00	0	0	0	6:45- 7:00	2	1	3	12:45- 1:00	18	13	31	6:45- 7:00	4	1	5
1:00- 1:15	0	0	0	7:00- 7:15	1	3	4	1:00- 1:15	18	12	30	7:00- 7:15	4	2	6
1:15- 1:30	0	1	1	7:15- 7:30	1	4	5	1:15- 1:30	11	22	33	7:15- 7:30	1	1	2
1:30- 1:45	0	0	0	7:30- 7:45	3	11	14	1:30- 1:45	22	13	35	7:30- 7:45	3	3	6
1:45- 2:00	0	0	0	7:45- 8:00	4	7	11	1:45- 2:00	19	8	27	7:45- 8:00	0	0	0
2:00- 2:15	1	0	1	8:00- 8:15	3	5	8	2:00- 2:15	14	20	34	8:00- 8:15	0	0	0
2:15- 2:30	1	1	2	8:15- 8:30	5	8	13	2:15- 2:30	17	7	24	8:15- 8:30	1	0	1
2:30- 2:45	0	0	0	8:30- 8:45	6	3	9	2:30- 2:45	12	17	29	8:30- 8:45	0	0	0
2:45- 3:00	0	0	0	8:45- 9:00	5	3	8	2:45- 3:00	20	17	37	8:45- 9:00	1	1	2
3:00- 3:15	1	1	2	9:00- 9:15	9	10	19	3:00- 3:15	19	9	28	9:00- 9:15	4	1	5
3:15- 3:30	0	0	0	9:15- 9:30	11	9	20	3:15- 3:30	16	12	28	9:15- 9:30	4	0	4
3:30- 3:45	0	0	0	9:30- 9:45	6	12	18	3:30- 3:45	15	9	24	9:30- 9:45	0	2	2
3:45- 4:00	0	0	0	9:45-10:00	4	8	12	3:45- 4:00	22	11	33	9:45-10:00	0	0	0
4:00- 4:15	0	0	0	10:00-10:15	9	15	24	4:00- 4:15	13	12	25	10:00-10:15	0	1	1
4:15- 4:30	0	0	0	10:15-10:30	8	5	13	4:15- 4:30	19	14	33	10:15-10:30	3	1	4
4:30- 4:45	0	0	0	10:30-10:45	6	15	21	4:30- 4:45	25	9	34	10:30-10:45	2	0	2
4:45- 5:00	0	0	0	10:45-11:00	9	8	17	4:45- 5:00	15	11	26	10:45-11:00	1	0	1
5:00- 5:15	0	1	1	11:00-11:15	3	11	14	5:00- 5:15	12	7	19	11:00-11:15	0	1	1
5:15- 5:30	2	1	3	11:15-11:30	10	10	20	5:15- 5:30	11	13	24	11:15-11:30	1	0	1
5:30- 5:45	0	0	0	11:30-11:45	14	17	31	5:30- 5:45	9	4	13	11:30-11:45	0	0	0
5:45- 6:00	0	0	0	11:45-12:00	13	9	22	5:45- 6:00	6	3	9	11:45-12:00	1	0	1

AM COMMUTER PERIOD (05:00 - 09:00)	MOV 2	MOV 6	TOTAL
TWO-DIRECTIONAL PEAK :	-------	-------	7:00 AM - 8:00 AM
AM - PEAK HR TIME	35	31	66
AM - PEAK HR VOLUME			4.53
AM - K FACTOR (%)	52.61	47.39	100.00
AM - D %			
DIRECTIONAL PEAK :	8:00 AM - 9:00 AM	7:00 AM - 8:00 AM	
AM PEAK - HR TIME	19	31	
AM PEAK - HR VOLUME			

PM COMMUTER PERIOD (15:00 - 19:00)	MOV 2	MOV 6	TOTAL
TWO-DIRECTIONAL PEAK :	-------	-------	3:45 PM - 4:45 PM
PM - PEAK HR TIME	79	46	125
PM - PEAK HR VOLUME			11.72
PM - K FACTOR (%)	63.20	36.80	100.00
PM - D %			
DIRECTIONAL PEAK :	3:45 PM - 4:45 PM	3:30 PM - 4:30 PM	
PM PEAK - HR TIME	79	86	
PM PEAK - HR VOLUME			

AM PERIOD (05:00 - 12:00)			
TWO-DIRECTIONAL PEAK :			11:00 AM - 12:00 PM
AM - PEAK HR TIME	40	47	87
AM - PEAK HR VOLUME			8.16
AM - K FACTOR (%)	45.98	54.02	100.00
AM - D %			

PM PERIOD (12:00 - 24:00)			
TWO-DIRECTIONAL PEAK :			12:00 PM - 1:00 PM
PM - PEAK HR TIME	69	54	123
PM - PEAK HR VOLUME			12.43
PM - K FACTOR (%)	56.88	43.12	100.00
PM - D %			

NON-COMMUTER PERIOD (09:00 - 15:00)			
TWO-DIRECTIONAL PEAK :			12:00 PM - 1:00 PM
PEAK HR TIME	69	64	133
PEAK HR VOLUME			
DIRECTIONAL PEAK :	1:30 PM - 2:30 PM	11:30 AM - 12:30 PM	
PEAK HR TIME	72	64	
PEAK HR VOLUME			

6 - HR, 12 - HR, 24 - HR PERIODS			
AM 6 - HR PERIOD (06:00 - 12:00)	134	177	311
AM 12 - HR PERIOD (00:00 - 12:00)	159	192	351
PM 6 - HR PERIOD (12:00- 18:00)	244	294	538
PM 12 - HR PERIOD (12:00 - 24:00)	438	315	753
24 HOUR PERIOD	569	497	1,066
D %	53.38	46.62	100.00

029/032
FEDEX KINKOS 0937
05/21/2004 09:53 FAX 8082345501

ISLAND : Maui
STATION NO : C-12-B
AUX NO.:
FUND SYSTEM :
FILE : Seg

STATION DESCRIPTION : Lower Honoapiilani Road at Kahana Bridge Maui

TC NO : C-12-B
ID NO : 182

COUNT GROUP ID :
ROUTE NO : M.P.:
HWY ST NAME : Lower Honoapiilani Rd
MOV (1), DIR : To Honoapiilani Hwy
MOV (5), DIR : To Napilihau St

MOV (1), TYPE :
MOV (5), TYPE :

D-02 BEG SURVEY DATE : 04/01/03
D-01 BEG SURVEY DATE : 04/01/03

START TIME : 09:15 AM
START TIME : 09:15 AM

TIME-AM	MOV 1	MOV 5	TOTAL	TIME-AM	MOV 1	MOV 5	TOTAL	TIME-PM	MOV 1	MOV 5	TOTAL	TIME-PM	MOV 1	MOV 5	TOTAL
12:00-12:15	4	1	5	6:00- 6:15	3	10	13	12:00-12:15	36	35	71	6:00- 6:15	32	39	71
12:15-12:30	0	3	3	6:15- 6:30	7	7	14	12:15-12:30	33	42	75	6:15- 6:30	31	39	70
12:30-12:45	5	1	6	6:30- 6:45	6	17	23	12:30-12:45	27	24	51	6:30- 6:45	29	24	53
12:45- 1:00	3	1	4	6:45- 7:00	7	16	23	12:45- 1:00	43	36	79	6:45- 7:00	24	39	63
1:00- 1:15	6	2	8	7:00- 7:15	14	26	40	1:00- 1:15	27	37	64	7:00- 7:15	29	21	50
1:15- 1:30	3	0	3	7:15- 7:30	14	34	48	1:15- 1:30	32	49	81	7:15- 7:30	30	27	57
1:30- 1:45	1	1	2	7:30- 7:45	16	27	43	1:30- 1:45	32	36	68	7:30- 7:45	19	18	37
1:45- 2:00	1	3	4	7:45- 8:00	30	38	68	1:45- 2:00	36	44	80	7:45- 8:00	18	20	38
2:00- 2:15	0	0	0	8:00- 8:15	24	27	51	2:00- 2:15	33	38	71	8:00- 8:15	18	15	33
2:15- 2:30	2	4	6	8:15- 8:30	26	30	56	2:15- 2:30	21	38	59	8:15- 8:30	14	12	26
2:30- 2:45	3	2	5	8:30- 8:45	31	31	62	2:30- 2:45	32	44	76	8:30- 8:45	19	18	37
2:45- 3:00	3	0	3	8:45- 9:00	23	37	60	2:45- 3:00	42	33	75	8:45- 9:00	13	15	28
3:00- 3:15	1	0	1	9:00- 9:15	29	45	74	3:00- 3:15	30	35	65	9:00- 9:15	16	15	31
3:15- 3:30	0	2	2	9:15- 9:30	27	35	62	3:15- 3:30	31	39	70	9:15- 9:30	12	15	27
3:30- 3:45	0	0	0	9:30- 9:45	32	28	60	3:30- 3:45	33	40	73	9:30- 9:45	9	11	20
3:45- 4:00	0	0	0	9:45-10:00	42	26	68	3:45- 4:00	36	42	78	9:45-10:00	10	14	24
4:00- 4:15	0	1	1	10:00-10:15	31	34	65	4:00- 4:15	30	55	85	10:00-10:15	13	14	27
4:15- 4:30	2	0	2	10:15-10:30	27	32	59	4:15- 4:30	35	42	77	10:15-10:30	9	7	16
4:30- 4:45	0	2	2	10:30-10:45	47	28	75	4:30- 4:45	32	34	66	10:30-10:45	14	12	26
4:45- 5:00	1	1	2	10:45-11:00	43	29	72	4:45- 5:00	28	27	55	10:45-11:00	7	4	11
5:00- 5:15	1	5	6	11:00-11:15	35	48	83	5:00- 5:15	42	58	100	11:00-11:15	4	8	12
5:15- 5:30	2	2	4	11:15-11:30	31	43	74	5:15- 5:30	40	46	86	11:15-11:30	4	1	5
5:30- 5:45	1	5	6	11:30-11:45	29	47	76	5:30- 5:45	37	36	73	11:30-11:45	7	9	16
5:45- 6:00	1	9	10	11:45-12:00	38	38	76	5:45- 6:00	27	31	58	11:45-12:00	4	6	10

AM COMMUTER PERIOD (05:00 - 09:00)	MOV 1	MOV 5	TOTAL
TWO-DIRECTIONAL PEAK :			7:45 AM - 8:45 AM
AM - PEAK HR TIME	********	********	237
AM - PEAK HR VOLUME	131	128	5.99
AM - K FACTOR (%)			100.00
AM - D %	46.84	53.16	
DIRECTIONAL PEAK :			
AM PEAK - HR TIME	7:45 AM - 8:45 AM	7:15 AM - 8:15 AM	
AM PEAK - HR VOLUME	131	126	

AM PERIOD (00:00 - 12:00)			
TWO-DIRECTIONAL PEAK :			12:00 AM - 12:00 PM
AM - PEAK HR TIME			309
AM - PEAK HR VOLUME	133	176	7.81
AM - K FACTOR (%)			100.00
AM - D %	43.04	56.96	

NON-COMMUTER PERIOD (09:00 - 15:00)			
TWO-DIRECTIONAL PEAK :			11:00 AM - 12:00 PM
PEAK HR TIME			309
PEAK HR VOLUME	133	176	
DIRECTIONAL PEAK :			
PEAK HR TIME	10:30 AM - 11:30 AM	11:00 AM - 12:00 PM	
PEAK HR VOLUME	134	176	

PM COMMUTER PERIOD (15:00 - 19:00)	MOV 1	MOV 5	TOTAL
TWO-DIRECTIONAL PEAK :			5:00 PM - 6:00 PM
PM - PEAK HR TIME	********	********	317
PM - PEAK HR VOLUME	146	171	8.01
PM - K FACTOR (%)			100.00
PM - D %	46.06	53.94	
DIRECTIONAL PEAK :			
PM PEAK - HR TIME	4:45 PM - 5:45 PM	3:30 PM - 4:30 PM	
PM PEAK - HR VOLUME	147	179	

PM PERIOD (12:00 - 24:00)			
TWO-DIRECTIONAL PEAK :			5:00 PM - 6:00 PM
PM - PEAK HR TIME			317
PM - PEAK HR VOLUME	146	171	8.01
PM - K FACTOR (%)			100.00
PM - D %	46.06	53.94	

6 - HR, 12 - HR, 24 - HR PERIODS			
AM 6 - HR PERIOD (06:00 - 12:00)	631	793	1,240
AM 12 - HR PERIOD (00:00 - 12:00)	653	780	1,433
PM 6 - HR PERIOD (12:00 - 18:00)	797	941	1,738
PM 12 - HR PERIOD (12:00 - 24:00)	1,181	1,344	2,524
24 HOUR PERIOD	1,834	2,124	3,958
D %	46.34	53.66	100.00

028/032
FEDEX KINKOS 0937
45501

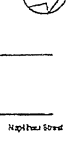
24-HOUR TRAFFIC COUNT - STATION SUMMARY

HAWAII STATE DEPARTMENT OF TRANSPORTATION
HIGHWAY PLANNING BRANCH

Station No : C-12-B

Location : Lower Honoapiilani Road at Kahana Bridge

STATION CHARACTERISTICS	INTERSECTION APPROACHES				
	LEG 1	LEG 2	LEG 3	LEG 4	
Traffic Control					
Width of Approach (Ft)					
Number of Lanes at Approach					
Separate Turning Lane (Lt, Rt, Lt/Rt)					
Parking (AM, PM, All Day, None)					
Bus Stop (NS: Near Side, FS: Far Side)					



DATE	24-HOUR TRAFFIC VOLUMES		
	D-1	D-2	TOTAL
	MOV 5	MOV 1	
04/26-27/99	2025	1946	3971
04/17-18/01	1987	1863	3850
04/01-02/03*	2124	1834	3958

Hwyph_07\E Waiehu\Sta

*March 19, 2003 Start of Operation Iraqi Freedom

STATION NO : C-12-B

VEHICLE TYPE CLASSIFICATION (TCOMP - 13 CATEGORIES)

HAWAII STATE DEPARTMENT OF TRANSPORTATION
HIGHWAY PLANNING BRANCH

Island : Maui Station No : C-12-C
Hwy/St : Honoapiilani Highway Location : 0.47 Miles West of Honolua Bridge
Route System : Route No : M.P. : Route Direction (D-1) = MOV (5)
Survey Date : 04/01-02/03 Survey Period : 09:00 AM - 09:00 AM
File : Seg Hwy/St : Route No : M.P. :

VEHICLE TYPE		A.M. PEAK (11:00 - 12:00)			P.M. PEAK (12:30 - 1:30)			24-HOUR VOLUME (09:00 AM - 09:00 AM)			
		DIRECTION		TOTAL	DIRECTION		TOTAL	DIRECTION		TOTAL	VERTICAL %
		MOV 1	MOV 5		MOV 1	MOV 5		MOV 1	MOV 5		
PASSENGER CARS											
1	MTC	5		5	6		6	79	2	81	5.62
2	Car	48	63	111	40	101	141	396	824	1220	84.68
3	PU/Van	1		1	1	1	2	29	38	67	4.65
16	Unclassified	7		7	6	3	9	48	15	63	4.37
Sub-Total		61	63	124	53	105	158	552	879	1431	99.30
TRUCKS & BUSES											
4	Bus										
5	2X, 6 Tires							2	3	5	0.35
6	3X, SUT							1		1	0.07
7	4X, SUT										
8	2S1,3S1,2S2										
9	3S2,3-2,2-3							1	2	3	0.21
10	6/6+X S-Tlr										
11	5X M-Tlr										
12	6X M-Tlr										
13	7X M-Tlr								1	1	0.07
Sub - Total		0	0	0	0	0	0	4	6	10	0.70
TOTAL		61	63	124	53	105	158	556	885	1441	100%
Distribution (D) %		49.2	50.8	100%	33.5	66.5	100%	38.6	61.4	100%	
Trucks (T) %		0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.7	
K %				8.6			11.0			100%	

Hwyph_01\E\Weekend.xls

STATION NO : C-12-C

24-HOUR TRAFFIC COUNT STATION SUMMARY

HAWAII STATE DEPARTMENT OF TRANSPORTATION
HIGHWAY PLANNING BRANCH

Station No : C-12-C Island : Maui
Highway/Street : Honoapiilani Highway
Location : 0.47 Miles West of Honolua Bridge
Fund System : Route No : M.P. : Rte Dir (D-1)=Mov (5)

	ROAD SECTION	
	D-1	D-2
Number of Lanes		
Lane Width (Ft)		
Lateral Clearance (Ft) Left/Right		
Detection Method (Loops/Hoses)		
Special Conditions :		
Highway Divided : No___ Yes___ Type :		

FILE : SEG (1)

M1 = 12 Hrs Manual/24 Hrs Data Estimated
M2 = 24 Hrs Manual
M3 = 12 Hrs Manual/Truck & Cycle Count Only
A = 24 Hrs ATR
I = 24 Hrs IRD, Piezo Cables
I2 = 24 Hrs IRD, Piezo Cables/Truck & Cycle Count Only

DATE	SURVEY TYPE	A.M. PEAK HOUR						P.M. PEAK HOUR						24-HOUR PERIOD					
		VOLUME (VEH)			TRUCK (T) %			VOLUME (VEH)			TRUCK (T) %			VOLUME (VEH)			TRUCK (T) %		
		TRAFFIC DIRECTION			TRAFFIC DIRECTION			TRAFFIC DIRECTION			TRAFFIC DIRECTION			TRAFFIC DIRECTION			TRAFFIC DIRECTION		
		MOV 1	MOV 5	TOTAL	MOV 1	MOV 5	TOTAL	MOV 1	MOV 5	TOTAL	MOV 1	MOV 5	TOTAL	MOV 1	MOV 5	TOTAL	MOV 1	MOV 5	TOTAL
04/30-05/01/97	A	66	111	177	1.5	1.8	1.7	108	75	183	4.6	0.0	2.7	886	949	1835	4.4	3.1	3.7
04/26-27/99	A	83	147	230	6.0	3.4	4.3	105	100	205	1.0	3.0	2.0	973	1141	2114	3.7	3.0	3.3
04/24-25/01	A	80	96	176	6.3	4.2	5.1	76	81	157	6.6	2.5	4.5	746	837	1583	3.4	3.5	3.4
04/01-02/03*	A	61	63	124	0.0	0.0	0.0	53	105	158	0.0	0.0	0.0	556	885	1441	0.7	0.7	0.7

Hwyph_01\E\Weekend.xls

*March 19, 2003 Start of Operation Iraqi Freedom

STATION NO : C-12-C

APPENDIX M

Existing Traffic Signal Timing

4/8/2003 State of Hawaii, Department of Transportation, Highways Division

ISLAND : Maui
STATION NO : C-12-C
AUX NO :
FUND-SYSTEM :
FILE : Seg (VTC)

STATION DESCRIPTION : Honoapiilani Highway
0.47 Miles West of Honoboa Bridge
Maui

TC NO : C-12-C
ID NO : 206, 33

COUNT GROUP ID :
ROUTE NO : M.P. :
HWY ST NAME : Honoapiilani Hwy
MOV (1), DIR : To Wailuku D-02
MOV (5), DIR : To Kahukoloa D-01

MOV (1), TYPE :
MOV (5), TYPE :

BEG SURVEY DATE : 04/01/03
BEG SURVEY DATE : 04/01/03

START TIME : 09:00 AM
START TIME : 09:00 AM

TIME-AM	MOV 1	MOV 5	TOTAL	TIME-AM	MOV 1	MOV 5	TOTAL	TIME-PM	MOV 1	MOV 5	TOTAL	TIME-PM	MOV 1	MOV 5	TOTAL
12:00-12:15	1	1	2	6:00- 6:15	0	3	3	12:00-12:15	8	29	37	6:00- 6:15	3	20	23
12:15-12:30	0	2	2	6:15- 6:30	2	1	3	12:15-12:30	11	21	32	6:15- 6:30	9	20	29
12:30-12:45	0	0	0	6:30- 6:45	2	5	7	12:30-12:45	11	21	32	6:30- 6:45	6	7	13
12:45- 1:00	0	0	0	6:45- 7:00	1	9	10	12:45- 1:00	13	26	39	6:45- 7:00	3	12	15
1:00- 1:15	0	0	0	7:00- 7:15	2	8	10	1:00- 1:15	11	35	46	7:00- 7:15	1	14	15
1:15- 1:30	0	0	0	7:15- 7:30	3	6	9	1:15- 1:30	23	41	64	7:15- 7:30	4	7	11
1:30- 1:45	0	0	0	7:30- 7:45	2	2	4	1:30- 1:45	7	25	32	7:30- 7:45	1	1	2
1:45- 2:00	0	1	1	7:45- 8:00	8	10	18	1:45- 2:00	14	20	34	7:45- 8:00	2	2	4
2:00- 2:15	0	0	0	8:00- 8:15	2	11	13	2:00- 2:15	12	16	28	8:00- 8:15	4	1	5
2:15- 2:30	1	0	1	8:15- 8:30	4	12	16	2:15- 2:30	20	20	40	8:15- 8:30	3	0	3
2:30- 2:45	0	0	0	8:30- 8:45	5	4	9	2:30- 2:45	17	31	48	8:30- 8:45	0	1	1
2:45- 3:00	0	1	1	8:45- 9:00	8	8	16	2:45- 3:00	16	18	34	8:45- 9:00	2	0	2
3:00- 3:15	0	0	0	9:00- 9:15	9	9	18	3:00- 3:15	17	15	32	9:00- 9:15	1	0	1
3:15- 3:30	0	0	0	9:15- 9:30	15	14	29	3:15- 3:30	10	22	32	9:15- 9:30	2	2	4
3:30- 3:45	0	0	0	9:30- 9:45	12	12	24	3:30- 3:45	11	22	33	9:30- 9:45	3	0	3
3:45- 4:00	0	0	0	9:45-10:00	15	11	26	3:45- 4:00	15	21	36	9:45-10:00	2	1	3
4:00- 4:15	0	0	0	10:00-10:15	18	11	29	4:00- 4:15	12	23	35	10:00-10:15	0	1	1
4:15- 4:30	0	0	0	10:15-10:30	14	13	27	4:15- 4:30	16	21	37	10:15-10:30	1	3	4
4:30- 4:45	0	0	0	10:30-10:45	16	10	26	4:30- 4:45	9	20	29	10:30-10:45	0	2	2
4:45- 5:00	0	0	0	10:45-11:00	7	14	21	4:45- 5:00	10	23	33	10:45-11:00	2	1	3
5:00- 5:15	0	0	0	11:00-11:15	15	12	27	5:00- 5:15	8	22	30	11:00-11:15	0	1	1
5:15- 5:30	1	0	1	11:15-11:30	19	14	33	5:15- 5:30	11	20	31	11:15-11:30	1	2	3
5:30- 5:45	0	4	4	11:30-11:45	8	17	25	5:30- 5:45	6	24	30	11:30-11:45	1	1	2
5:45- 6:00	2	3	5	11:45-12:00	19	20	39	5:45- 6:00	10	20	30	11:45-12:00	1	0	1

AM COMMUTER PERIOD (05:00 - 09:00)	MOV 1	MOV 5	TOTAL
TWO-DIRECTIONAL PEAK :	-------	-------	7:45 AM - 8:45 AM
AM - PEAK HR TIME	19	37	56
AM - PEAK HR VOLUME			0.89
AM - K FACTOR (%)	33.93	66.07	100.00
AM - D %			
DIRECTIONAL PEAK :	7:45 AM - 8:45 AM	7:45 AM - 8:45 AM	
AM PEAK - HR TIME	19	37	
AM PEAK - HR VOLUME			

AM PERIOD (00:00 - 12:00)			
TWO-DIRECTIONAL PEAK :			11:00 AM - 12:00 PM
AM - PEAK HR TIME	61	63	124
AM - PEAK HR VOLUME			0.81
AM - K FACTOR (%)	49.19	50.81	100.00
AM - D %			

NON-COMMUTER PERIOD (09:00 - 15:00)			
TWO-DIRECTIONAL PEAK :			12:30 PM - 1:30 PM
PEAK HR TIME	33	105	138
PEAK HR VOLUME			
DIRECTIONAL PEAK :	2:00 PM - 3:00 PM	12:45 PM - 1:45 PM	
PEAK HR TIME	63	109	
PEAK HR VOLUME			

PM COMMUTER PERIOD (15:00 - 19:00)	MOV 1	MOV 5	TOTAL
TWO-DIRECTIONAL PEAK :	-------	-------	3:30 PM - 4:30 PM
PM - PEAK HR TIME	54	87	141
PM - PEAK HR VOLUME			0.78
PM - K FACTOR (%)	38.30	61.70	100.00
PM - D %			
DIRECTIONAL PEAK :	3:30 PM - 4:30 PM	4:15 PM - 5:15 PM	
PM PEAK - HR TIME	54	89	
PM PEAK - HR VOLUME			

PM PERIOD (12:00 - 24:00)			
TWO-DIRECTIONAL PEAK :			12:30 PM - 1:30 PM
PM - PEAK HR TIME	53	105	158
PM - PEAK HR VOLUME			0.84
PM - K FACTOR (%)	33.54	66.46	100.00
PM - D %			

4 - HR, 12 - HR, 24 - HR PERIODS			
AM 4 - HR PERIOD (06:00 - 10:00)	206	234	440
AM 12 - HR PERIOD (00:00 - 12:00)	311	248	559
PM 4 - HR PERIOD (15:00 - 19:00)	293	338	631
PM 12 - HR PERIOD (12:00 - 24:00)	543	677	980
24 HOUR PERIOD	556	843	1,441
D %	38.58	61.42	100.00

ID: 808 873 3944

MAY-21-04 14:17 FROM: D.O.T. HIGHWAYS

Coordination

Column Numbers →	Plan								
Plan Name →									
Cycle Length	100	100	100	100	100	100	100	100	100
Phase 1 - ForceOff	55	60	60	63	60	61	65	65	65
Phase 2 - ForceOff	0	0	0	0	0	0	0	0	0
Phase 3 - ForceOff	20	15	20	25	20	25	25	25	25
Phase 4 - ForceOff	40	40	40	40	40	40	40	40	40
Phase 5 - ForceOff	55	60	60	61	60	63	65	65	65
Phase 6 - ForceOff	0	0	0	0	0	0	0	0	0
Phase 7 - ForceOff	20	15	20	25	20	25	25	25	25
Phase 8 - ForceOff	40	40	40	40	40	40	40	40	40
Ring Offset	0	0	0	0	0	0	0	0	0
Offset 1	0	0	0	0	0	0	0	0	0
Offset 2	0	0	0	0	0	0	0	0	0
Offset 3	0	0	0	0	0	0	0	0	0
Permissive	12	12	12	12	12	12	12	12	12
Hold Release	255	255	255	255	255	255	255	255	255
Zone Offset	0	0	0	0	0	0	0	0	0

<C Page>

(* = Coordination Recall)

Sync Phases

Plan 1 - Sync	2 6
Plan 2 - Sync	2 6
Plan 3 - Sync	2 6
Plan 4 - Sync	2 6
Plan 5 - Sync	2 6
Plan 6 - Sync	2 6
Plan 7 - Sync	2 6
Plan 8 - Sync	2 6
Plan 9 - Sync	2 6
Coord Ped *	
NEMA Hold	

<C Page>

Configuration

Column Numbers →	
Exclusive Phases	
RR-1 Clear Phases	
RR-2 Clear Phases	
RR-2 Limited Service	
Prot / Perm Phases	4 1 5 7
Overlap A - Green Omit	
Overlap B - Green Omit	
Overlap C - Green Omit	
Overlap D - Green Omit	
Overlap Yellow Flash	
EV-A Phases	1 6
EV-B Phases	4 7
EV-C Phases	2 5
EV-D Phases	3 8
Extra 1 Config. Bits	1
IC Select (Interconnect)	2

<E Page>

Configuration

RR Overlap A - Phases	
RR Overlap B - Phases	
RR Overlap C - Phases	
RR Overlap D - Phases	
Ped 2P	2
Ped 6P	6
Ped 4P	4
Ped 8P	
Yellow Flash Phases	
Overlap A - Phases	
Overlap B - Phases	
Overlap C - Phases	
Overlap D - Phases	
Restricted Phases	
Assign 5 Outputs	7

<E Page>

Extra 1 Flags
1 = TBC Type 1
2 = NEMA Ext. Coord
3 = Auto Daylight Savings
4 = EV Advance
5 =
6 = Special Event
7 = Preempt Operation
8 = Split Ring Operation

Assign 5 Outputs
(Ped Load-switch Yellows)
1 = Right Turn Overlap
2 = TOD Output
3 = EV Beacon - Steady
4 = EV Beacon - Flashing
5 = Special Event Outputs
6 = Phase 3 & 7 Ped
7 = Advanced Warning Sign
8 =

Force-Off Adjust	0

Coord Force-Off Adjust for Ped Service <C+D+F>

Transition Type	0

TBC Transition <C+D+D>

Transition Type
0 = Shortway
Non-zero = Lengthen

IC Select Flags
1 =
2 = Modem
3 = 7-Wire Slave
4 = Flash / Free
5 =
6 = Simplex Master
7 = 7-Wire Master
8 = Offset Interrupter

Lag Phases

Free Lag	2 4 6 8
Plan 1 - Lag	2 4 6 8
Plan 2 - Lag	2 4 6 8
Plan 3 - Lag	2 4 6 8
Plan 4 - Lag	2 4 6 8
Plan 5 - Lag	2 4 6 8
Plan 6 - Lag	2 4 6 8
Plan 7 - Lag	2 4 6 8
Plan 8 - Lag	2 4 6 8
Plan 9 - Lag	2 4 6 8
Coord Max *	
Coord Lag *	

<C Page>

ID: 808 873 3944

MAY-21-04 14:17 FROM: D.O.T. HIGHWAYS

Group Assignment: NONE
Field Master Assignment: NONE
System Reference Number: 17

N/S Street Name: Akahele
E/W Street Name: Honoapiilani

Last Database Change: 1/27/2003 16:27

Change Record

Change	By	Date	Change	By	Date

Notes:

Communication Addresses

Drop Number	14	<C+0+0>
Zone Number	14	<C+0+1>
Area Number	1	<C+0+2>
Area Address	14	<C+0+3>
QuicNet Channel	comm:	(QuicNet)

Manual Selection

Manual Plan		<C+A+1>
Manual Offset		<C+B+1>

Start / Revert Times

Max Initial	20	<F+0+E>
Red Revert	5.0	<F+0+F>
All Red Start	5.0	<F+C+0>

Phase Timing - Bank 1

Column Numbers →	Phase							
Phase Names →								
Ped Walk	0	7	0	7	0	7	0	0
Ped FDW	0	11	0	13	0	21	0	0
Min Green	5	10	5	5	5	15	5	5
Type 3 Limit	0	0	0	0	0	0	0	0
Added Initial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Veh Extension	2.0	5.0	2.0	3.0	2.0	5.0	2.0	3.0
Max Gap	2.0	5.0	2.0	3.0	2.0	5.0	2.0	3.0
Min Gap	2.0	5.0	2.0	3.0	2.0	5.0	2.0	3.0
Max Limit	15	70	15	25	15	70	15	25
Max Limit 2	15	70	15	25	15	70	15	25
.....	0	0	0	0	0	0	0	0
Call To Phase	0	0	0	0	0	0	0	0
Reduce By	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Reduce Every	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Yellow Change	3.0	5.0	3.0	4.0	3.0	5.0	3.0	4.0
Red Clear	1.0	2.0	1.0	1.0	1.0	2.0	1.0	1.0

<F Page>

Preempt Timing

RR-1 Delay	0
RR-1 Clear	10
EV-A Delay	0
EV-A Clear	1
EV-B Delay	0
EV-B Clear	1
EV-C Delay	0
EV-C Clear	1
EV-D Delay	0
EV-D Clear	1
RR-2 Delay	0
RR-2 Clear	10
View EV Delay	---
View EV Clear	---
View RR Delay	---
View RR Clear	---

Phase Functions

Permit	12345678
Red Lock	
Yellow Lock	
Min Recall	2 6
Ped Recall	
View Set Peds	.....
Rest In Walk	
Red Rest	
Dual Entry	2 4 6 8
Max Recall	
Soft Recall	
Max 2	
Cond. Service	
Man Cntrl Calls	
Yellow Start	2 6
First Phases	3 7

Manual Plan
0 = Automatic
1-9 = Plan 1-9
14 = Free
15 = Flash

Manual Offset
0 = Automatic
1 = Offset A
2 = Offset B
3 = Offset C

Row	Delay	Carry-over	Detector Name	332 Input File	Detector Number
	0.0	0.0		I-1	14
	0.0	0.0		I-2U	1
	0.0	0.0		I-2L	5
	0.0	0.0		I-3U	21
	0.0	0.0		I-3L	25
	0.0	0.0		I-4	9
	0.0	0.0		I-5	16
	0.0	0.0		I-6U	3
	0.0	0.0		I-6L	7
	0.0	0.0		I-7U	23
	0.0	0.0		I-7L	27
	0.0	0.0		I-8	11
	0.0	0.0		I-9U	18
	0.0	0.0		I-9L	20
	---	---	---	---	---
	---	---	---	---	---

Row	Delay	Carry-over	Detector Name	332 Input File	Detector Number
	0.0	0.0		J-1	13
	0.0	0.0		J-2U	2
	0.0	0.0		J-2L	6
	0.0	0.0		J-3U	22
	0.0	0.0		J-3L	26
	0.0	0.0		J-4	10
	0.0	0.0		J-5	15
	0.0	0.0		J-6U	4
	0.0	0.0		J-6L	8
	0.0	0.0		J-7U	24
	0.0	0.0		J-7L	28
	0.0	0.0		J-8	12
	0.0	0.0		J-9U	17
	0.0	0.0		J-9L	19
	---	---	---	---	---
	---	---	---	---	---

Detector Delay & Carryover <D Page>

Row		Green Clear	Yellow Change	Red Clear	Load-Switch #
	Overlap A	0.0	0.0	0.0	0
	Overlap B	0.0	0.0	0.0	0
	Overlap C	0.0	0.0	0.0	0
	Overlap D	0.0	0.0	0.0	0

Overlap Timing <F Page> <D Page>

Row	Detector Numbers	
	1 2 3 4 5 6 7 8	12345678
	9 10 11 12 - - - -	1234
	13 14 15 16 17 18 19 20	12345678
	- - - - 21 22 23 24	5678
	- - - - - - - -	1234
	- 25 26 27 28 - - -	2345

Note: Installed data is for all detectors to be active (ie, all flag bits set). A Detector which is "not flagged", will not be active as a Phase Detector, and WILL NOT call or extend its associated phase. It will still function as a System Detector.

Active Detectors <D Page>

Row		Detector Number
	System Det. # 1	0
	System Det. # 2	0
	System Det. # 3	0
	System Det. # 4	0
	System Det. # 5	0
	System Det. # 6	0
	System Det. # 7	0
	System Det. # 8	0

System Detectors <D Page>

Max ON (minutes)	5	<D+A+E>
Max OFF (minutes)	60	<D+A+F>

Detector Failure Monitor

Phase Number	0	<F+C+1>
Time Before Yellow	0.0	<F+C+3>

Advance Warning Beacon - Sign 1

Phase Number	0	<F+D+1>
Time Before Yellow	0.0	<F+D+3>

Advance Warning Beacon - Sign 2

Long Failure	0.0	<F+0+6>
Short Failure	0.0	<F+0+7>

Power Cycle Correction (Default = 0.5)

Disable Parity	0	<D+B+0>

Dial-Up Telephone Communications
(If set to a non-zero value, parity will be disabled)

MAY-21-04 14:18 FROM: D.O.T. HIGHWAYS ID: 808 873 3544 PAGE 4

Row	Time	Plan	Offset	Day of Week
	00:00	0	0	
	00:00	0	0	
	00:00	0	0	
	00:00	0	0	
	00:00	0	0	
	00:00	0	0	
	00:00	0	0	
	00:00	0	0	
	00:00	0	0	
	00:00	0	0	
	00:00	0	0	
	00:00	0	0	
	00:00	0	0	
	00:00	0	0	

TOD Coordination
<9 Key with C+D+9=0>

Time	Func	Day of Week	Phases/Bits
00:00	0		
00:00	0		
00:00	0		
00:00	0		
00:00	0		
00:00	0		
00:00	0		
00:00	0		
00:00	0		
00:00	0		
00:00	0		
00:00	0		
00:00	0		
00:00	0		

TOD Function
<7 Key>
<D Page>

Time	Plan	Offset	Day of Week
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	

Holiday # 1
TOD Coordination
<9 Key with C+D+8=1>

Time	Plan	Offset	Day of Week
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	

Holiday # 2
TOD Coordination
<9 Key with C+D+9=2>

Time	Plan	Offset	Day of Week
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	
00:00	0	0	

Holiday # 3
TOD Coordination
<9 Key with C+D+9=3>

Plan Select
1 thru 9 = Coordination Plan 1 thru 9
14 or E = Free
15 or F = Flash

Offset Select
A = Offset A
B = Offset B
C = Offset C

T.O.D. Functions
0 = Permitted Phases
1 = Red Lock
2 = Yellow Lock
3 = Veh Min Recall
4 = Ped Recall
5 =
6 = Red In Walk
7 = Red Rest
8 = Double Entry
9 = Veh Max Recall
A = Veh Soft Recall
B = Minimum 2
C = Conditional Service
D = Free Leg Phases
E = Bit 1 - Local Override
Bit 2 - Phase Bank 2
Bit 3 - Phase Bank 3
Bit 4 - Disable Detector OFF Monitor
Bit 7 - Detector Count Monitor
Bit 8 - Real Time Soft Monitor
F = Output Bits 1 thru 4

Month Select
1 = January
2 = February
3 = March
4 = April
5 = May
6 = June
7 = July
8 = August
9 = September
A = October
B = November
C = December

Row		Day	Year	Month	Day of Week
	Holiday # 1 Date	0	0	0	
	Holiday # 2 Date	0	0	0	
	Holiday # 3 Date	0	0	0	

Holiday Dates
<8 Key>

MAY-21-04 14:18 FROM: D.O.T. HIGHWAYS ID: 808 873 3544

INTERSECTION: KAHANA RIDGE DATE: 9/18/97

200

PHASE TIMING

KEYSTROKES: F+PHASE+INTERVAL

INTERVAL		Phase 1	2	3	4	5	6	7	8	PREEMPT	E	
WALK	0		9		9		9			RR1 DELAY		0
FLASH D/W	1		15		15		15			RR1 CLEAR		1
MIN GREEN	2	5	10		6	5	10		6	EVA DELAY		2
TYPE 3 DET	3									EVA CLEAR		3
ADD/VEH	4									EVB DELAY		4
VEH EXTEN *	5	2	4		3	2	4		3	EVB CLEAR		5
MAX GAP *	6	2	4		3	2	4		3	EVC DELAY		6
MIN GAP *	7	2	4		3	2	4		3	EVC CLEAR		7
MAX EXTEN	8	10	50		25	15	50		25	EVD DELAY		8
MAX 2	9	10	50		25	15	50		25	EVD CLEAR		9
	A									RR2 DELAY		A
CALL TO PHASE	B									RR2 CLEAR		B
REDUCE BY	C									EV CLR TMR		C
REDUCE EVERY	D									EV DLY TMR		D
YELLOW	E	3	4		4	3	4		4	RR CLR TMR		E
RED CLEAR	F	1	1		1	1	1		1	RR DLY TMR		F

MAX INITIAL (F-0-E) = ______

RED REVERT (F-0-F) = ______

ALL RED START (F-C-0)= ______

* MUST BE SAME FOR NON-DENSITY OPERATION

PHASE FUNCTION FLAGS

KEYSTROKES: F+F+FUNCTION#

		Phase 1	2	3	4	5	6	7	8
PERMIT	0	X	X		X		X		X
RED LOCK	1								
YELLOW LOCK	2								
VEH RECALL	3		X				X		
PED RECALL	4								
PEDS	5								
REST-IN-WALK	6								
RED REST	7								
DOUBLE ENTRY	8		X		X		X		X
MAX RECALL	9								
SOFT RECALL	A								
MAX 2	B								
COND SERVE	C								
RESERVED	D								
STARTUP	E		X				X		
FIRST PHASES	F								

JMC

OVERLAP TIMING

KEYSTROKE: F+COLOR CODE+OVERLAP

	9 GREEN	C YELLO	D RED
OVERLAP A			
OVERLAP B			
OVERLAP C			
OVERLAP D			

BI TRAN SYSTEMS, INC.

INTERSECTION: Honoapiilani@Akahele

Row	Phase								
Column Numbers --->									
Phase Names --->									
Ped Walk	0	7	0	7	0	7	0	7
Ped FDW	0	10	0	10	0	10	0	10
Min Green	3	7	3	7	3	7	3	7
Type 3 Limit	0	0	0	0	0	0	0	0
Added Initial	0.0	1.2	0.0	1.2	0.0	1.2	0.0	1.2
Veh Extension	0.5	3.5	0.5	3.5	0.5	3.5	0.5	3.5
Max Gap	0.5	5.0	0.5	5.0	0.5	5.0	0.5	5.0
Min Gap	0.5	2.0	0.5	2.0	0.5	2.0	0.5	2.0
Max Limit	17	40	17	40	17	40	17	40
Max Limit 2	30	70	30	70	30	70	30	70
------	0	0	0	0	0	0	0	0
Call To Phase	0	0	0	0	0	0	0	0
Reduce By	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Reduce Every	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Yellow Change	3.0	4.0	3.0	4.0	3.0	4.0	3.0	4.0
Red Clear	0.0	0.5	0.0	1.0	0.0	0.5	0.0	1.0

Phase Timing - Bank 2 <F Page>

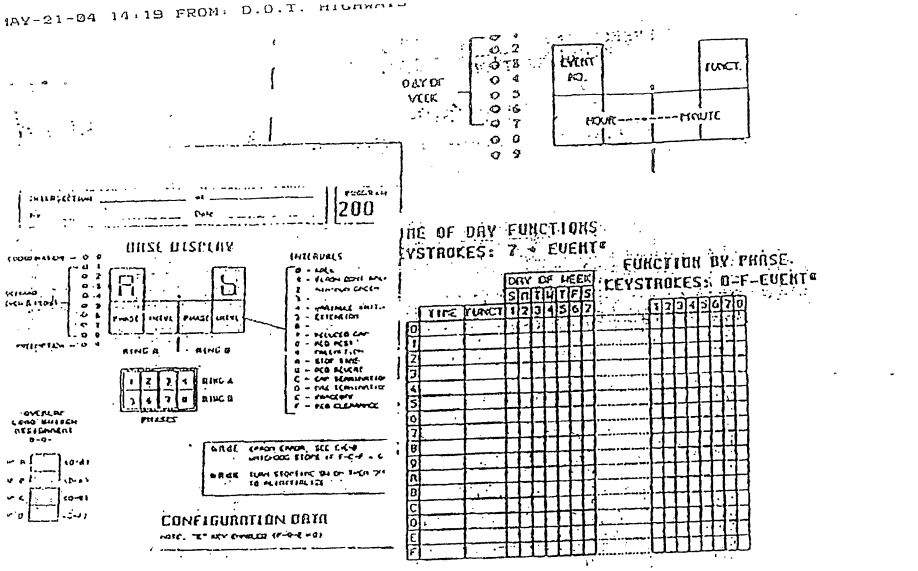
Row	Phase							
Column Numbers --->								
Phase Names --->								
Ped Walk	0	7	0	7	0	7	0	7
Ped FDW	0	10	0	10	0	10	0	10
Min Green	3	7	3	7	3	7	3	7
Type 3 Limit	0	0	0	0	0	0	0	0
Added Initial	0.0	1.2	0.0	1.2	0.0	1.2	0.0	1.2
Veh Extension	0.5	3.5	0.5	3.5	0.5	3.5	0.5	3.5
Max Gap	0.5	5.0	0.5	5.0	0.5	5.0	0.5	5.0
Min Gap	0.5	2.0	0.5	2.0	0.5	2.0	0.5	2.0
Max Limit	17	40	17	40	17	40	17	40
Max Limit 2	30	70	30	70	30	70	30	70
------	0	0	0	0	0	0	0	0
Call To Phase	0	0	0	0	0	0	0	0
Reduce By	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Reduce Every	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Yellow Change	3.0	4.0	3.0	4.0	3.0	4.0	3.8	4.0
Red Clear	0.0	0.5	0.0	1.0	0.0	0.5	0.0	1.0

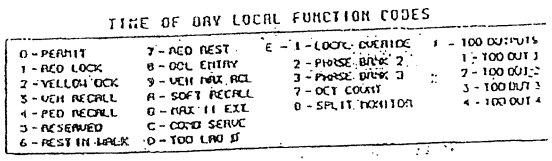
Phase Timing - Bank 3 <F Page>

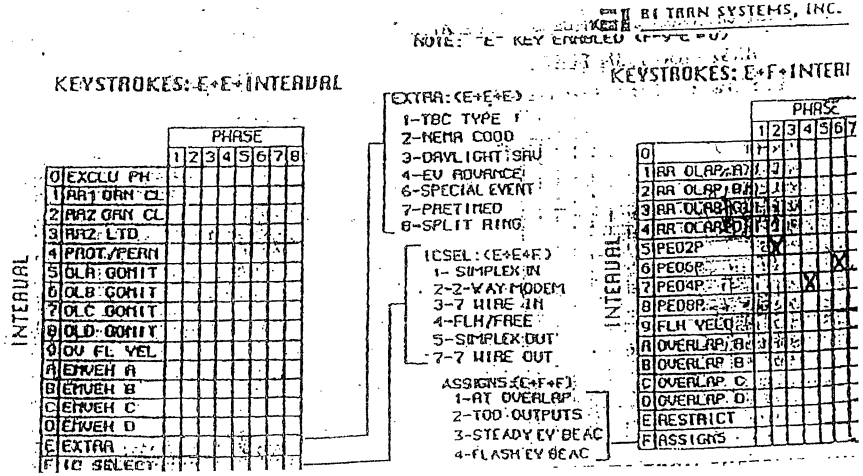
	Time	Dwell	Hold	Advance	Force Off	Vehicle Call	Perma Phases	Ped Omit	Output
Delay Only -->	0	---	---	---	---	---	---	---	---
	0	0							
	0	0							
	0	0							
	0	0							
	0	0							
	0	0							
	0	0							
	0	0							
	0	0							
Limited Service Int -->	...	0							
	0	0							
	0	0							
	0	0							
	0	0							
	0	0							

<-- Limited Service Interval (Set Dwell = 255)

Special Event Schedule <C Page with F+9+F=22>







HONOAPILANI AT NAPILIHAU

DATE:

ITEM	PHASE:	HONO EBL <1>	HONO WBT <2>	<3>	NAPI NBT <4>	HONO WBL <5>	HONO EBT <6>	<7>	NAPI SBT <8>
<0>	WALK	0.0	5.0	0.0	5.0	0.0	5.0	0.0	0.0
<1>	FLASH D/W	0.0	20.0	0.0	19.0	0.0	12.0	0.0	0.0
<2>	MIN GRN	5.0	15.0	0.0	5.0	5.0	15.0	0.0	5.0
<3>	TYPE 3 DET	0.0	15.0	0.0	0.0	0.0	15.0	0.0	0.0
<4>	ADD/VEH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<5>	VEH EXT.	2.0	4.5	0.0	2.5	2.0	4.5	0.0	2.5
<6>	MAX GAP	2.0	4.5	0.0	2.5	2.0	4.5	0.0	2.5
<7>	MIN GAP	2.0	4.5	0.0	2.5	2.0	4.5	0.0	2.5
<8>	MAX EXT	15.0	40.0	0.0	24.0	15.0	40.0	0.0	26.0
<9>	MAX 2	15.0	40.0	0.0	24.0	15.0	40.0	0.0	26.0
<A>									
<B>	CALL TO PH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<C>	REDUCE: BY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<D>	EVERY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<E>	YELLOW	3.0	4.0	0.0	4.0	3.0	4.0	0.0	4.0
<F>	RED CLEAR	1.0	2.0	0.0	~~1.0~~ 2.0 KL	1.0	2.0	0.0	~~1.0~~ 2.0 KL

COMMENTS:

1. Ped Clearance is based on 3.5 ft/sec. (MUTCD allows 4 fps).
2. Most of the values are conservative and are consistent with those normally used in the Maui District. They can be adjusted to suit after monitoring of actual field conditions.

Hawaii D.O.T. LOWER HPLANI at HONOAPIILANI Intersection # 2
PHASE BANK 1 ID: 000000
7:10:52 10/25/ 2 -- PHASE TIMING PARAMETERS -- Last Change: 7/18/

	PHASE:	NBL <1>	SBT <2>	WBT <3>	EBT <4>	SBL <5>	NBT <6>	<7>	<8>
<0>	WALK	0	7	0	7	0	7	0	0
<1>	FLASH D/W	0	23	0	14	0	16	0	0
<2>	MIN GREEN	3	15	5	5	3	15	3	7
<3>	TYPE 3 DET	0	20	0	0	0	0	0	0
<4>	ADD/VEH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2
<5>	VEH EXTEN	2.0	5.0	3.0	3.0	2.0	5.0	0.5	3.5
<6>	MAX GAP	2.0	5.0	3.0	3.0	2.0	5.0	0.5	5.0
<7>	MIN GAP	2.0	5.0	3.0	3.0	2.0	5.0	0.5	2.0
<8>	MAX EXTEN	20	70	21	15	10	70	17	40
<9>	MAX 2	20	70	21	15	10	70	30	70
<A>									
<B>	CALL TO PH	0	0	0	0	0	0	0	0
<C>	REDUCE: BY	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
<D>	EVERY	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0
<E>	YELLOW	3.0	5.0	4.0	4.0	3.0	5.0	3.0	4.0
<F>	RED CLEAR	1.0	1.0	1.0	1.0	1.0	1.0	0.0	1.0

<F-column-row>

Post-it® Fax Note 7671 | Date 5-21-04 | # of pages ▶
To Phillip Lowell | From Marlene Shibuya
Co./Dept. | Co.
Phone # | Phone # 873-3540
Fax # 243-4475 | Fax #

Hawaii D.O.T. HALAWAI at HONOAPIILANI Intersection # 4
PHASE BANK 1 ID: 000000
7:10:33 10/25/ 2 -- PHASE TIMING PARAMETERS -- Last Change: 7/18/

	PHASE:	NBL <1>	SBT <2>	<3>	WBT <4>	SBL <5>	NBT <6>	<7>	EBT <8>
<0>	WALK	0	0	0	0	0	0	0	0
<1>	FLASH D/W	0	0	0	0	0	0	0	0
<2>	MIN GREEN	3	15	0	5	3	15	0	5
<3>	TYPE 3 DET	0	15	0	0	0	15	0	0
<4>	ADD/VEH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<5>	VEH EXTEN	1.0	5.0	0.0	2.0	1.0	5.0	0.0	2.0
<6>	MAX GAP	1.0	5.0	0.0	2.0	1.0	5.0	0.0	2.0
<7>	MIN GAP	1.0	5.0	0.0	2.0	1.0	5.0	0.0	2.0
<8>	MAX EXTEN	15	60	0	40	15	60	0	40
<9>	MAX 2	15	60	0	70	15	60	0	70
<A>									
<B>	CALL TO PH	0	0	0	0	0	0	0	0
<C>	REDUCE: BY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<D>	EVERY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<E>	YELLOW	3.0	4.0	0.0	4.0	3.0	4.0	0.0	4.0
<F>	RED CLEAR	1.0	1.0	0.0	1.0	1.0	1.0	0.0	1.0

Hawaii D.O.T. PUUKOLII at HONOAPIILANI Intersection # 3
PHASE BANK 1 ID: 000000
7:10:16 10/25/ 2 -- PHASE TIMING PARAMETERS -- Last Change: 7/18/

PHASE:		NBL <1>	SBT <2>	<3>	WBT <4>	SBL <5>	NBT <6>	<7>	EBT <8>
<0>	WALK	0	8	0	10	0	8	0	0
<1>	FLASH D/W	0	12	0	16	0	15	0	0
<2>	MIN GREEN	5	20	0	12	5	20	0	7
<3>	TYPE 3 DET	0	10	0	0	0	10	0	0
<4>	ADD/VEH	0.0	3.0	0.0	0.0	0.0	3.0	0.0	0.0
<5>	VEH EXTEN	2.0	5.0	0.0	3.0	2.0	5.0	0.0	3.0
<6>	MAX GAP	2.0	5.0	0.0	3.0	2.0	5.0	0.0	3.0
<7>	MIN GAP	2.0	5.0	0.0	3.0	2.0	5.0	0.0	3.0
<8>	MAX EXTEN	20	90	0	30	20	90	0	30
<9>	MAX 2	40	90	0	30	40	90	0	40
<A>									
<B>	CALL TO PH	0	0	0	0	0	0	0	0
<C>	REDUCE: BY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<D>	EVERY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<E>	YELLOW	3.0	4.0	0.0	4.0	3.0	4.0	0.0	4.0
<F>	RED CLEAR	1.0	2.0	0.0	1.0	1.0	2.0	0.0	1.0

Hawaii D.O.T. KAANAPALI at HONOAPIILANI Intersection #
PHASE BANK 1 ID: 000000
7:09:43 10/25/ 2 -- PHASE TIMING PARAMETERS -- Last Change: 7/18/

PHASE:		NBL <1>	SBT <2>	<3>	<4>	SBL <5>	NBT <6>	WBT <7>	EBT <8>
<0>	WALK	0	7	0	0	0	7	7	0
<1>	FLASH D/W	0	25	0	0	0	11	23	0
<2>	MIN GREEN	5	10	3	5	5	10	5	5
<3>	TYPE 3 DET	0	0	0	0	0	0	0	0
<4>	ADD/VEH	0.0	0.5	0.0	0.5	0.0	0.5	0.5	0.5
<5>	VEH EXTEN	2.0	4.0	0.5	2.0	2.0	4.0	3.0	2.0
<6>	MAX GAP	2.0	4.0	0.5	2.0	2.0	4.0	3.0	2.0
<7>	MIN GAP	2.0	4.0	0.5	2.0	2.0	4.0	3.0	2.0
<8>	MAX EXTEN	40	85	17	40	20	85	20	40
<9>	MAX 2	40	85	30	40	20	85	20	40
<A>									
<B>	CALL TO PH	0	0	0	0	0	0	0	0
<C>	REDUCE: BY	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
<D>	EVERY	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
<E>	YELLOW	5.0	5.0	3.0	4.0	5.0	5.0	5.0	5.0
<F>	RED CLEAR	1.0	1.0	0.0	1.0	1.0	1.0	2.0	2.0

PAGE
ID: 808 873 3544
ID: 808 873 3544
OCT-25-02 08:57 FROM: D.O.T. HIGHWAYS

INTERSECTION: 009 CivicCenter@HPilani

(* = Coordination Recall)

Coordination <C Page>

Row	Column Numbers → / Plan Names →	Plan:								
	Cycle Length	130	135	100	100	100	100	100	100	100
	Phase 1 - ForceOff	37	45	60	63	63	61	65	65	65
	Phase 2 - ForceOff	0	0	0	0	0	0	0	0	0
	Phase 3 - ForceOff	0	0	20	25	20	25	25	25	25
	Phase 4 - ForceOff	20	27	40	40	40	40	40	40	40
	Phase 5 - ForceOff	37	45	60	61	60	63	65	65	65
	Phase 6 - ForceOff	0	0	0	0	0	0	0	0	0
	Phase 7 - ForceOff	0	0	20	25	20	25	25	25	25
	Phase 8 - ForceOff	20	27	40	40	40	40	40	40	40
	Ring Offset	0	0	0	0	0	0	0	0	0
	Offset 1	2	0	0	0	0	0	0	0	0
	Offset 2	0	0	0	0	0	0	0	0	0
	Offset 3	0	0	0	0	0	0	0	0	0
	Permissive	12	12	12	12	12	12	12	12	0
	Hold Release	255	255	255	255	255	255	255	255	0
	Zone Offset	0	0	0	0	0	0	0	0	0

Bytec Phases <C Page>

Plan 1 - Sync	2 6
Plan 2 - Sync	2 6
Plan 3 - Sync	2 6
Plan 4 - Sync	2 6
Plan 5 - Sync	2 6
Plan 6 - Sync	2 6
Plan 7 - Sync	2 6
Plan 8 - Sync	2 6
Plan 9 - Sync	2 6
Coord Phase *	2 6
MEMA Hold	

Configuration <E Page>

Column Numbers →	
Exclusive Phases	
RR-1 Clear Phases	
RR-2 Clear Phases	
RR-2 Limited Service	
Prot / Perm Phases	
Overlap A - Green Omit	
Overlap B - Green Omit	
Overlap C - Green Omit	
Overlap D - Green Omit	
Overlap Yellow Flash	
EV-A Phases	1 6
EV-B Phases	
EV-C Phases	2 5
EV-D Phases	4
Bytec 1 Config. Bits	1 4
IC Select (interconnect)	2

Configuration <E Page>

RR Overlap A - Phases	
RR Overlap B - Phases	
RR Overlap C - Phases	
RR Overlap D - Phases	
Ped 2P	
Ped 6P	6
Ped 4P	4
Ped 8P	
Yellow Flash Phases	
Overlap A - Phases	
Overlap B - Phases	
Overlap C - Phases	
Overlap D - Phases	
Restricted Phases	
Assign 5 Outputs	

Bytec 1 Bits
0 = TBC Type 1
1 = RBack Ext. Closet
2 = Auto Daylight Savings
3 = EV Advance
4 = Special Event
5 = Preempt Operation
6 = Split Lag Operation
7 =

Bytec 4 Outputs
(Port Expander Yellows)
1 = Right Turn Overlap
2 = TOD Outputs
3 = EV Beacon - Steady
4 = EV Beacon - Flashing
5 = Special Event Outputs
6 = Phase 3 & 7 Ped
7 = Advanced Warning Sign
8 =

Force-Off Adjust: 0
Coord Force-Off Adjust for Ped Service <C+D+F>

Transition Type: 0
TBC Transitions <C+D+D>

Transition Type
0 = Stop-time
Non-zero = Lengthen

IC Select Pins
1 =
2 = Modem
3 4 7-Wire Slave
4 = Flash / Free
5 =
6 = Simplex Master
7 = 7-Wire Master
8 = Offset Interruptor

Lag Phases <C Page>

Free Lag	2 4 6 8
Plan 1 - Lag	2 4 6 8
Plan 2 - Lag	2 4 6 8
Plan 3 - Lag	2 4 6 8
Plan 4 - Lag	2 4 6 8
Plan 5 - Lag	2 4 6 8
Plan 6 - Lag	2 4 6 8
Plan 7 - Lag	2 4 6 8
Plan 8 - Lag	2 4 6 8
Plan 9 - Lag	2 4 6 8
Coord Max *	
Coord Lag *	

PAGE
ID: 808 873 3544
ID: 808 873 3544
MAY-21-04 13:46 FROM: D.O.T. HIGHWAYS
OCT-25-02 08:57 FROM: D.O.T. HIGHWAYS

INTERSECTION: 009 CivicCenter@HPilani

Group Assignment: NONE
Field Master Assignment: FM1 Lahaina
System Reference Number: 9

N/S Street Name: Honoapiilani Hwy
E/W Street Name: Civic Center

Last Database Change: 10/9/2002 14:37

Notes:

Change Record					
Change	By	Date	Change	By	Date

Drop Number	0	<C+0+0>
Zone Number	0	<C+0+1>
Area Number	1	<C+0+2>
Area Address	9	<C+0+3>
QuicNet Channel	0	(QuicNet)

Communication Addresses

Manual Plan		<C+A+1>
Manual Offset		<C+B+1>

Manual Selection

Max Initial	20	<F+0+E>
Ped Revert	5.0	<F+0+F>
All Red Stop	5.0	<F+C+0>

Start / Revert Times

Phase Timing - Bank 1 <F Page>

Row	Column Numbers → / Phase Names →	Phase							
	Ped Walk	0	0	0	7	0	7	0	0
	Ped FDW	0	0	0	17	0	12	0	0
	Min Green	5	15	0	5	5	15	0	5
	Type 3 Limit	0	0	0	0	0	0	0	0
	Added Initial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Veh Extension	2.0	5.0	0.0	3.0	2.0	5.0	0.0	3.0
	Max Gap	2.0	5.0	0.0	3.0	2.0	5.0	0.0	3.0
	Min Gap	2.0	5.0	0.0	3.0	2.0	5.0	0.0	3.0
	Max Limit	15	60	0	20	15	60	0	20
	Max Limit 2	10	60	0	20	10	60	0	20
	-------	0	0	0	0	0	0	0	0
	Call To Phase	0	0	0	0	0	0	0	0
	Reduce By	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Reduce Every	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Yellow Change	3.0	4.0	0.0	4.0	3.0	4.0	0.0	4.0
	Red Clear	1.0	1.0	0.0	1.0	1.0	1.0	0.0	1.0

Preempt Timing

RR-1 Delay	0
RR-1 Clear	10
EV-A Delay	0
EV-A Clear	1
EV-B Delay	0
EV-B Clear	1
EV-C Delay	0
EV-C Clear	1
EV-D Delay	0
EV-D Clear	1
RR-2 Delay	0
RR-2 Clear	10
Max EV Delay	---
Max EV Clear	---
Max RR Delay	---
Max RR Clear	---

Phase Functions <F Page>

Permit	12 456 8
Ped Lock	1 45
Yellow Lock	1 45
Min Recall	2 6
Ped Recall	
Max Ped Rest	------
Ped In Walk	
Ped Pace	
Dual Entry	2 4 6 8
Max Recall	
Soft Recall	
Max 2	
Cond. Service	
Max Cond Calls	
Yellow Start	2 6
Red Rest	4 8

Manual Plan
0 = Automatic
1-9 = Plan 1-9
10 = Free
11 = Flash

Manual Offset
0 = Automatic
1 = Offset A
2 = Offset B
3 = Offset C

I

Environmental Noise Assessment Report

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Consultants in Acoustics and Performing Arts Technologies

Environmental Noise Assessment Report
Pulelehua Community
Kapalua, Maui, Hawaii

January 2005

DLAA Project No. 04-27

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1.0 EXECUTIVE SUMMARY

1.1 The Pulelehua Community will be located south of Kapalua, Maui, Hawaii, and is positioned between the Honoapi'ilani Highway and the Kapalua West Maui Airport. The project proposes to develop approximately 312 acres of land for mixed-uses including residences, commercial, civil facilities, a public school, and other facilities necessary to create a true community.

1.2 The dominant noise sources during the project construction phase will probably be earth moving equipment, such as bulldozers and diesel powered trucks. Typical road construction equipment, such as asphalt or concrete paving machines will also be required. Noise from construction activities will occur on the project site. Noise from construction activities should be short term and must comply with State Department of Health noise regulations.

1.3 Vehicular traffic volumes in the area will increase due to the project. Traffic noise predictions for the year 2011 including Pulelehua and the 24 other planned West Maui projects show increases less than 3 dB over the existing conditions. The noise impact due to Pulelehua traffic is less than 2 dB over the future (2011) predictions without Pulelehua. Increases in noise level less than 3 dB is not considered significant because a 3 dB increase is not perceptible to most people. No impacts due to project generated vehicular traffic noise were found.

1.4 Initial worst-case scenario projections for traffic noise were analyzed for compliance with FHWA and HUD noise criteria. Residences that have a direct line-of-sight to Honoapi'ilani Highway and are at least 300 feet from the centerline of the highway satisfy the FHWA noise criteria. Residences that are at least 500 feet from the centerline of the highway satisfy the HUD noise criteria. However, these calculations do not include noise mitigation provided by the existing earth berm along Honoapi'ilani Highway. Analysis of anticipated finished grade elevations indicate that only minor modifications to the existing earth berm will be needed to ensure that all residences within the Pulelehua Community satisfy the FHWA and HUD noise criteria.

1.5 Using the maximum number of possible operations (140 per day) a set of DNL contours were developed using the FAA noise model. The results show that Pulelehua will not be significantly impacted by aircraft noise now or in the future. Mitigation will include buyer notification and no single wall construction will used in the residential portion of the project. Detailed information on airport noise and noise contours is included in a separate report.

1.6 Acoustical treatments and considerations should be incorporated into the design of the new school. Noise from the schools outdoor mechanical equipment must comply with the State of Hawaii noise limits at the property lines, and noise generated inside of the school should be kept under 50 dBA. Prior to construction of the new school, a noise study specific to the school will be conducted to evaluate the exterior noise environment at the school.

2.0 PROJECT DESCRIPTION

The Pulelehua Community is located south of Kapalua, Maui, Hawaii, and includes approximately 312 acres of land between the Kapalua West Maui Airport and the Honoapi'ilani Highway. The community will contain mixed-uses for residential, commercial facilities, public school, civic facilities, places of worship, parks, gardens, and open space. A pineapple field covers much of the existing area.

Approximately 882 homes are planned for the community, at least 50 percent of which will be offered for low, low-moderate, or gap-group incomes of local residents. The homes will be divided into several neighborhoods with connecting roads and walk/bike trails. Live-work units facilities will line the project border closest to the airport.

3.0 NOISE STANDARDS AND GUIDELINES

Various local and federal agencies have established guidelines and standards for assessing environmental noise impacts and set noise limits as a function of land use. A brief description of common acoustic terminology used in these guidelines and standards is presented in Appendix A.

3.1 State of Hawaii, Department of Health (DOH), Community Noise Control

The State of Hawaii Department of Health Community Noise Control Statute [Reference 1] defines three classes of zoning districts and specifies corresponding maximum permissible sound levels due to *stationary* noise sources such as air-conditioning units, exhaust systems, generators, compressors, pumps, etc. The State Department of Health (DOH) Statute does not specifically address most *moving* sources, such as vehicular traffic noise, air traffic noise, or rail traffic noise. However, the DOH Statute does include equipment related to agricultural, construction, and industrial activities, which may not be stationary.

These levels are enforced by the State Department of Health (DOH) for any location at or beyond the property line and shall not be exceeded for more than 10% of the time during any 20-minute period. The specified noise limits which apply are a function of the zoning and time of day as shown in Figure 1. With respect to mixed zoning districts, the statute specifies that the primary land use designation shall be used to determine the applicable zoning district class and the maximum permissible sound level. In determining the maximum permissible sound level, the DOH takes the ambient noise level into account. The DOH statute regarding noise is an enforceable regulation.

3.2 U.S. Federal Highway Administration (FHWA)

The FHWA defines four land use categories and assigns corresponding maximum hourly equivalent sound levels, L_{eq}, for traffic noise exposure [Reference 2], which are listed in Figure 2. For example, Category B, defined as picnic and recreation areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals, has a corresponding maximum exterior L_{eq} of 67dBA and a maximum

interior L_{eq} of 52 dBA. These limits are viewed as design goals, and all projects meeting these limits are deemed in conformance with FHWA noise standards. Calculation of traffic noise levels should be conducted using the Federal Highway Administration's Traffic Noise Model, 1978 [Reference 3].

3.3 Hawaii Department of Transportation (HDOT)

The HDOT has adopted FHWA's design goals for traffic noise exposure in its noise analysis and abatement policy [Reference 4]. According to the policy, a traffic noise impact occurs when the predicted traffic noise levels "approach" or exceed FHWA's design goals or when the predicted traffic noise levels "substantially exceed the existing noise levels." The policy also states that "approach" means at least 1 dB less than FHWA's design goals and "substantially exceed the existing noise levels" means an increase of at least 15 dB.

3.4 U.S. Department of Housing and Urban Development (HUD)

HUD's environmental noise criteria and standards in 24 CFR 51 [Reference 5] were established for determining housing project site acceptability. These standards are based on day-night equivalent sound levels, L_{dn}, and are not limited to traffic noise exposure. However, for project sites in the vicinity of highways, the L_{dn} may be estimated to be equal to the design hour $L_{eq(h)}$, provided "heavy trucks (vehicles with three or more axles) do not exceed 10 percent of the total traffic flow in vehicles per 24 hours and the traffic flow between 10:00 p.m. and 7:00 a.m. does not exceed 15 percent of the average daily traffic flow in vehicles per 24 hours." For these same conditions, L_{dn}, may also be estimated as 3 dB less than the design hour L_{10}.

HUD site acceptability criteria rank sites as Acceptable, Normally Unacceptable, or Unacceptable. "Acceptable" sites are those where exterior noise levels do not exceed an L_{dn} of 65 dBA. Proposed housing projects on "Acceptable" sites do not require additional noise attenuation other than that provided by customary building techniques. "Normally Unacceptable" sites are those where the L_{dn} is above 65 dBA, but does not exceed 75 dBA. Housing on "Normally Unacceptable" sites requires some form of noise abatement, either at the property line or in the building construction, to ensure the interior noise levels are acceptable. "Unacceptable" sites are those where the L_{dn} is 75 dBA or higher. The term "Unacceptable" does not necessarily mean that housing cannot be built on those sites, however, more elaborate sound attenuation will likely be needed.

3.5 Federal Aviation Administration (FAA) & State Department of Transportation (DOT), Airports Division

Airport noise and noise contour maps are not included in this report. However, it is important to note the FAA and DOT rules and regulations in this Environmental Noise Assessment report. Detailed information, calculations, etc. can be found in the airport noise contour map report. This report will only summarize the results of the airport noise and noise contour map report.

The FAA addresses guidelines for compatible land uses that surround airports [Reference 6]. Noise contour maps are expressed in terms of yearly day-night average sound levels, L_{dn}, due to aircraft operations. The FAA states that residences outside of the 65 L_{dn} noise contour are compatible without restrictions. Residences between the 65 and 75 L_{dn} contours are only compatible if noise mitigation measures are incorporated into the building structure. Residences inside of the 75 L_{dn} noise contour are generally not compatible.

The State of Hawaii, Department of Transportation, Airports Division has adopted noise restrictions that are more strict than the FAA. In most cases, the DOT states maximum noise limits that are 5 dB lower than the FAA. For example, the DOT states that residences outside of the 60 L_{dn} noise contour are compatible. Residences between 60 and 70 L_{dn} contours are only compatible if noise mitigation treatments are implemented.

3.6 Board of Education (BOE)

BOE policy 6700 [Reference 7] sets four classroom noise level requirements.

1. Soundproofing design shall be used to reduce the noise level whenever the internal noise level exceeds 50 dBA.

2. Noise control shall be provided for all school facilities which generate exterior noise levels at the property line exceeding State of Hawaii noise limits.

3. Noise control measures shall be installed in classrooms and administration/staff facilities (excluding shop classrooms) whenever 50 percent of the intruding noise level measurements inside the classroom with windows and doors open and the room empty exceeds 55 dBA.

4. Air conditioning shall be provided to facilities exposed to exterior noise levels greater than L_{10} =65dBA.

4.0 POTENTIAL NOISE IMPACTS DUE TO THE COMMUNITY

4.1 Project Construction Noise & On-Site Equipment

Development of the Pulelehua Community will involve excavation, grading, and other typical construction activities during construction. The various construction phases of the project may generate significant amounts of noise. The surrounding residences may be impacted by the construction noise due to their proximity to the project. The actual noise levels produced during construction will be a function of the methods employed during each stage of the construction process. Typical ranges of construction equipment noise are shown in Figure 4.

4.2 Projection of Project Generated Mechanical Noise

Since the existing property is primarily pineapple fields, the activities and operations will likely increase noise levels in the area. However, the increase in noise level is not expected to be excessive. Rather noise levels in the area are expected to be typical of residential and commercial uses. Noise levels generated by the new residents and commercial areas should conform to the State DOH rules and regulations, which states maximum permissible noise limits at individual property lines.

4.3 Projection of Project Generated Vehicular Traffic Noise

The addition of the new residences and business in Pulelehua area will increase traffic along the Honoapi'ilani Highway and on roads in the vicinity of the community. Analysis of traffic noise was completed for the existing (2004) condition, future (2011) with the other 24 West Maui projects (without Pulelehua), and future (2011) with all 25 projects (including Pulelehua). All traffic noise predictions and calculations were completed using the FHWA Traffic Noise Model (1978) [Reference 3].

The results of the traffic noise analyses are shown in Table 1. The increase in noise in the year 2011 from Pulelehua and the future West Maui projects is expected to be less than 3 dB. The increase in noise level specifically due to increased traffic from the Pulelehua community is expected to be less than 2 dB over the future (2011) noise levels without Pulelehua. A description of the West Maui projects is included in Appendix B. Noise level increases less than 3 dB are not perceptible to most people, and therefore, are not deemed significant. No impact is found relating to community generated vehicular traffic noise.

Table 1 shows that the noise levels along the Honoapiilani Highway exceed the FHWA maximum noise level of 67 dBA at 100 feet from the road. However, the table shows that the existing traffic noise levels already exceed the FHWA maximum limits. Since the existing noise levels along Honoapiilani Highway already exceed the FHWA limits, no noise impact was found, because the increase in noise level due to the project is less than 3 dB. The impact of the Honoapiilani traffic noise on the Pulelehua community is described under Section 4.4 and 4.5 of this report.

4.4 Compliance with FHWA Land Use Noise Limits

The FHWA and State DOT land use noise limit for a residential area is $L_{eq} = 67$ dBA. Based on the traffic projections along the Honoapi'ilani Highway in the Year 2011, including all 25 planned West Maui projects [See Appendix B], any homes that are 300 feet or more from the centerline of Honoapi'ilani Highway satisfy the FHWA noise criteria. This calculation assumes a worst case scenario, which is a direct line-of-sight from the home to the highway. However, the existing berm provides noise mitigation to the community by blocking the line-of-sight to many homes. Minor modifications to the existing berm can be expected

to ensure all homes within the Pulelehua Community satisfy the FHWA noise criteria. Noise mitigation is discussed in Section 5.0 of this report.

4.5 Compliance with HUD Noise Criteria

For the Pulelehua Community, the HUD noise criteria address two primary noise sources, the airport and Honoapi'ilani Highway. All homes in the project will be outside of the L_{dn} 65 dBA airport noise contour. Therefore, the residences will meet the HUD "acceptable" rating for airport noise. In addition, all homes that are at least 500 feet from the centerline of Honoapi'ilani Highway meet the HUD criteria for roadway noise. Similar to the FHWA analysis, This calculation assumes the worst case scenario, which includes traffic projections of all 25 planned West Maui projects, and a direct line-of-sight between the home and the highway. Again, minor modifications to the existing berm can be expected so that all homes within the Pulelehua Community satisfy the HUD criteria. The HUD criteria is not a statutory requirement, but is needed for HUD financing. Homes that are within 500 feet may still meet the HUD criteria if noise mitigation is implemented into the design of the community. Noise mitigation is discussed in Section 5.0 of this report.

4.6 Compliance with FAA and State DOT Airports Division Noise Guidelines

The West Maui Airport currently has approximately 25 operations per day. Using the FAA approved and developed computer noise model, Day Night Noise Level (DNL) contours were developed for the airport. The airport is subject to strict limits on the number of operations and type of aircraft. These limits include that jet and helicopter operations are not permitted and night operations are prohibited.

Under the rules in effect, the airport could grow to 140 operations per day. However, the three aviation forecasts that have been prepared for the airport predict that the airport will never achieve this level of operations. In fact, the most recent forecast predicts that the airport will reach only about 28 operations per day by the year 2025.

Using the maximum number of possible operations (140 per day) a set of DNL contours were developed using the FAA noise model. The results show that Pulelehua will not be significantly impacted by aircraft noise now or in the future. Mitigation will include buyer notification and no single wall construction will used in the residential portion of the project. Detailed information on airport noise and noise contours is included in a separate report.

4.7 Compliance with BOE Noise Requirements

Pulelehua will include a new school in the community. The design and construction of the new school should incorporate acoustical treatments and considerations. Noise from the building's HVAC system and other significant noise sources will generate noise inside of the school. These noise sources should be analyzed to ensure the noise levels do not exceed 50 dBA within the

classrooms and other occupied spaces in the school. In addition, noise generated by the school's outdoor stationary mechanical equipment (usually, chillers, generators, condensing units, etc.) must comply with the State of Hawaii noise limits at the school property lines.

The BOE addresses exterior noise levels in the form of the 10% exceedance noise level, L_{10}. However, the FAA airport noise contours are expressed in yearly day-night averages, L_{dn}, and FHWA noise predictions use the peak hour equivalent sound level, L_{eq}. The FAA and FHWA calculations do not directly correlate to the BOE L_{10} noise limits. Although the anticipated noise levels near the school are not excessive, short bursts of noise (i.e., from aircraft landing/take-off) may cause the L_{10} to exceed 65 dBA during peak airport operation time periods.

Since the noise impacts on the school, as they relate to the BOE requirements, cannot be determined at this time, a follow-up noise study specific to the school will be conducted, prior to construction of the new school.

5.0 NOISE IMPACT MITIGATION

5.1 Mitigation of Construction Noise

In cases where construction noise exceeds, or is expected to exceed the State's "maximum permissible" property line noise levels [Reference 1], a permit must be obtained from the State DOH to allow the operation of vehicles, cranes, construction equipment, power tools, etc., which emit noise levels in excess of the "maximum permissible" levels.

In order for the State DOH to issue a construction noise permit, the contractor must submit a noise permit application to the DOH, which describes the construction activities for the project. Prior to issuing the noise permit, the State DOH may require action by the contractor to incorporate noise mitigation into the construction plan. The DOH may also require the contractor to conduct noise monitoring or community meetings inviting the neighboring residents and business owners to discuss construction noise. The contractor should use reasonable and standard practices to mitigate noise, such as using mufflers on diesel and gasoline engine machines, using properly tuned and balanced machines, etc. However, the State DOH may require additional noise mitigation, such as temporary noise barriers, or time of day usage limits for certain kinds of construction activities.

Specific permit restrictions for construction activities [Reference 1] are:

> "No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels ... before 7:00 a.m. and after 6:00 p.m. of the same day, Monday through Friday."

> "No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels... before 9:00 a.m. and after 6:00 p.m. on Saturday."
>
> "No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels on Sundays and on holidays."

The use of hoe rams and jack hammers 25 lbs. or larger, high pressure sprayers, chain saws, and pile drivers must be restricted to 9:00 a.m. to 5:30 p.m., Monday through Friday.

The DOH noise permit does not limit the noise *level* generated at the construction site, but rather the *times* at which noisy construction can take place. Therefore, noise mitigation for construction activities should be addressed using project management, such that the time restrictions within the DOH permit are followed.

Most construction equipment falls under the terms and conditions of the Hawaii DOH issued noise permit. This permit allows noisy construction activities to take place during the daytime hours (see the specific hours reference above). However, any activities that require overnight operation or operation outside of the permit hours, such as a water pump or electric generator for lights, must meet the State's maximum permissible sound limits according to the applicable zoning district class. Temporary enclosures or barrier walls may be required to adequately mitigate noise from this equipment. If it is not feasible or practical to meet the State's noise limits, the contractor may apply for a noise variance with the Hawaii DOH.

5.2 Mitigation of Project Generated Mechanical Noise

The design of the new Pulelehua Community should give consideration to controlling the noise emanating from stationary mechanical equipment, such as chiller, compressors, air conditioning units, etc. so as to comply with the State Department of Health *Community Noise Control* rules [Reference 1]. Noisy equipment should be located away from neighbors and residential units, as much as is practical. Enclosed mechanical rooms may be required for some equipment.

5.3 Mitigation of Projected Year 2011 Traffic Noise from Honoapi'ilani Highway

Although the Pulelehua Community does not significantly impact Honoapi'ilani Highway traffic noise, new homes should be built far enough away from the road to meet the FHWA and HUD noise guidelines. The existing earth berm along Honoapi'ilani Highway is an effective sound barrier, reducing traffic noise from the highway to the Pulelehua Community. Minor modifications to the existing berm can be expected to ensure that all homes within the community satisfy both the FHWA and HUD criteria. The HUD noise criteria is only needed for HUD financing and is not a statutory requirement. The needed berm height will depend on the finished grade elevations of the new community. However, preliminary

calculations of anticipated grade elevations show only minor modifications to the existing berm will be needed.

5.4 Mitigation of Noise for the new School

The design of the new school will incorporate acoustical treatments, as needed to meet the State of Hawaii noise limits at the School property lines and the BOE noise limits inside of the school due to internal school noises. In addition, a follow-up noise study will be conducted to evaluate the noise impact of exterior noises on the new school, prior to construction of the new school.

6.0 REFERENCES

1. Chapter 46, *Community Noise Control*, Department of Health, State of Hawaii, Administrative Rules, Title 11, September 23, 1996.

2. *Department of Transportation, Federal Highway Administration Procedures for Abatement of Highway Traffic Noise,* Title 23, CFR, Chapter 1, Subchapter J, Part 772, 38 FR 15953, June 19, 1973; Revised at 47 FR 29654, July 8, 1982.

3. *Federal Highway Administration's Traffic Noise Model,* FHWA-RD-77-108; U.S. Department of Transportation, December 1978.

4. *Noise Analysis and Abatement Policy,* Department of Transportation, Highways Division, State of Hawaii, June 1977.

5. *Department of Housing and Urban Development Environmental Criteria and Standards*, Title 24, CFR, Part 51, 44 FR 40860, July 12, 1979; Amended by 49 FR 880, January 6, 1984.

6. *FAA Regulations on Airport Noise Compatibility Planning Programs,* Code of Federal Regulations, Title 14, Chapter 1, Subchapter 1, Part 150; Issued by 49 FR 49269, December 18, 1984; corrected by 50 FR 5063, February 6, 1985; amended by 53 FR 8723, March 16, 1988; corrected by 53 FR 9726, March 24, 1988.

7. *Policies and Standards for School Facilities Design*, Board of Education, Appendix A, Acoustical and Environmental Control, March 1995.

Table 1
Predicted Traffic Noise Levels With and Without the Project and Resulting Increases Due to the Project

Noise levels shown in the table are based on peak-hour traffic volumes, and are expressed in A-weighted decibels (dBA).

	Location 1* (Honoapiilani Hwy)		Location 2* (Hoohui St.)	
	AM	**PM**	**AM**	**PM**
Existing (Calculated)	67.7	69.0	62.4	64.0
Future With West Maui Projects Without Pulelehua (2011)	69.2	70.0	64.3	64.9
Future With West Maui Projects With Pulelehua (2011)	70.4	71.1	65.1	65.8
Future Increase With West Maui Projects Without Pulelehua (2011)	1.5	1.0	1.9	0.9
Future Increase With West Maui Projects With Pulelehua (2011)	2.7	2.1	2.7	1.8
Future Increase Due to the Project (2011)	**1.2**	**1.1**	**0.8**	**0.9**

* Location 1 – 100 feet west of Honoapiilani Highway
Location 2 - 50 feet south of Hoohui Street

APPENDIX A

Acoustic Terminology

Acoustic Terminology

Sound Pressure Level

Sound, or noise, is the term given to variations in air pressure that are capable of being detected by the human ear. Small fluctuations in atmospheric pressure (sound pressure) constitute the physical property measured with a sound pressure level meter. Because the human ear can detect variations in atmospheric pressure over such a large range of magnitudes, sound pressure is expressed on a logarithmic scale in units called decibels (dB). Noise is defined as Aunwanted@ sound.

Technically, sound pressure level (SPL) is defined as:

$$SPL = 20 \log (P/P_{ref}) \text{ dB}$$

where P is the sound pressure fluctuation (above or below atmospheric pressure) and P_{ref} is the reference pressure, 20 μPa, which is approximately the lowest sound pressure that can be detected by the human ear. For example:

If P = 20 μPa, then SPL = 0 dB
If P = 200 μPa, then SPL = 20 dB
If P = 2000 μPa, then SPL = 40 dB

The sound pressure level that results from a combination of noise sources is not the arithmetic sum of the individual sound sources, but rather the logarithmic sum. For example, two sound levels of 50 dB produce a combined sound level of 53 dB, not 100 dB. Two sound levels of 40 and 50 dB produce a combined level of 50.4 dB.

Human sensitivity to changes in sound pressure level is highly individualized. Sensitivity to sound depends on frequency content, time of occurrence, duration, and psychological factors such as emotions and expectations. However, in general, a change of 1 or 2 dB in the level of sound is difficult for most people to detect. A 3 dB change is commonly taken as the smallest perceptible change and a 6 dB change corresponds to a noticeable change in loudness. A 10 dB increase or decrease in sound level corresponds to an approximate doubling or halving of loudness, respectively.

A-Weighted Sound Level

Studies have shown conclusively that at equal sound pressure levels, people are generally more sensitive to certain higher frequency sounds (such as made by speech, horns, and whistles) than most lower frequency sounds (such as made by motors and engines)[1] at the same level. To address this preferential response to frequency, the A-weighted scale was developed. The A-weighted scale adjusts the sound level in each frequency band in much the same manner that the human auditory system does. Thus the A-weighted sound level (read as "dBA") becomes a single number that defines the level of a sound and has some correlation with the sensitivity of the human ear to that sound. Different sounds with the same A-weighted sound level are perceived as being equally loud. The A-weighted noise level is commonly used today in environmental noise analysis and in noise regulations. Typical values of the A-weighted sound level of various noise sources are shown in Figure A-1.

Equivalent Sound Level

The Equivalent Sound Level (L_{eq}) is a type of average which represents the steady level that, integrated over a time period, would produce the same energy as the actual signal. The actual *instantaneous* noise levels typically fluctuate above and below the measured L_{eq} during the measurement period. The A-weighted L_{eq} is a common index for measuring environmental noise. A graphical description of the equivalent sound level is shown in Figure A-2.

Statistical Sound Level

The sound levels of long-term noise producing activities such as traffic movement, aircraft operations, etc., can vary considerably with time. In order to obtain a single number rating of such a noise source, a statistically-based method of expressing sound or noise levels has been developed. It is known as the Exceedence Level, L_n. The L_n represents the sound level that is exceeded for n% of the measurement time period. For example, L_{10} = 60 dBA indicates that for the duration of the measurement period, the sound level exceeded 60 dBA 10% of the time. Typically, in noise regulations and standards, the specified time period is one hour. Commonly used Exceedence Levels include L_{01}, L_{10}, L_{50}, and L_{90}, which are widely used to assess community and environmental noise. A graphical description of the equivalent sound level is shown in Figure A-2.

Day-Night Equivalent Sound Level

The Day-Night Equivalent Sound Level, L_{dn}, is the Equivalent Sound Level, L_{eq}, measured over a 24-hour period. However, a 10 dB penalty is added to the noise levels recorded between 10 p.m. and 7 a.m. to account for people's higher sensitivity to noise at night when the background noise level is typically lower. The L_{dn} is a commonly used noise descriptor in assessing land use compatibility, and is widely used by federal and local agencies and standards organizations.

---

[1] D.W. Robinson and R.S. Dadson, AA Re-Determination of the Equal-Loudness Relations for Pure Tones,@ *British Journal of Applied Physics*, vol. 7, pp. 166 - 181, 1956. (Adopted by the International Standards Organization as Recommendation R-226.

Appendix B: Summary of West Maui Project

Project #	Project Name	Location	Proposed Buildout	Estimated Development by 2011
1	Honolua Ridge	North of Kapalua	Phases I & II; 49 SF lots	25 units
2	Kapalua Mauka	Kapalua; mauka of Honoapiilani Hwy.	690 units; 390 SF; 300 MF most units resort residential	75 SF 90 MF
3	Pailolo	North Kahana/Napili	25 SF units	25 SF units
4	Maui Preparatory Academy	Mauka of Honoapiilani Hwy; Mahinahina area	540 students; pre-K to Grade 12	540 students; pre-K to Grade 12
5	Villas at Kahana Ridge	Kahana Ridge	117 MF units	117 MF units
6	Pulelehua	Mahinahina mauka of Honoapiilani Hwy	882 mixed residential; commercial; public with 318 potential Ohanas	882 mixed residential; commercial; public with 318 potential Ohanas
7	Maui Breakers	Mahinahina	90 MF units	90 MF units
8	DHHL Honokowai	Honokowai/next to Pulelehua	411 SF units	0 units
9	Marriott expansion	Kaanapali	303 addl. timeshare units; 336 fewer hotel rooms	457 timeshare units; 55 hotel rooms
10	Hyatt expansion	Kaanapali	326 lockout units	196 timeshare units
11	Kihune	Napili	20 MF units	20 MF units
12	Intrawest	North Beach Lot 4	700 MF units	700 MF units
13	Ka'anapali 2020	Kaanapali; mauka of Honoapiilani Hwy.	1,257 SF; 1,163 MF; 390 mixed-use MF; commercial; public; golf	200 SF; 200 MF
14	Starwood	North Beach Lot 2	258 MF units + 258 lockout units	258 MF units + 65 lockout units
15	Palisades at Ka'anapali	Kaanapali mauka of Honoapiilani Hwy,	132 SF units	132 SF units
16	Land Tech	Kaanapali	18 SF units	18 SF units
17	Villages at Leialii	West Maui	4,846 units; 2006 SF 2840 MF	104 SF
18	West Maui Resource Center -- Phase II	Above Lahaina Regional Park	16 units transitional housing; 10 units long-term housing	26 units
19	Lokahi Pacific	Lahaina	12 SF units	12 SF units
20	Wainee Village	Lahaina mauka of Honoapiilani Hwy	575 units; 400 SF; 175 MF	100 SF; 60 MF
21	Plantation Inn	Lahaina	14 MF units	14 MF units
22	Puunoa Village	Lahaina, mauka of Honoapiilani Hwy	268 SF units	0 units
23	Makila	Launiupoko	40 SF units + 40 Ohana units	40 SF units + 40 Ohana units
24	Olowalu	Olowalu	20 SF units + 20 Ohana units	20 SF units + 20 Ohana units
25	Ukumehame	Ukumehame	46 SF units + 46 Ohana units	46 SF units + 46 Ohana units

More specifically these new developments include the following (arranged in order from north to south):

1. Honolua Ridge

Honoula Ridge is located north of Kapalua and will consist of 49 single-family detached dwelling units constructed in two phases. It is estimated 25 dwelling units will be constructed by 2011. This is a single use development. No internal capture is expected.

2. Kapalua Mauka

The Kapalua Mauka development will occupy 925 acres on the mauka side of Honoapillani Highway. The 690 dwelling unit project will be comprised of 180 single-family rural lots on 275.3 acres, 510 single and multiple family units on 515 acres of urban land, commercial uses, and 18 holes of golf. Primary access will be via a main entrance opposite Office Road and Honoapiilani Highway. A 20-year buildout period is expected.

Project data and traffic projections were drawn from the Traffic Impact Assessment Report for Kapalua PD-2 Development (Parsons Brinkerhoff; December, 2001)

3. Pailolo (formerly Pu'u Kahana)

Pailolo is located in North Kahana/Napili and will consist of 25 single family dwelling units. Development completion is expected prior to 2011. Due to the proximity of this development to resort-type land uses, a 15% internal capture is expected.

4. Maui Preparatory Academy

This project will occupy a 15 acre site on the mauka side of Honoapiilani Highway. The first phase is planned to open in Fall 2005, with an anticipated enrollment of 90 students in grades 6, 7 and 8. In 2007, four classes of pre-Kindergarten will be added, and in 2011, an additional primary grade (36 students) will be added. The school is expected to add an additional primary

grade level each succeeding year to reach full enrollment of 540 students by 2013 in grades pre-Kindergarten through grade 12.

2011 AM and PM peak hour trips were estimated by determining the average annual growth rate of trips projected from 2008 to 2013, and then applying that growth rate to the intervening years to 2011.

Project data and traffic projections were drawn from the Traffic Impact Report for Maui Preparatory Academy (Wilson Okamoto Corporation; April, 2004)

5. Villas at Kahana Ridge

This development is located at Kahana Ridge and will consist of 117 multiple-family dwelling. These units are under construction now and are expected to be completed by 2005.

Because this is a single use development, no internal capture is expected.

6. Pulelehua

Project data and traffic projections were drawn from the Pulelehua-specific sections of this report.

7. Maui Breakers

Project is located makai the highway between Pulelehua and DHHL Honokowai. It currently has 24 condominium units and plans to add 90 units in Phase I.

8. DHHL Honokowai

DHHL Honokowai is located adjacent to Pulelehua and will consist of 411 single-family dwelling units. It is estimated these units will not be constructed by 2011.

9. Marriott Expansion

This is an addition of the Marriott Marriot Hotel to the Marriott Ocean Club at Kaanapali. The Project is located along the makai side of Nohea Kai Drive.

As proposed, the Project will consist of 457 hotel units and an estimated 55 "lock out" units for a new total 512 units. The result is that AM and PM peak hour trip generation increases only marginally.

Project data and traffic projections were drawn from the Traffic Impact Assessment Report for Maui Marriott Ocean Club (Philip Rowell and Associates; December 10, 2002)

10. Hyatt Expansion

This is an expansion of an existing Hyatt development located at Kaanapali and consisting of 173 apartment units and 173 lock-out units. For this traffic analysis, it was estimated 25% of the lock-out units would be occupied (43 units) for a total 196 occupied dwelling units. Due to the resort nature of this development, 25% internal capture is assumed.

11. Kihune

The Kihune development is located in Napili and consists of 20 multiple-family dwelling units. Project completion is expected by 2011. Due to the single use character, no internal capture is expected.

12. Intrawest

The Intrawest development is located at North Beach (Lot 4) and consists of 700 multiple-family dwelling units. All dwelling units are expected to be completed by 2011. Due to the resort nature of this area, 25% internal capture is assumed.

13. Ka'anapali 2020

This 4,000 acre project is also located on the mauka side of Honoapiilani Highway. Ka'anapali 2020 is expected to be implemented over a 25-year buildout period. Included is a mix of residential, recreational, open space, golf course, public/quasi public and commercial uses. Present plans show 1,257 single family units, 1,163 multi-family units, and 390 mixed use/multiple-family units.

14. Starwood

Starwood is located at North Beach (Lot 2) and consists of 258 multiple family dwelling units and 258 lockout units. Project completion is expected prior to 2011. For this analysis, it is assumed 25% (65) of the lock-out units will be occupied, yielding 323 total occupied units. Due to the resort nature of this area, 25% internal capture is assumed.

15. Palisades at Kaannapali

The Palisades at Kaanapali project is located mauka of Honoapiilani Highway, across from Kaanapali Resort. It consists of 132 single-family dwelling units, constructed in several phases, with an estimated completion by 2010. This is a curvilinear, suburban-style single use development. No internal capture is expected.

16. Land Tech

Land Tech is an 18 single-family dwelling unit project located in Kaanapali. Completion is expected by 2011. Due to the coastal resort nature of this area, 25% internal capture is assumed.

17. Villages at Leialii

The Villages at Leialii project is located in West Maui and, at buildout, is planned for a total 4,846 dwelling units; 2,006 single-family and 2,840 multiple family. By 2011, it is estimated 104 single-family dwelling units will be constructed. Due to the single use nature of this project (by 2011), no internal capture is utilized.

18. West Maui Resource Center Phase II

West Maui Resource Center Phase II is located above Lahaina Regional Park and consists of 16 units of traditional housing and 10 units of long term housing. It is estimated all dwelling units will be constructed by 2011.

19. Lokahi Pacific

Lokahai Pacific is located in Lahaina and consists of 12 single-family dwelling units. Project completion is expected by 2005. Due to the single-use nature of this project, no internal capture is utilized.

20. Wainee Village

The Wainee Village project is located in Lahaina, mauka of Honoapiilani Highway. Although 575 dwelling units are planned for buildout; 400 single-family and 175 multiple family, it is estimated 100 single-family and 60 multiple family units will be constructed by 2011. Due to the location of this project, 15% internal capture has been utilized.

21. Plantation Inn

This project involves adding 14 additional units to an existing 17 unit hotel located along the south side of Lahainaluna Road, midway between Luakini Street and Wainee Street.

Project data and traffic projections were drawn from the Traffic Impact Assessment: Proposed Expansion of Plantation Inn (Philip Rowell and Associates; May 8, 2002)

22. Puunoa Village

This project is located south of Lahaina, between Honoapiilani Highway and the Pu'u Noa Agricultural Subdivision. It will include development of 268 single-family residential units.

It is estimated these units will not be constructed by 2011.

Project data and traffic projections were drawn from the Traffic Impact Assessment Report for Pu'u Noa Residential Subdivision (Austin, Tsutsumi & Associates, Inc.; April, 2003).

23. Makila

The Makila project is located in Launiupoko and consists of 40 single-family dwelling units and 40 Ohana units. It is estimated all dwelling units will be constructed by 2011. Due to the single use nature of this project, no internal capture is utilized.

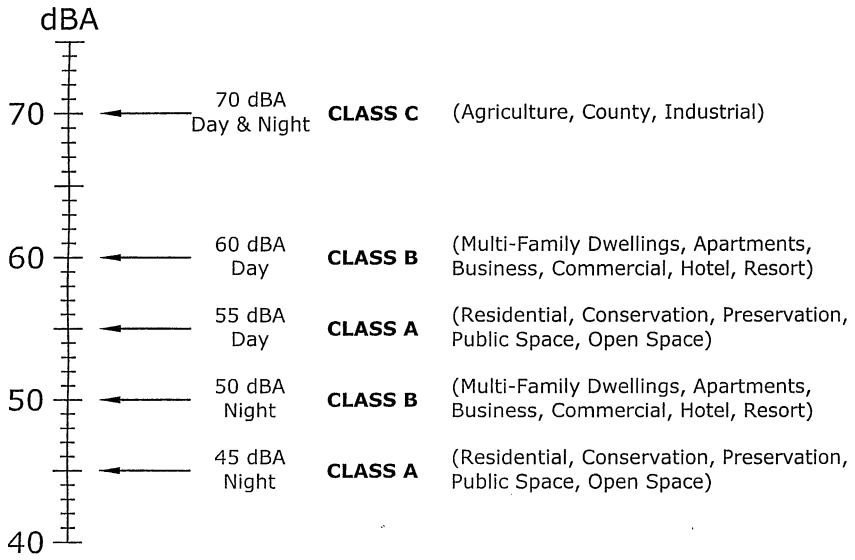
24. Olowalu

The Olowalu project is located in Olowalu and consists of 20 single-family dwelling units and 20 Ohana units. It is estimated all dwelling units will be constructed by 2011. Due to the single use nature of this project, no internal capture is utilized.

25. Ukumehame

The Ukumehame project is located in Ukumehame and consists of 46 single-family dwelling units and 46 Ohana units. It is estimated all dwelling units will be constructed by 2011. Due to the single use nature of this project, no internal capture is utilized.
Sdfsdfdd

Zoning District	Day Hours (7 AM to 10 PM)	Night Hours (10 PM to 7 AM)
CLASS A Residential, Conservation, Preservation, Public Space, Open Space	55 dBA	45 dBA
CLASS B Multi-Family Dwellings, Apartments, Business, Commercial, Hotel, Resort	60 dBA	50 dBA
CLASS C Agriculture, County, Industrial	70 dBA	70 dBA



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Hawaii Department of Health Maximum Permissible Sound Levels for Various Zoning Districts

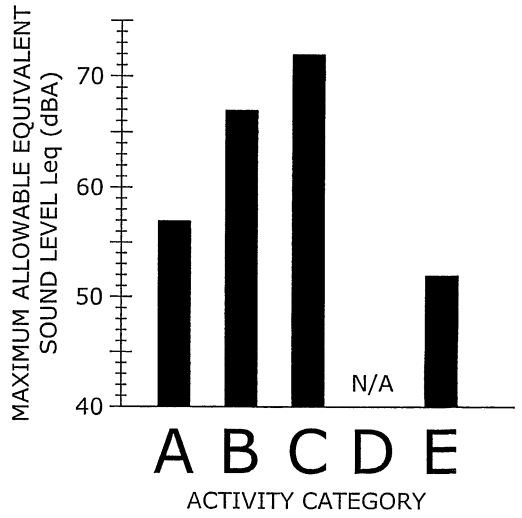
Pulelehua Community

not to scale

Date: January 2005 | Project No.: 04-27 | Drawn By: TRB

Figure No 1

ACTIVITY CATEGORY	ACTIVITY CATEGORY DESCRIPTION	MAXIMUM EQUIVALENT SOUND LEVEL $L_{eq(h)}$
A	LANDS ON WHICH SERENITY AND QUIET ARE OF EXTRAORDINARY SIGNIFICANCE AND SERVE AN IMPORTANT PUBLIC NEED AND WHERE THE PRESERVATION OF THOSE QUALITIES IS ESSENTIAL IF THE AREA IS TO CONTINUE TO SERVE ITS INTENDED PURPOSE.	57 dBA (EXTERIOR)
B	PICNIC AREAS, RECREATION AREAS, PLAYGROUNDS, ACTIVE SPORT AREAS, PARKS, RESIDENCES, MOTELS, HOTELS, ACHOOLS, CHURCHES, LIBRARIES, AND HOSPITALS.	67 dBA (EXTERIOR)
C	DEVELOPED LANDS, PROPERTIES, OR ACTIVITIES NOT INCLUDED IN ACTIVITY CATEGORIES A OR B ABOVE.	72 dBA (EXTERIOR)
D	UNDEVELOPED LAND	N/A
E	RESIDENCES, MOTELS, HOTELS, PUBLIC MEETING ROOMS, SCHOOLS, CHURCHES, LIBRARIES, HOSPITALS, AND AUDITORIUMS.	52 dBA (INTERIOR)



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Federal Highways Administration Recommended Equivalent Hourly Sound Levels Based on Land Use

Pulelehua Community

not to scale

Date: January 2005 | Project No.: 04-27 | Drawn By: TRB

Figure No 2

NOTE: BASED ON LIMITED AVAILABLE DATA SAMPLES

Typical Sound Levels from Construction Equipment

Figure No 4

Pulelehua Community

not to scale

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Noise Prediction Locations

Figure No 3

Pulelehua Community

not to scale

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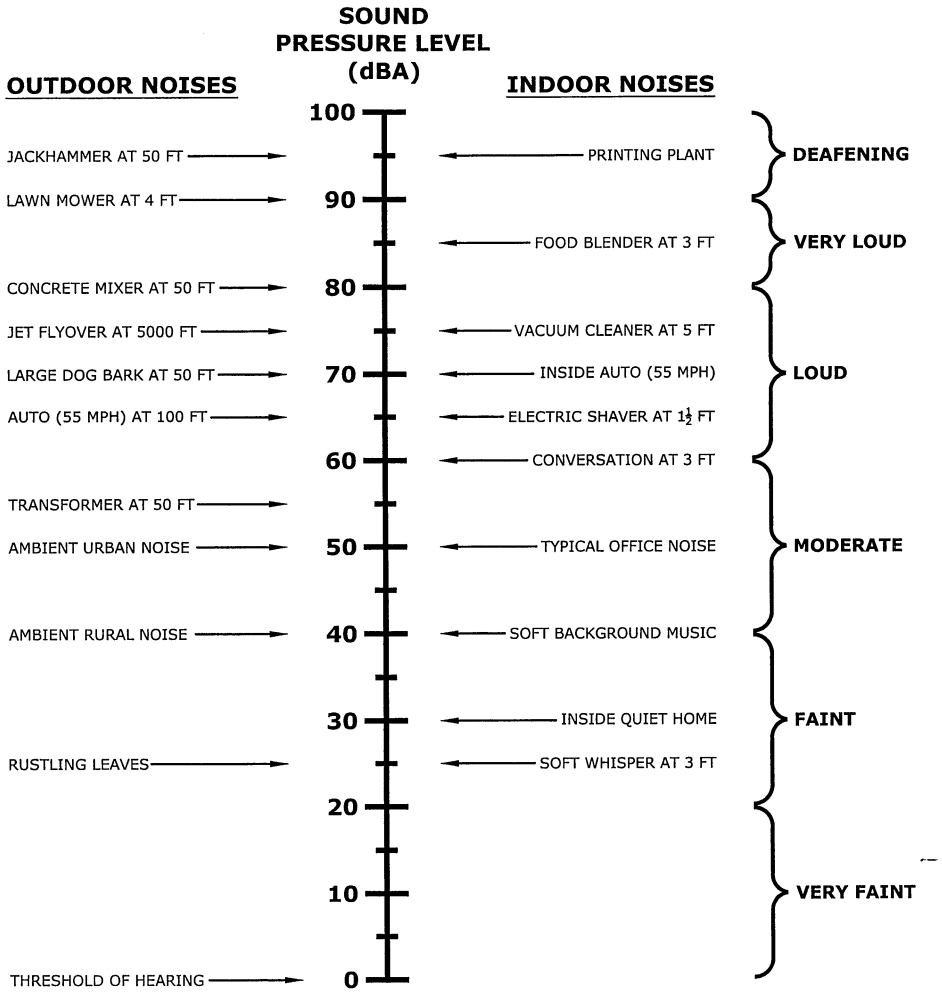

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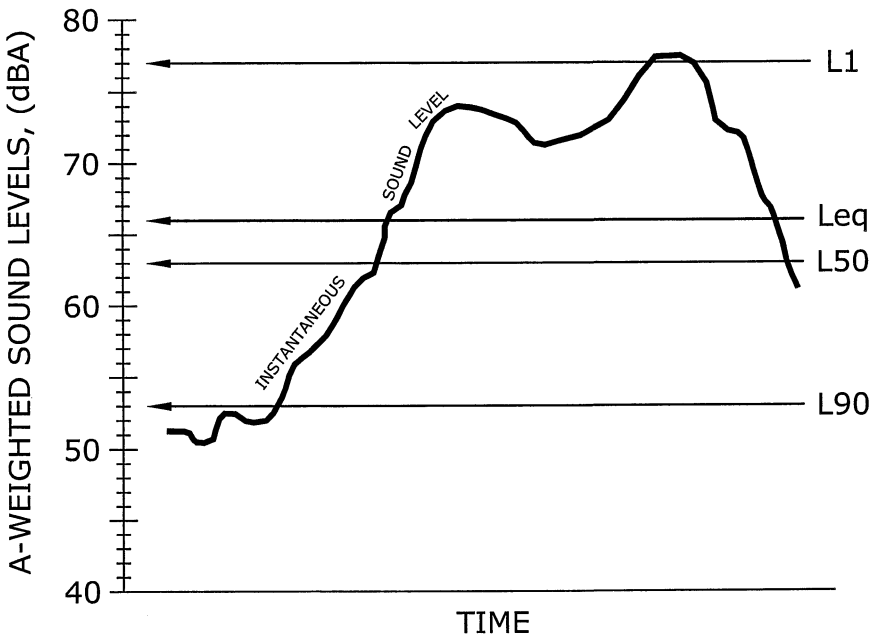
Common Outdoor/Indoor Sound Levels

Pulelehua Community

not to scale

Date: January 2005 | Project No.: 04-27 | Drawn By: TRB

Figure No A-1



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Example Graph of Equivalent Sound Level and Statistical Sound Levels

Pulelehua Community

not to scale

Date: January 2005 | Project No.: 04-27 | Drawn By: TRB

Figure No A-2

J

Air Quality Study

AIR QUALITY STUDY

FOR THE PROPOSED

PULELEHUA COMMUNITY

KAPALUA, MAUI, HAWAII

Prepared for:

Kapalua Land Company, Ltd.

February 2005

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1.0 SUMMARY

Kapalua Land Company, Ltd. is proposing to develop the Pulelehua Community on 312 acres of predominantly vacant land located in the Mahinahina area of West Maui. Pulelehua will consist of 882 residential units, up to 318 Ohana units, 175,000 square feet of commercial and office space, and churches, schools and other related facilities. Development and full occupancy of the Pulelehua is expected to be completed by 2011. 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. Potential impacts on Pulelehua from nearby West Maui Airport are also examined.

Both federal and state standards have been established to maintain ambient air quality. At the present time, seven parameters are regulated including: particulate matter, sulfur dioxide, hydrogen sulfide, nitrogen dioxide, carbon monoxide, ozone and lead. Hawaii air quality standards are comparable to the national standards except those for nitrogen dioxide and carbon monoxide which are more stringent than the national standards.

Regional and local climate together with the amount and type of human activity generally dictate the air quality of a given location. The climate of the Mahinahina area is very much affected by its near coastal situation and by nearby mountains. Winds are variable but are often trade winds from the north or northeast. Temperatures in the Mahinahina area are generally very consistent and moderate with an average daily temperature range of

about 66°F to 85°F. The extreme minimum temperature recorded at nearby Kaanapali is 47°F, while the extreme maximum temperature is 98°F. Average annual rainfall in the area amounts to about 20 to 30 inches.

No ambient air quality data for the Kapalua area has been reported by the state Department of Health. However, except for periodic impacts from distant volcanic emissions (vog) and possibly occasional localized impacts from traffic congestion, the present air quality of the Mahinahina area is good.

If Pulelehua is given the necessary approvals to proceed, it is inevitable that some short- and long-term impacts on air quality will occur either directly or indirectly as a consequence of Pulelehua's construction and use. Short-term impacts from fugitive dust will likely occur during the construction phase. To a lesser extent, exhaust emissions from stationary and mobile construction equipment, from the disruption of traffic, and from workers' vehicles may also affect air quality during the period of construction. State air pollution control regulations require that there be no visible fugitive dust emissions at the property line. Hence, an effective dust control plan must be implemented to ensure compliance with state regulations. Fugitive dust emissions can be controlled to a large extent by watering of active work areas, using wind screens, keeping adjacent paved roads clean, and by covering of open-bodied trucks. Other dust control measures 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 Pulelehua areas early in the construction schedule will also reduce dust emissions. Monitoring dust at Pulelehua's boundary

during the period of construction could be considered as a means to evaluate the effectiveness of the dust control program. Exhaust emissions can be mitigated by moving construction equipment and workers to and from the site during off-peak traffic hours.

After construction, motor vehicles coming to and from Pulelehua will result in a long-term increase in air pollution emissions in the project area. To assess the impact of emissions from these vehicles, an air quality modeling study was undertaken to estimate current ambient concentrations of carbon monoxide at intersections in the project vicinity and to predict future levels both with and without Pulelehua. During worst-case conditions, model results indicated that present 1-hour and 8-hour carbon monoxide concentrations are well within both the state and the national ambient air quality standards. In the year 2011 without Pulelehua, carbon monoxide concentrations were predicted to remain unchanged despite the expected increase in ambient traffic volumes. This is because older vehicles that emit more air pollution will be retired during the intervening years. With Pulelehua in the year 2011, the maximum carbon monoxide concentrations were estimated to increase by about 10 to 15 percent in the project area compared to the without project case, but concentrations should remain well within state and federal standards. Implementing mitigation measures for traffic-related air quality impacts is thus 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.

In evaluating Pulelehua, it may be appropriate to consider not only impacts created by the community but also potential impacts on Pulelehua from nearby air pollution sources. The potential impact on Pulelehua from aircraft emissions occurring at the adjacent West Maui Airport was evaluated, and the impact was found to be insignificant due to the relatively small emission rates. Wind patterns will also tend to make any impacts on air quality within the project area extremely unlikely due to the position of project areas with respect to the airport runways and the likely trajectory of air pollution emissions. Much of the emissions that do occur from airport operations are emitted during aircraft taxiing at interior locations of the airport, and these emissions will be substantially dispersed by the time they reach the airport boundary.

2.0 INTRODUCTION

Kapalua Land Company, Ltd. is proposing to develop the Pulelehua community on approximately 312 acres of land in the Mahinahina area of West Maui (see Figure 1 for project location). The proposed development is a master planned community that includes 882 primary residential unit, up to 318 Ohana units, approximately 175,000 square feet of commercial space, and areas for schools, churches and other civic uses. It is intended to be a pedestrian

community that emphasizes walking and biking within the development. The Pulelehua site is mauka of Honapiilani Highway near the West Maui Airport. The site is bordered by Honapiilani Highway on the west, the West Maui Airport on the east, and Department of Hawaiian Homelands property to the south. Presently, the majority of the site is vacant land. Construction of the community is expected to be completed in phases with full development and occupancy by 2011.

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. Potential impacts on Pulelehua from nearby air pollution sources are also discussed. Measures to mitigate impacts either by the project or on the project are suggested where possible and appropriate.

3.0 AMBIENT AIR QUALITY STANDARDS

Ambient concentrations of air pollution are regulated by both national and state ambient air quality standards (AAQS). National AAQS are specified in Section 40, Part 50 of the Code of Federal Regulations (CFR), while State of Hawaii AAQS are defined in Chapter 11-59 of the Hawaii Administrative Rules. Table 1 summarizes both the national and the state AAQS that are specified in the cited documents. As indicated in the table, national and state AAQS have been established for particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and lead. The state has also set a standard for hydrogen sulfide. National AAQS are stated in terms of both primary and secondary

standards for most of the regulated air pollutants. National primary standards are designed to protect the public health with an "adequate margin of safety". National secondary standards, on the other hand, define levels of air quality necessary to protect the public welfare from "any known or anticipated adverse effects of a pollutant". Secondary public welfare impacts may include such effects as decreased visibility, diminished comfort levels, or other potential injury to the natural or man-made environment, e.g., soiling of materials, damage to vegetation or other economic damage. In contrast to the national AAQS, Hawaii State AAQS are given in terms of a single standard that is designed "to protect public health and welfare and to prevent the significant deterioration of air quality".

Each of the regulated air pollutants has the potential to create or exacerbate some form of adverse health effect or to produce environmental degradation when present in sufficiently high concentration for prolonged periods of time. The AAQS specify a maximum allowable concentration for a given air pollutant for one or more averaging times to prevent harmful effects. Averaging times vary from one hour to one year depending on the pollutant and type of exposure necessary to cause adverse effects. In the case of the short-term (i.e., 1- to 24-hour) AAQS, both national and state standards allow a specified number of exceedances each year.

The Hawaii AAQS are in some cases considerably more stringent than the comparable national AAQS. In particular, the Hawaii 1-hour AAQS for carbon monoxide is four times more stringent than the comparable national limit. The U.S. Environmental Protection Agency (EPA) is currently working on a plan to phase out the

national 1-hour ozone standard in favor of the new (and more stringent) 8-hour standard.

The Hawaii AAQS for sulfur dioxide were relaxed in 1986 to make the state standards essentially the same as the national limits. In 1993, the state also revised its particulate standards to follow those set by the federal government. During 1997, the federal government again revised its standards for particulate, but the new standards were challenged in federal court. A Supreme Court ruling was issued during February 2001, and at this time, it is expected that the new standards for particulate will be implemented by 2005. To date, the Hawaii Department of Health has not updated the state particulate standards. In September 2001, the state vacated the state 1-hour standard for ozone and an 8-hour standard was adopted.

4.0 REGIONAL AND LOCAL CLIMATOLOGY

Regional and local climatology significantly 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 Pulelehua site is located along the western coast of the island of Maui. The topography of Maui Island is dominated by the great volcanic masses of Haleakala (10,023 feet) and the West Maui

Mountains (5,788 feet). The island consists entirely of the slopes of these mountains and of a connecting isthmus. Haleakala is still considered to be an active volcano and last erupted about 1790.

Maui lies well within the belt of northeasterly trade winds generated by the semi-permanent Pacific high pressure cell to the north and east. Portions of the western coast of the island of Maui, however, are sheltered from the trade winds by high terrain. The Pulelehua site lies in an area that is partially sheltered from the trade winds when they are more easterly, but the area may be exposed to the trade winds when they become more northerly. Local winds such as land/sea breezes and/or upslope/downslope winds also influence the wind pattern for the area. During the daytime, when the trade winds are weak or blocked by the terrain, 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 probably results in a somewhat larger average diurnal temperature variation compared to windward locations at the same elevation. At Kaanapali, located about 3 miles south of Pulelehua, average daily minimum and maximum temperatures are 66°F and 85°F, respectively [1]. The extreme minimum temperature on record at this location is 47°F, and the extreme maximum is 98°F. Temperatures at the Pulelehua site are very 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 Kapalua 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 nearby mountains. 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 concentra-

tions 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 relatively dry due to its leeward location. At Kaanapali, average annual rainfall amounts to about 16 inches with the summer months being the driest [1]. Rainfall at the project site is probably slightly higher than at Kaanapali with annual amounts that are probably near 20 inches.

5.0 PRESENT AIR QUALITY

Present air quality in Mahinahina 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 Maui for calendar year 1993. The emission rates shown in the table pertain to manmade emissions only, i.e., emissions from natural sources are not included. As suggested in

the table, most of the manmade particulate and sulfur oxides emissions on Maui originate from point sources, such as power plants and other fuel-burning industries. Nitrogen oxides emissions are roughly equally divided between point sources and area sources (mostly motor vehicle traffic). The majority of carbon monoxide emissions occur from area sources (motor vehicle traffic and sugar cane burning), while hydrocarbons are emitted mainly from point sources.

The largest sources of air pollution in the project area are probably agricultural operations and automobile traffic using Honoapiilani Highway. Emissions from these sources consist primarily of particulate, carbon monoxide and nitrogen oxides.

The State Department of Health operates a network of air quality monitoring stations at various locations around the state, but only very limited data are available for Maui Island. Particulate data are collected at Kihei and at Paia, but data from these locations probably would not be representative of the project area. No monitoring stations are located in the West Maui area, and insofar as is known, no air quality data have been reported for this area. Given the limited air pollution sources in the area, it is likely that air pollution concentrations are near natural background levels, except possibly for locations adjacent to agricultural operations or near traffic-congested intersections. 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 PULELEHUA

Short-term direct and indirect impacts on air quality could potentially occur due to 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 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 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 Pulelehua's construction phase is essential.

Adequate fugitive dust control can usually be accomplished by the establishment of a frequent watering program to keep bare-dirt surfaces in construction areas from becoming significant sources of dust. In dust-prone or dust-sensitive areas, other control measures such as limiting the area that can be disturbed at any given time, applying chemical soil stabilizers, mulching and/or using wind screens may be necessary. Control regulations further stipulate that open-bodied trucks be covered at all times when in motion if they are transporting materials that could be blown away. Haul trucks tracking dirt onto paved streets from unpaved areas is often a significant source of dust in construction areas. Some means to alleviate this problem, such as road cleaning or tire washing, may be appropriate. Paving of parking areas and/or establishment of landscaping as early in the construction schedule as possible can also lower the potential for fugitive dust emissions. Monitoring dust at the project property line could be considered to quantify and document the effectiveness of dust control measures.

On-site mobile and stationary construction equipment also will emit air pollutants from engine exhausts. The largest of this equipment is usually diesel-powered. Nitrogen oxides emissions from diesel engines can be relatively high compared to gasoline-powered equipment, but the standard for nitrogen dioxide is set on an annual basis and is not likely to be violated by short-term construction equipment emissions. Carbon monoxide emissions from diesel engines, on the other hand, are low and should be

relatively insignificant compared to vehicular emissions on nearby roadways. It should be noted that there are no populated developments adjacent to the Pulelehua site which are downwind of the prevailing trade winds.

Pulelehua's 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 PULELEHUA

7.1 Roadway Traffic

After construction is completed, use of the proposed facilities will result in increased motor vehicle traffic in the project area, potentially causing long-term impacts on ambient air quality. Motor vehicles with gasoline-powered engines are significant sources of carbon monoxide. They also emit nitrogen oxides and other contaminates.

Federal air pollution control regulations require that new motor vehicles be equipped with emission control devices that reduce emissions significantly compared to a few years ago. In 1990, the President signed into law the Clean Air Act Amendments. This

legislation requires further emission reductions, which have been phased in since 1994. More recently, additional restrictions were signed into law during the Clinton administration, which will begin to take effect during the next decade. The added restrictions on emissions from new motor vehicles will lower average emissions each year as more and more older vehicles leave the state's roadways. It is estimated that carbon monoxide emissions, for example, will go down by an average of about 30 to 40 percent per vehicle during the next 10 years due to the replacement of older vehicles with newer models.

To evaluate the potential long-term indirect ambient air quality impact of increased roadway traffic associated with a project such as this, computerized emission and atmospheric dispersion models can be used to estimate ambient carbon monoxide concentrations along roadways leading to and from Pulelehua. 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, three scenarios were selected for the carbon monoxide modeling study: (1) year 2004 with present conditions, (2) year 2011 without the project, and (3) year 2011 with the project. Year 2011 is when full development and occupancy is expected to be achieved. To begin the modeling study of the three scenarios, critical receptor areas in the vicinity of the Pulelehua site 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, four key intersections identified in the traffic study were selected for air quality analysis. These included the following intersections:

- Honapiilani Highway at Lower Honapiilani Road;
- Honapiilani Highway at Akahele Street;
- Honapiilani Highway at Hoohui Road;
- Honapiilani Highway at Napilihau Street.

The above intersections were selected for analysis based on the existing and projected higher traffic volumes and, in some cases, lower levels-of-service that are expected to occur at these locations. The traffic impact assessment report for Pulelehua [4] describes the existing and projected traffic conditions and laneage configurations of these intersections in detail. For the purposes of this analysis, Akahele Street was assumed to remain signalized for the future (2011) scenarios.

The main objective of the modeling study was to estimate maximum 1-hour average carbon monoxide concentrations for each of the three scenarios studied. To evaluate the significance of the estimated concentrations, a comparison of the predicted values for each scenario can be made. Comparison of the estimated values to the national and state AAQS was also used to provide another measure of significance.

Maximum carbon monoxide concentrations typically coincide with peak traffic periods. The traffic impact assessment report

evaluated morning and afternoon peak traffic periods. These same periods were evaluated in the air quality impact assessment.

The EPA computer model MOBILE6 [5] was used to calculate vehicular carbon monoxide emissions for each year studied. One of the key inputs to MOBILE6 is vehicle mix. Unless very detailed information is available, national average values are typically assumed, which is what was used for the present study. Based on national average vehicle mix figures, the present vehicle mix in the project area was estimated to be 43.6% light-duty gasoline-powered automobiles, 43.6% light-duty gasoline-powered trucks and vans, 3.6% heavy-duty gasoline-powered vehicles, 0.2% light-duty diesel-powered vehicles, 8.4% heavy-duty diesel-powered trucks and buses, and 0.6% motorcycles. For the future scenarios studied, the vehicle mix was estimated to change slightly with fewer light-duty gasoline-powered automobiles and more light-duty gasoline-powered trucks and vans.

Ambient temperatures of 59 and 68 degrees F were used for morning and afternoon peak-hour emission computations, respectively. These are conservative assumptions since morning/afternoon ambient temperatures will generally be warmer than this, and emission estimates given by MOBILE6 generally have an inverse relationship to the ambient temperature.

After computing vehicular carbon monoxide emissions through the use of MOBILE6, this data was then input into 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 based on assumed free-flow vehicle speeds corresponding to the posted speed limits (25 to 45 mph depending on location).

Model roadways were set up to reflect roadway geometry, physical dimensions and operating characteristics. Concentrations predicted by air quality models generally are not considered valid within the roadway-mixing zone. The roadway-mixing zone is

usually taken to include 3 meters on either side of the traveled portion of the roadway and the turbulent area within 10 meters of a cross street. Model receptor sites were thus located at the edges of the mixing zones near all intersections that were studied for all three scenarios. This implies that pedestrian sidewalks either already exist or are assumed to exist in the future. All receptor heights were placed at 1.5 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 2003. Although increased traffic is expected to occur within the Mahinahina area within the next

several years with or without Pulelehua, 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 scenarios studied.

Predicted Worst-Case 1-Hour Concentrations

Table 3 summarizes the 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 three scenarios: year 2004 with existing traffic, year 2011 without the project and year 2011 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 (2004) case was 4.6 mg/m^3. This was projected to occur during the morning peak traffic hour near the intersection of Honapiilani Highway and Lower Honapiilani Road. Concentrations at other locations and times studied were 3.8 mg/m^3 or lower. All predicted worst-case 1-hour concentrations for the 2004 scenario were well within both the national AAQS of 40 mg/m^3 and the state standard of 10 mg/m^3.

In the year 2011 without the proposed project, the predicted worst-case concentrations did not change substantially compared to the existing case, despite expected increases in traffic volumes

at the intersections studied. Emissions from the higher volumes of traffic will be offset by the decrease in motor vehicle emissions on a per-vehicle-basis that is expected to occur over the next several years, which is the result of older motor vehicles being retired. For the 2011 without project scenario, the highest worst-case 1-hour concentration was again predicted to occur during the morning at the intersection of Honapiilani Highway and Lower Honapiilani Road. A value of 4.3 mg/m^3 was predicted to occur at this location. Peak-hour worst-case values at the other locations and times studied for the 2011 without project scenario ranged between 1.8 and 4.0 mg/m^3. All projected worst-case concentrations for this scenario remained within the state and national standards.

The predicted highest 1-hour worst-case concentrations for the 2011 with project scenario were about 10 to 15 percent higher compared to the 2011 without project case. The highest worst-case concentration for this scenario, 5.0 mg/m^3, was predicted to occur during the morning at the intersection of Honapiilani Highway and Lower Honoapiilani Road. The highest concentrations at other locations and times studied ranged between 2.2 and 4.5 mg/m^3. All predicted worst-case 1-hour concentrations for the 2011 with project scenario were well within both the national and the state AAQS.

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 Pulelehua 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 4. For the 2004 scenario, the estimated worst-case 8-hour carbon monoxide concentrations for the four locations studied ranged from 1.4 mg/m^3 at the intersection of Honapiilani Highway and Napilihau Street to 2.3 mg/m^3 at Honapiilani Highway and Lower Honapiilani Road. The estimated worst-case concentrations were well within both the state standard of 5 mg/m^3 and the national limit of 10 mg/m^3.

For the year 2011 without project scenario, worst-case concentrations ranged between 1.5 and 2.2 mg/m^3, with the highest concentration at the Honapiilani Highway and Lower Honapiilani Road intersection. Concentrations at all four locations studied remained essentially unchanged compared to the existing case. All predicted concentrations were within the standards.

For the 2011 with project scenario, the highest worst-case concentrations increased by about 10 to 15 percent compared to the without project case. Concentrations ranged from 1.6 mg/m^3 at Honapiilani Highway and Napilihau Road to 2.5 mg/m^3 at Honapiilani Highway and Lower Honapiilani Road. All predicted 8-hour concentrations for this scenario were well within both the national and the state AAQS.

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

Pulelehua also will cause indirect air pollution emissions from power generating facilities as a consequence of electrical power usage. The annual electrical demand of Pulelehua is estimated to reach approximately 10 million kilowatt-hours [12]. Electrical

power will most probably be provided mainly by fossil fuel-fired generating facilities, but some of the power may also be derived from solar power, wind power or other sources. In order to meet the electrical power needs, 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 5 are estimates of the indirect air pollution emissions that would result from Pulelehua's 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 electrical demand amount to less than 1 percent of the present air pollution emissions occurring on Maui even if all power is assumed to be derived from fossil fuel.

7.3 Solid Waste Disposal

Solid waste generated by the proposed development when fully completed and occupied is not expected to exceed about 2000 tons per year [12]. 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. If the solid waste was burned to generate power instead buried in a landfill, the emissions shown in Table 6 could result. These would represent only a very small fraction of the current island-wide emissions.

8.0 IMPACTS ON PULELEHUA FROM WEST MAUI AIRPORT

In addition to assessing the potential air quality impacts of Pulelehua on the surrounding area, the reverse problem of impacts of air pollution sources located in the surrounding area on the residents of Pulelehua is also of interest. For Pulelehua, the issue of primary concern is the West Maui Airport located immediately to the west of the site.

Table 7 shows the aircraft mix at West Maui Airport for the year 2004. Aircraft traffic at West Maui Airport is comprised almost entirely of commuter-type turbo-prop aircraft. Emissions from turbo-prop aircraft consist primarily of nitrogen oxides and carbon monoxide. Most of these emissions will occur along airport taxi-ways and along the runway. For safe operation, the runway at the West Maui Airport is aligned approximately north/south to minimize the runway crosswind component. Aircraft normally land and takeoff into the wind. As reported in the airport noise study [13], winds from the north are the predominant wind direction, resulting in about 80 percent of all aircraft operations on Runway 20 (operating from south to north).

As reported in the airport noise study [13], the West Maui Airport had just over 9,000 aircraft operations in 2004, or an average of 12.5 landing/takeoff (LTO) cycles per day. The volume of aircraft traffic has decreased over the past several years from 23,000 operations in 1989. Access rules enforced at the airport allow for a maximum of 51,000 annual operations, or a maximum of 70 LTO cycles per day. According to the Airport Noise Study, it is unlikely that airport operations would reach the maximum allowable operations. This is due to the physical constraints which may be

created by the existing apron space and terminal. It should also be noted that the current DOT forecast indicates only a slight increase in airport operations between 2004 and 2025.

Emission data for the specific aircraft types using West Maui Airport are not available, but data for a DeHavilland DHC-6, which is of the same aircraft class, have been reported. These data are shown in Table 8 in terms of emission amounts per LTO cycle for carbon monoxide, hydrocarbons, nitrogen oxides and sulfur oxides. Emission estimates for particulate matter are not available, but these are assumed to be negligible.

Estimates of annual emissions can be obtained by applying the LTO emission factors given in Table 8 to the annual LTO cycles for the airport. The results for the year 2004 airport operations and for future maximum operations are presented in Table 9. In the year 2004, emissions were estimated to amount to: 7.4 tons of carbon monoxide, 4.6 tons of hydrocarbons, 1.5 tons of nitrogen oxides, and 0.1 tons of sulfur oxides. With maximum airport operations, annual emissions would amount to: 41.5 tons of carbon monoxide, 25.7 tons of hydrocarbons, 8.2 tons of nitrogen oxides, and 0.7 tons of sulfur oxides. Estimates of particulate emissions were not available, but these are assumed to be insignificant.

Table 10 shows the defined significant emission rates (in tons per year) for carbon monoxide, nitrogen oxides, volatile organic compounds (hydrocarbons), sulfur dioxide and particulate matter as specified by the Hawaii Department of Health. These values are primarily intended to apply to point sources and not area sources

such as airports, but the values can nevertheless be used as a "yardstick" to measure the significance of the estimated emissions from aircraft operations at West Maui Airport. Emissions (or changes in emissions) below the significant emission rates are considered minor enough that any air quality impacts will likely be small and further analysis is probably unnecessary. Emissions above the significant levels generally indicate that a more detailed examination of the potential impact of those emissions may be warranted.

Comparing the significant emission rates to the estimated emissions given in Table 9, it can be seen that in year 2004 emissions of carbon monoxide, hydrocarbons, nitrogen oxides and sulfur oxides were much less than the significant emission rates. Even with a substantial increase in aircraft operations in the future, emissions from aircraft should stay below the significant emission rates.

With detailed information concerning aircraft operations at the airport and prevailing meteorological conditions, computer modeling could be used to quantitatively assess air pollution concentrations at the airport boundary and adjacent nearby areas. However, based on the level of activity at the airport and the associated air pollution emission rates, such an analysis does not appear to be warranted. Even without performing a detailed quantitative analysis, it can be determined that a large percentage of the emissions occurring in the airport area will result from aircraft taxiing at interior locations of the airport, and these emissions will tend to be dispersed by the time they reach areas beyond the airport boundary. Northerly winds will likely carry these emissions away from the project area much of

the time. During periods when the trade winds are weak or absent, daytime winds will likely move onshore much of the time, making the project site upwind of the airport and unaffected by airport emissions. During the nighttime when winds will likely often move downslope causing the project area to be downwind of the airport, there are no aircraft operations. Thus, with the project site positioned primarily to the west of the airport, any related impacts on Pulelehua from aircraft emissions should be minimal.

9.0 CONCLUSIONS AND RECOMMENDATIONS

The major potential short-term air quality impact of Pulelehua will occur from the emission of fugitive dust during construction. Uncontrolled fugitive dust emissions from construction activities are estimated to amount to about 1.2 tons per acre per month, depending on rainfall. To control dust, active work areas and any temporary unpaved work roads should be watered at least twice daily on days without rainfall. Use of wind screens and/or limiting the area that is disturbed at any given time will also help to contain fugitive dust emissions. Wind erosion of inactive areas of the site that have been disturbed could be controlled by mulching or by the use of chemical soil stabilizers. Dirt-hauling trucks should be covered when traveling on roadways to prevent windage. A routine road cleaning and/or tire washing program will also help to reduce fugitive dust emissions that may occur as a result of trucks tracking dirt onto paved roadways in the project area. Paving of parking areas and establishment of landscaping early in the construction schedule will also help to control dust. Monitoring dust at the project boundary during the period of construction could be considered as a means to evaluate the effectiveness of the project dust control program and to adjust the program if necessary.

During construction phases, emissions from engine exhausts (primarily consisting of carbon monoxide and nitrogen oxides) will also occur both from on-site construction equipment and from vehicles used by construction workers and from trucks traveling to and from Pulelehua. 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 Pulelehua is completed, any long-term impacts on air quality in the area due to emissions from project-related motor vehicle traffic should be small. Worst-case concentrations of carbon monoxide should remain within both the state and the national ambient air quality standards. Implementing any air quality mitigation measures for long-term traffic-related impacts is probably unnecessary and unwarranted.

Any long-term impacts on air quality due to indirect emissions from supplying Pulelehua with electricity and from the disposal of waste materials generated by Pulelehua will likely be small based on the relatively small magnitudes of these emissions. Nevertheless, indirect emissions from Pulelehua electrical demand could likely be reduced somewhat by incorporating energy-saving features into 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. This could reduce solid waste volumes, which would in turn reduce any related air pollution emissions proportionately.

The potential impact on Pulelehua from aircraft emissions occurring at the adjacent West Maui Airport should be insignificant due to the relatively small emission rates. Much of the emissions that do occur will be emitted from interior locations of the airport and will be substantially dispersed by the time they reach the airport boundary. Also, the local wind pattern can be expected to carry emissions away from project areas much of the time.

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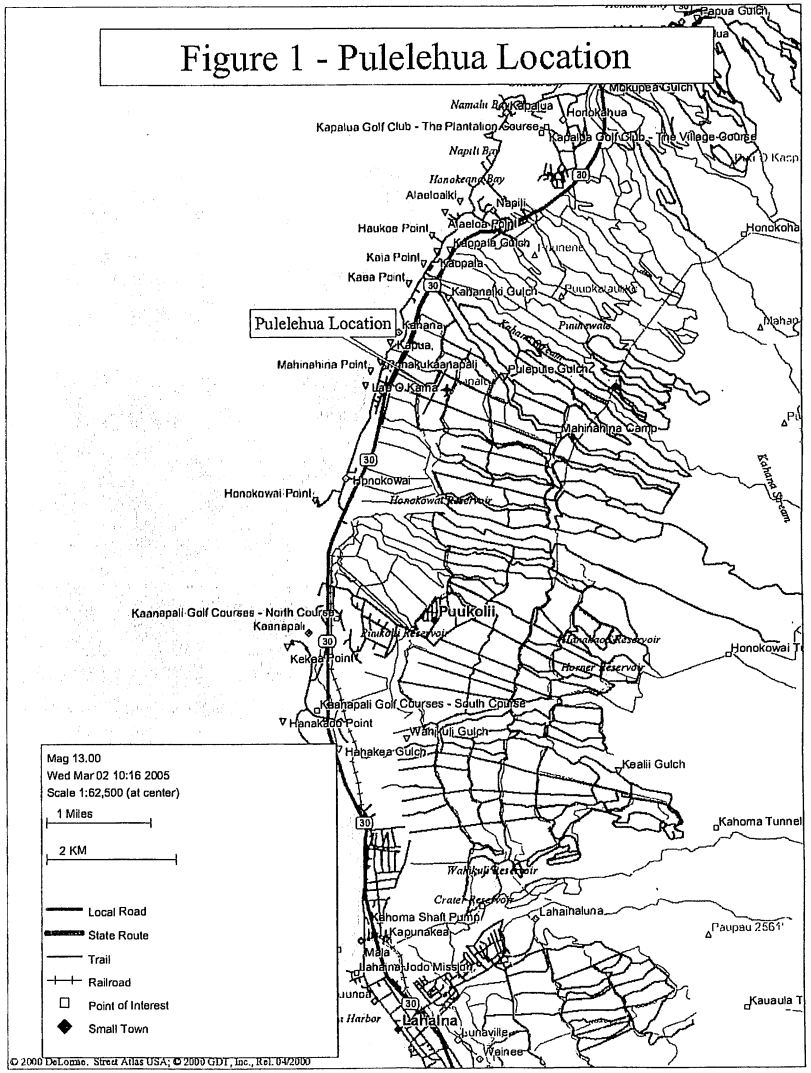

Table 1

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)	$\mu g/m^3$	Annual 24 Hours	50[a] 150[b]	50[a] 150[b]	50 150[c]
Particulate Matter (<2.5 microns)	$\mu g/m^3$	Annual 24 Hours	15[a] 65[d]	15[a] 65[d]	- -
Sulfur Dioxide	$\mu g/m^3$	Annual 24 Hours 3 Hours	80 365[c] -	- - 1300[c]	80 365[c] 1300[c]
Nitrogen Dioxide	$\mu g/m^3$	Annual	100	100	70
Carbon Monoxide	mg/m^3	8 Hours 1 Hour	10[c] 40[c]	- -	5[c] 10[c]
Ozone	$\mu g/m^3$	8 Hours 1 Hour	157[e] 235[f]	157[e] 235[f]	157[e] -
Lead	$\mu g/m^3$	Calendar Quarter	1.5	1.5	1.5
Hydrogen Sulfide	$\mu g/m^3$	1 Hour	-	-	35[c]

[a] Three-year average of annual arithmetic mean.

[b] 99th percentile value averaged over three years.

[c] Not to be exceeded more than once per year.

[d] 98th percentile value averaged over three years.

[e] Three-year average of fourth-highest daily 8-hour maximum.

[f] Standard is attained when the expected number of exceedances is less than or equal to 1.

Table 2

AIR POLLUTION EMISSIONS INVENTORY FOR ISLAND OF MAUI, 1993

Air Pollutant	Point Sources (tons/year)	Area Sources (tons/year)	Total (tons/year)
Particulate	63,275	7,030	70,305
Sulfur Oxides	6,419	nil	6,419
Nitrogen Oxides	7,312	8,618	15,930
Carbon Monoxide	4,612	20,050	24,662
Hydrocarbons	1,991	234	2,225

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

ESTIMATED WORST-CASE 1-HOUR CARBON MONOXIDE CONCENTRATIONS
ALONG ROADWAYS NEAR PULELEHUA
(milligrams per cubic meter)

Roadway Intersection	Year/Scenario					
	2004/Present		2011/Without Project		2011/With Project	
	AM	PM	AM	PM	AM	PM
Honapiilani Highway at Lower Honapiilani Road	4.6	3.1	4.3	2.8	5.0	3.0
Honapiilani Highway at Akahele Street	3.8	3.0	4.0	2.6	4.5	3.0
Honapiilani Highway at Hoohui Road	3.2	2.6	3.4	2.2	3.9	2.4
Honapiilani Highway at Napilihau Street	2.8	2.1	2.9	1.8	3.2	2.2

Hawaii State AAQS: 10
National AAQS: 40

Table 4

ESTIMATED WORST-CASE 8-HOUR CARBON MONOXIDE CONCENTRATIONS
ALONG ROADWAYS NEAR PULELEHUA
(milligrams per cubic meter)

Roadway Intersection	Year/Scenario		
	2004/Present	2011/Without Project	2011/With Project
Honapiilani Highway at Lower Honapiilani Road	2.3	2.2	2.5
Honapiilani Highway at Akahele Street	1.9	2.0	2.2
Honapiilani Highway at Hoohui Road	1.6	1.7	2.0
Honapiilani Highway at Napilihau Street	1.4	1.5	1.6

Hawaii State AAQS: 5
National AAQS: 10

Table 5

ESTIMATED INDIRECT AIR POLLUTION EMISSIONS FROM PULELEHUA ELECTRICAL DEMAND[a]

Air Pollutant	Emission Rate (tons/year)
Particulate	3
Sulfur Dioxide	26
Carbon Monoxide	3
Volatile Organics	<1
Nitrogen Oxides	12

[a]Based on U.S. EPA emission factors for utility boilers [2]. Assumes project electrical demand of 10 million kw-hrs per year. Estimated emission rates assume low-sulfur oil used to generate power.

Table 6

ESTIMATED INDIRECT AIR POLLUTION EMISSIONS FROM PULELEHUA SOLID WASTE DISPOSAL DEMAND[a]

Air Pollutant	Emission Rate (tons/year)
Particulate	<1
Sulfur Dioxide	<1
Carbon Monoxide	2
Nitrogen Oxides	5

[a]Based on U.S. EPA emission factors for refuse-derived fuel-fired combustors [2]. Assumes spray dryer/fabric filter for emissions control and solid waste disposal demand of 2000 tons per year.

Table 7

AIRCRAFT MIX AT WEST MAUI AIRPORT FOR 2004

Aircraft	Percent of Total
Cessna 208 Caravan	0.41
Cessna 402	0.86
Cessna 414	0.11
DHC 8-100	63.39
P68C Partenavia	8.06
PA-31-250	0.34
PA-31-350	26.83

Source: "Day Night Noise Level Contours, West Maui Airport", prepared for Kapalua Land Co., Ltd., prepared by Mestre Greve Associates, Laguna, CA, January 5, 2005

Table 8

DHC-6 EMISSION DATA

Mode	Emission Rate (lb/LTO)					Time in Mode (mins)
	Carbon Monoxide	Hyrdo-carbons	Nitrogen Oxides	Sulfur Oxides	Particu-late	
Takeoff	0.007	Nil	0.055	0.0038	N/A	0.50
Taxi In/Out	2.46	1.94	0.088	0.018	N/A	10.0
Climbout	0.040	Nil	0.23	0.018	N/A	2.5
Approach	0.74	0.07	0.27	0.018	N/A	4.5
Total	3.25	2.01	0.64	0.058	NA	17.5

Number of engines: 2

Source: Compilation of Air Pollutant Emission Factors, Volume II: Mobile Sources, Fourth Edition Including Supplements A, AP-42, U.S. Environmental Protection Agency, Research Triangle Park, NC, January 1991.

Table 9

ESTIMATED ANNUAL EMISSIONS AT WEST MAUI AIRPORT

Year	Annual Emissions (tons)				
	Carbon Monoxide	Hyrdo-carbons	Nitrogen Oxides	Sulfur Oxides	Particu-late
2004	7.4	4.6	1.5	0.1	N/A
Future Maximum	41.5	25.7	8.2	0.7	N/A

Note: Year 2004 emissions based on an average of 12.5 LTO cycles per day. Future maximum emissions are based on 70 LTO cycles per day.

Table 10

SIGNIFICANT AIR POLLUTION EMISSION RATES

Air Pollutant	Significant Emission Rate (tons/year)
Carbon Monoxide	100
Nitrogen Oxides	40
Volatile Organic Compounds	40
Sulfur Dioxide	40
Particulate Matter (total)	25
Particulate Matter (<10 microns)	15

Source: Hawaii Administrative Rules, Title 11, Department of Health, Chapter 60, Air Pollution Control

K

Public Costs/Benefits Assessment

Public Costs/Benefits Assessment
of the Proposed
PULELEHUA COMMUNITY
Mahinahina, West Maui, Hawaii

THE HALLSTROM GROUP INC.
REAL ESTATE
CONSULTANTS
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June 24, 2005

Mr. Robert M. McNatt
Maui Land & Pineapple Company, Inc.
120 Kane Street
Kahului, Maui, Hawaii 96732

Public Costs/Benefits Assessment
of the Proposed Pulelehua Community
Mahinahina, West Maui, Hawaii

Dear Mr. McNatt:

At your request, we have completed a study quantifying the probable impacts on the State and County public purses resulting from the Pulelehua Community, a master-planned, local resident-oriented development to be located on 312 acres mauka of Honoapiilani Highway, abutting the Kapalua/West Maui Airport, approximately six miles north of Lahaina Town, West Maui, Hawaii.

The intent is to develop a series of interconnected neighborhoods providing complete, quality lifestyle opportunities in close proximity to West Maui employment, service providers and civic/recreational amenities. Some 51 percent of the units will be priced according to county affordability guidelines, and approximately 310 of the house lots will have the potential for future ohana units.

This report is a continuation of our prior market and economic analyses which was based on a then-envisioned project containing 895 total residential units, including 151 apartments, 299 townhouse and flats, and 445 cottages and single-family homes. Under the original plans, the community was also to have approximately 96,475 square feet of retail/commercial and 78,000 square feet of mixed-use floor space on some 15 acres of project-serving "neighborhood" business sites. The master plan also provided for a variety of public/civic uses, and open space/parklands.[1]

(1) We note, as is typical during the planning and entitlement effort of a proposed master planned community, unit counts are subject to change. The most current design renditions have unit counts slightly different than those used in our initial and this follow-up study. We do not believe these minor count evolutions affect the primary indications of our analyses.

The development goal is to help address the acute need for full-time residential units in West Maui. Although the study region is the focal point of the island's visitor industry and a vital component of the Maui economy, there has not been a major residential inventory addition in years, and it remains one of the tightest housing markets in the nation.

The Pulelehua site, identified on State of Hawaii Tax Maps as a portion of Second Division Tax Map Key 4-3-01, Parcel 31, is a moderately sloping site extending mauka from Honoapiilani Highway, above the Kahana and Mahinahina shoreline vacation villages, to the makai side of the Kapalua/West Maui Airport. The terrain in the area is generally regular (although there are two gulches bisecting the property), offers many superior ocean and mountain panoramas, and has a desirable moderate climate.

The focus of our assignment was three-fold:

1. To estimate the actual and/or per capita costs to the State and County purses resulting from the development of the proposed Pulelehua community.

2. To quantify the primary projected tax receipt benefits flowing to the State and County purses from development and use of Pulelehua via real property, gross excise, and income taxes.

3. To identify other real property and "value" benefits for the West Maui region associated with the subject project

The pertinent results from our study are contained in the following summary report. This assignment is based entirely on the findings of our *Market Study and Economic Impact Analysis of the Proposed Pulelehua Community*, published March 1, 2005, with only limited additional new research undertaken. And, although our findings are being presented within a free-standing document, it is assumed the reader has access to the previous market study report. As noted, unit counts have been minorly altered since our original investigation and analysis. We have used the past counts in order to maintain consistency in our modeling process and do not believe that the nominal revisions materially impact findings.

This study was prepared for Maui Land & Pineapple Company, Inc. (ML&P), with Robert McNatt of ML&P and Tom Schnell of PBR Hawaii (project entitlement planners) being the primary client contacts. The purpose of this assignment is to provide public costs/benefits conclusions regarding the proposed Pulelehua community for use in land use entitlement petitions for the property, and for internal planning purposes. The publication date of the report is June 24, 2005.

All conclusions presented herein are subject to the identified limiting conditions, assumptions and certifications of The Hallstrom Group, Inc., in addition to any others set forth in the text or tables. All work has been completed in conformance with the Code of Professional Ethics and Standards of Professional Appraisal Practice of the Appraisal Institute, and the Uniform Standards of Professional Appraisal Practice (USPAP).

Based on our investigation and analysis we conclude:

- The County of Maui will receive some $8 million in real property tax revenues during the first decade of development and use of Pulelehua, and stabilized receipts of $1.5 million annually thereafter. The revenues would be substantially higher (upwards of 30 percent) were the development entirely market-priced; however, the inclusion of a significant affordable-price housing component will limit the assessment base.

- The State of Hawaii will receive circa $64.4 million in income gross excise tax revenues during the first ten years of subject community life, stabilizing at $12.7 million per year thereafter. Again, these revenues would be much higher were the project designed as a typical development, exploiting highway frontages for intense commercial uses, maximizing housing densities and minimizing open space allowances.

- If analyzed on an "actual cost" basis, the additional government operations associated with the project will total some $992,000 to the county and $3.5 million to the State annually at build-out.

- From a "per capita" public costs perspective, the additional government operations associated with Pulelehua after completion will total circa $5.8 million per year for the County of Maui and $14.7 million for the State.

- Overall during its first decade of development and use, the estimated net returns to the State and County governments will be positive from an "actual cost" perspective. On a "per capita cost" basis, the State will have receipts greater than expenses during the first ten years, the County will have higher expenses than income.

- At stabilized use levels, both the County and State should experience some net "actual" cash flow benefits; the State moreso. However, both will have operating loses from a "per capita" viewpoint, which is typical for a local resident-oriented development having significant affordable-priced components.

- Additional direct benefits include the proposed donation of a 13-acre serviced school site, 10 acres of improved parks, and provisions for seven civic/community lots. Community amenities, including parks, pathways and open/nature spaces will be available for the general public.

- The commitment by the developer to price 51 percent of the proposed dwelling units to affordable and gap group housing needs, as opposed to market-priced homes, is inferring some $35.4 million in equity-based benefits directly into the West Maui community via Pulelehua. Additionally, the developer will be making a long-term capital commitment to regional housing needs of $40.6 million through the construction of 125 rental apartments.

- Supplemental regional public benefits from a real estate perspective include protection of highway frontage from large-scale commercial or residential uses; a lower overall housing unit density (2.8 per acre) than typical for a residential development with significant affordable components; and, actualization of a quality, modern, holistic lifestyle community which will become a standard for future regional urbanization.

We appreciate the opportunity to be of service in regard to this holding. Please contact us if further detail or discussion in the matter covered herein is required.

Respectfully submitted,

THE HALLSTROM GROUP, INC

James E. Hallstrom, Jr., MAI, CRE

/as

THE HALLSTROM GROUP INC.
REAL ESTATE
CONSULTANTS
& APPRAISERS

Public Costs/Benefits Assessment of the Proposed

PULELEHUA COMMUNITY

to be located at

Mahinahina, West Maui, Hawaii

Prepared for

Mr. Robert M. McNatt
Maui Land & Pineapple Company

June 2005

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Introduction

The proposed Pulelehua community will encompass approximately 312 acres in the mauka/northerly area of the Lahaina to Kapalua coastal corridor, adjacent to the Kapalua West Maui Airport, upslope from the Mahinahina and Kahana beachfront communities, and abutting the existing Kahana Ridge subdivision. The holding has a viable location for moderate intensity urban uses: being proximate to major employment centers, supporting businesses and services; offering desirable view/climate amenities and nearby recreational areas; and ready access onto a major island thoroughfare. It is a natural expansion area for the growing Kahana area.

In our previous market study and economic impact analysis regarding the proposed subject development, published March 2005, it was concluded:

- There is significant market support for the proposed Pulelehua housing units, with strong current and projected demand and scarce supply throughout West Maui. Community consumers and airport-related uses will support the secondary neighborhood light industrial and commercial components.

- The property is centrally located, with good access, climate and view characteristics, and is well-suited for the proposed development. The master plan will achieve market acceptance by providing desirable residential and neighborhood business opportunities for local residents.

- Full absorption of the 895 residential units and the 15 gross acres of mixed-use/ commercial sites comprising the Pulelehua project is estimated to require approximately six years.

- The construction of the project will bring $301.5 million in development capital into the Maui economy and create 8,399 worker years of employment and $278.8 million in wages during the initial 10-year build-out and use period. The on-site operating businesses and building maintenance will have 705 permanent full-time equivalent positions with $17.7 million in annual wages, and generate another 254 off-site/support jobs.

- The 895 units will have a de facto population of 2,669 persons, including 2,492 permanent residents, of which some 623 will be of school age and circa 411 will be public school attendees. The discretionary expenditures of the community into the Maui economy will be about $30.9 million annually.

Based on these conclusions, and others presented along with supporting models and data in the report we have completed an assessment on the direct and indirect impacts the proposed development will have on the State of Hawaii and County of Maui coffers.

The focus of our assignment was three-fold:

1. To estimate the actual and/or per capita costs to the State and County purses resulting from the development of the proposed Pulelehua community.

2. To quantify the projected primary, direct tax receipt benefits flowing to the State and County purses from development and use of Pulelehua via real property, gross excise, and income taxes.

3. To identify other real property and "value" benefits for the West Maui region associated with the subject project

The purpose of this analysis is to delineate the direct and some indirect areas in which the proposed subject mixed-use residential development will potentially impact the sphere of public agency resources, and quantify (where possible) the costs of providing expanded services to the project, versus the economic benefits that accrue to the community through an increase in local and state tax payments.

For most developments, potential direct costs to governmental services and programs include:

-- Police Protection
-- Fire Protection
-- Public Oversight Agencies
-- Infrastructure Services
-- Recreational Demands
-- Educational Needs

-- Infrastructure Costs
-- Various Other Services and Financial Commitments

Many of these costs will not be increased on the state or county levels as a direct result of the proposed Pulelehua community. There will be limited, increased off-site recreational needs directly attributable to the subject development; the major off-site public infrastructure items (highway and primary water/sewer mains) are already in place; and it is unlikely the development will require specific public subsidies, welfare services, bonding or capital improvements.

Direct tax benefits to the state and county coffers will primarily flow from the project and its operation over time from three major sources:

-- Real Property Taxes
-- Gross Excise Tax Receipts
-- State Income Taxes

Some cost/benefit issues are considered as off-setting, or "a wash," as the cost of the services to the government is theoretically directly reimbursed in the form of user fees. Building permits and utility hook-up fees are two prime examples. Other such items include workers compensation premiums and benefits, utility operations and associated use billing rates, and business oversight/registration verses licensing fees. These secondary and/or indirect items are excluded from this study.

The pertinent results from our study are contained in this brief summary report. Supporting materials contributing to these conclusions are in the addenda or on file. The narrative presentation is divided into four concise sections:

1. **Estimated Public Costs Associated with the Pulelehua Community**

2. **Estimated Tax Revenues Associated with the Pulelehua Community**

3. **Secondary, Supplementary and Other Public-Related Benefits Provided by the Pulelehua Development**

4. **Correlation of Findings**

The primary source information for this report is our March 2005 report *Market Study and Economic Impact Analysis of the Proposed Pulelehua Community*, along with the materials cited therein. Additional source materials specific for this assignment were provided by Maui Land & Pineapple Company, Ltd., PBR Hawaii, Inc., and the County of Maui and State of Hawaii websites.

Estimated Public Costs Associated with the Pulelehua Community

A focal concern of this analysis is the integration of the subject project into the overall state and Maui governmental services plan on both an actual and pro rata perspective.

From an actual public service cost perspective to Maui and state agencies, the subject will represent only a fraction of the county and state residential plant and overall urban lands in use. Given the vast number of housing units, resorts, businesses, and agricultural lands on the island, it is difficult to assert that of themselves the subject residents and users will create the need for meaningful expansion of existing public services.

No new schools, parks, highways, recreational facilities, service agencies, hospitals, or other public enterprises will be required specifically because of this project. The impact on the total regional land base will be minimal. Public safety facilities in Lahaina are reasonably proximate, generally have the personnel and equipment to service the businesses and buildings in Pulelehua, and will expand with overall community growth over the next decade as the project is built.

However, the need for additional services is a cumulative effect, each project, each resident, tourist and, to a lesser degree, business adds a little bit to the community base until increased "need thresholds" are reached.

In regard to some services, the effective actual impact may not be apparent from a cost perspective, merely creating greater demands which can be readily met through existing agencies and facilities without the need for additional workers or funds. Our analysis of Maui County and state budgets indicate the actual effect of governmental services relating to the subject would not create the need to greatly expand county and state services in and of itself.

As an alternative to actual cost estimates, which are often disparate as they inherently cannot provide for unexpected and/or atypical items, it is most common to project public costs on a per capita allocation.

This approach is generally appropriate for residential developments, as public costs and services generally accrue to where a person lives (or in the case of a tourist, where they are lodging).

Government services are holistic in nature, providing a foundation throughout a community, regardless of actual, specific impact on any given land holding. A resort development or business may not have a need for parks or schools, but they are essential to the patrons and workers and create the climate in which the resort or business operates. Similarly, government administration, capital projects and public welfare items may have no direct relation to a particular project, but provide the economic underpinnings that enhances overall economic success.

In order to meaningfully quantify public costs that may be associated with the subject development, we have therefore looked at the issue from both perspectives, on an actual cost basis and on a per capita allocation basis. This exercise is detailed in addenda Exhibit I.

In order to quantify public costs on an actual basis we have estimated the number of responses, type and per incident expenses for emergency services (police, fire and EMS), the costs of providing public education for the project children, and made allocations for road and other public maintenance.

We estimate that the base "actual" cost to the County of Maui upon build-out of the Pulelehua Community will be approximately $992,000 per year. The increased stabilized operational costs to the State of Hawaii will be approximately $3.5 million annually.

To estimate the effective subject public costs on a per capita basis we have taken the forecast de facto population of the project (2,699 persons) and multiplied it by the current per capita cost of State and County government operations ($5,520 and $2,185 per person annually, respectively).

The total annual per capita cost to the County of Maui runs from $817,000 in development Year 4, when the first finished improvements are occupied, to a stabilized level of $5.8 million in

Year 10 and beyond. The total per capita costs to the State of Hawaii increase from $2.1 million in the first year of occupancy to $14.7 million

Estimated Tax Revenues Associated with the Pulelehua Community

The foundational tax revenues flowing from Pulelehua resident and business activities to State and County coffers will be primarily produced via three tax sources: County real property taxes, State income taxes and State general excise taxes. Our estimates for each of these items on a year-by-year basis from breaking ground until build-out and stabilization of the subject community are detailed in addenda Exhibit II.

The County of Maui will receive property taxes from the Pulelehua landowners. We estimate the total assessed value of the community land and improvements will be some $384.8 million upon completion. This figure assumes the affordable component will be aggressively maintained and be accorded commensurately below-market assessments as long as the units meet established pricing criteria. And, the number and amount of homeowner exemptions and rates is maximized.

The resulting property tax paid to the County will increase from $129,000 in Year 1 to $1.5 million annually at build-out and beyond. During the initial ten years of the project, real property taxes will total some $8.0 million.

If fully assessed at market rates for all components, the assessed value of the community real property assets would be more than $500 million and the real property taxes to the County would be circa $2.3 million per year.

State income taxes will be paid by the construction workers building the project, the contractor and supplier businesses supporting the effort during the development period, the operating tenant businesses in the commercial and mixed-use spaces and their employees, and by resident households of Pulelehua.

The income taxes paid to the State will increase from $507,000 in Year 1 to a maximum level of $5.8 million in Year 10, stabilizing at the latter figure. During the initial ten years of the development the total income taxes paid is forecast to total $26.8 million.

The State will also receive gross excise tax payments from the economic activity at Pulelehua. This includes the construction contracts, commercial/mixed-use business activity, and the purchases made by community households using available disposable income.

The excise taxes paid to the state will grow from $1.95 million per year during the initial construction phase (Years 1 through 3), increasing to a total of $6.9 million annually in Year 10 and beyond. The total received by the State from this tax revenue source during the first decade of project life will be $37.7 million.

Secondary, Supplementary and Other Public-Related Benefits Provided by the Pulelehua Development

In addition the base tax receipts provided by the primary tax sources for the State and County, the Pulelehua development will also provide substantial supplementary/additional direct economic benefits to the public asset base. Among the readily quantifiable are:

- The developer will donate a fully-serviced 13 acre school site to the State Department of Education. The developer estimates the market value of the building site at circa $15 per square foot, or a total value of some $8.5 million.
- The developer will donate finished neighborhood parks to the County. The 10 acres of sites, facilities and landscaping are estimated to have a value/cost of circa $9.0 million (assuming $15 per square foot for the sites and $2.5 million in finished improvements).
- Numerous other Pulelehua community facilities will be available to the general public, including neighborhood parks, walking trails, open/nature spaces, and civic areas of the project.
- Up to seven lots in the community will be set aside for eventual civic/public-oriented uses which may include governmental agencies, general and special services, youth and senior centers, and other non-market uses.
- Conceptual plans are being forwarded to possibly incorporate a full-service medical clinic (including 24 hour emergency care) into the community, which would serve all of West Maui.

TABLE 1

PUBLIC COST/BENEFIT SUMMARY TABLE
Public Costs/Benefits Assessment of the Proposed Pulelehua Community
Mahinahina, West Maui, Hawaii
In Constant Year 2005 Dollars

Development Year	1	2	3	4	5	6	7	8	9	10	Total Years 1 Through 10	Stabilized
PUBLIC BENEFITS (Revenues)												
1. REAL PROPERTY TAXES												
Cumulative Assessed Values (1) (2)												
Improvements				$33,878,712	$67,757,424	$101,636,136	$135,514,848 #	$169,393,560 #	$203,272,272 #	$241,990,800		$241,990,800
Land	$15,600,000	$15,600,000	$15,600,000	$142,785,000	$142,785,000	$142,785,000	$142,785,000	$142,785,000	$142,785,000	$142,785,000		$142,785,000
Total Assessed Value	$15,600,000	$15,600,000	$15,600,000	$176,663,712	$210,542,424	$244,421,136	$278,299,848	$312,178,560	$346,057,272	$384,775,800		$384,775,800
TOTAL REAL PROPERTY TAXES	**$129,480**	**$129,480**	**$129,480**	**$683,269**	**$816,353**	**$949,437**	**$1,082,522**	**$1,215,606**	**$1,348,690**	**$1,500,787**	**$7,985,104**	**$1,500,787**
2. STATE INCOME TAXES												
Taxable Personal Income	$7,101,621	$7,101,621	$7,101,621	$25,982,538	$36,757,210	$47,531,882	$58,306,555	$69,081,227	$79,855,899	$94,347,087	$433,167,263	$94,347,087
Taxable Corporate Profits	$4,761,900	$4,761,900	$4,761,900	$5,926,088	$7,215,718	$8,505,348	$9,794,978	$11,084,608	$12,374,237	$14,510,451	$83,697,128	$14,510,451
Personal Taxes Paid	$411,894	$411,894	$411,894	$1,506,987	$2,131,918	$2,756,849	$3,381,780	$4,006,711	$4,631,642	$5,472,131	$25,123,701	$5,472,131
Corporate Taxes Paid	$95,238	$95,238	$95,238	$118,522	$144,314	$170,107	$195,900	$221,692	$247,485	$290,209	$1,673,943	$290,209
TOTAL STATE INCOME TAXES	**$507,132**	**$507,132**	**$507,132**	**$1,625,509**	**$2,276,233**	**$2,926,956**	**$3,577,680**	**$4,228,403**	**$4,879,127**	**$5,762,340**	**$26,797,644**	**$5,762,340**
4. STATE GROSS EXCISE TAX												
Taxable Transactions												
Construction Contracts	$43,290,000	$43,290,000	$43,290,000	$33,117,560	$33,117,560	$33,117,560	$33,117,560	$33,117,560	$33,117,560	$37,848,640	$366,424,000	
Disposable Income Purchases	$3,550,811	$3,550,811	$3,550,811	$13,672,713	$19,741,493	$25,810,273	$31,879,054	$37,947,834	$44,016,614	$52,041,001	$235,761,414	$104,385,926
Commercial Activity				$10,705,142	$21,410,284	$32,115,426	$42,820,568	$53,525,710	$64,230,852	$76,465,300	$301,273,282	$76,465,300
Total Taxable Transactions	$46,840,811	$46,840,811	$46,840,811	$57,495,415	$74,269,337	$91,043,259	$107,817,182	$124,591,104	$141,365,026	$166,354,941	$903,458,696	$166,354,941
TOTAL STATE EXCISE TAX	**$1,951,388**	**$1,951,388**	**$1,951,388**	**$2,395,259**	**$3,094,061**	**$3,792,862**	**$4,491,664**	**$5,190,465**	**$5,889,267**	**$6,930,347**	**$37,638,089**	**$6,930,347**
TOTAL GROSS PUBLIC REVENUES												
To Maui County (Item #1)	$129,480	$129,480	$129,480	$683,269	$816,353	$949,437	$1,082,522	$1,215,606	$1,348,690	$1,500,787	$7,985,104	$1,500,787
To State (Items #2 , 3 & 4)	$2,458,520	$2,458,520	$2,458,520	$4,020,768	$5,370,293	$6,719,818	$8,069,344	$9,418,869	$10,768,394	$12,692,687	$64,435,733	$12,692,687
AGGREGATE TAX REVENUES	**$2,588,000**	**$2,588,000**	**$2,588,000**	**$4,704,037**	**$6,186,646**	**$7,669,256**	**$9,151,865**	**$10,634,475**	**$12,117,084**	**$14,193,474**	**$72,420,837**	**$14,193,474**
PUBLIC COSTS (Expenses)												
By Maui County				$816,623	$1,633,246	$2,449,868	$3,266,491	$4,083,114	$4,899,737	$5,833,020	$22,982,098	$5,833,020
By State of Hawaii				$2,063,151	$4,126,303	$6,189,454	$8,252,606	$10,315,757	$12,378,909	$14,736,796	$58,062,977	$14,736,796
TOTAL PUBLIC COSTS				**$2,879,774**	**$5,759,548**	**$8,639,323**	**$11,519,097**	**$14,398,871**	**$17,278,645**	**$20,569,816**	**$81,045,075**	**$20,569,816**
TOTAL NET PUBLIC BENEFITS												
To Maui County	$129,480	$129,480	$129,480	($133,354)	($816,893)	($1,500,431)	($2,183,969)	($2,867,508)	($3,551,046)	($4,332,233)	($14,996,994)	($4,332,233)
To State of Hawaii	$2,458,520	$2,458,520	$2,458,520	$1,957,616	$1,243,990	$530,364	($183,262)	($896,889)	($1,610,515)	($2,044,109)	$6,372,756	($2,044,109)
AGGREGATE NET BENEFITS	**$2,588,000**	**$2,588,000**	**$2,588,000**	**$1,824,262**	**$427,098**	**($970,067)**	**($2,367,232)**	**($3,764,396)**	**($5,161,561)**	**($6,376,342)**	**($8,624,238)**	**($6,376,342)**

(1) Assessed value for improvements are based on estimated total ("All In") construction cost plus 20% (profit/other).

(2) Current land value estimated at $50,000 per acre. After development, apartment land at $50,000 per unit, townhouse/flats at $100,000 per unit, cottages/single family homes at $200,000 per unit, and mixed-use sites at $25 per square foot.

Source: The Hallstrom Group, Inc.

Such a facility, in addition to providing needed care for regional residents, would be a unifying, focal presence for medical services in the area and a major economic engine.

- By pricing 51 percent of the housing units at affordable levels, as opposed to market rates, an estimated $35.4 million (minimum) in real property equity built by the developer will be transferred to the qualified resident purchasers. This figure is based on the conservative assumption that the "affordable" units will be priced at 33 percent less than for a comparable "market" unit, and the "gap group" units 15 percent less.

- The developer will make a $40.6 million long-term capital commitment to the West Maui residential inventory by building and operating a 125 unit rental apartment.

Correlation of Findings

Our "most appropriate" public cost/benefit assessment model is displayed on Table 1, depicting the correlation of public service costs with the anticipated tax revenue benefits. The model is based on the "per capita" basis, the more conservative, if comprehensive, perspective.

Table 2 summarizes and compares our costs/benefits findings on both an actual cost and per capita allowance basis for a stabilized Pulelehua community following build-out.

As can be seen, on an actual basis the annualized State and County base additional operating costs resulting from the subject development are less than the anticipated primary tax revenues. The State of Hawaii will enjoy a yearly net revenue benefit of $9.2 million and the County of Maui $509,000.

From a per capita viewpoint, the State will experience a net operating surplus relative to Pulelehua of $6.4 million during the initial ten year development and use projection period, followed by a stabilized operating loss of $2.0 million per year after build-out. The County of Maui will experience a net operating loss in regard to the subject of $15.0 million during the first decade, and at $4.3 million per year thereafter. However, the County margins could readily improve beyond this level if real property tax assessments are pushed to their

maximum level for the market properties and minimal regard is given to maintaining lower taxes on affordable housing units.

Such net operating losses are typical for governmental agencies in regard to a local resident-oriented housing community when viewed on a per capita basis. This is particularly true for a project with a large affordable unit component and limited (or non-exploitive) commercial uses. It is a result of the axiom that "businesses pay taxes while residents require services."

Should a medical clinic be included in the development, as is presently being considered, the net costs/benefits ratios could change meaningfully towards the positive for the State (primarily) and the County (lesser so) due to the sharp increase in economic activity associated with major medical facility.

Exhibit I -- Quantification of Public Costs

Actual Costs

Maui County will directly incur several areas of actual, additional cost increases as a result of the Pulelehua community, primarily in regards to emergency services. Based on analysis of response frequencies, time/cost data, and past discussions with affected agencies, we have made general allowances for these items as summarized below.

Police/Enforcement -- The Maui County police department made 193,486 total responses in 2003, resulting in a total budget requirement of $32,158,001. The average cost per response was at $166 and the cost per capita of de facto population (175,000 persons) was $183.76.

Application of this per capita estimate to the subject de facto population (2,669 persons) results in a projected additional police program cost to the county of about $490,000 per year in 2005 dollars. As a residentially oriented, non-tourist, limited commercial community, it is expected cost rates would be about average.

This figure is supported by projections of subject-specific responses based on typical allowances made in the budgeting process. Using a base cost of $140 per hour for a responding officer (wages and benefits for responding/support/administrative personnel, overhead, capital costs, and amortized equipment), we estimate the annual additional police/enforcement cost to Maui County on a stabilized basis after project build-out will be about $443,520.

TABLE 2

SUMMARY OF ANNUAL PRIMARY GOVERNMENTAL TAX RECEIPTS AND PUBLIC SERVICE COSTS
Public Costs/Benefits Assessment of the Proposed Pulelehua Community
Mahinahina, West Maui, Hawaii
In Constant Year 2005 Dollars

	State of Hawaii					
	Actual Cost Comparison			Per Capita Allocation Comparison		
On Stabilized Basis At Build-Out	Receipts	Costs	Net Benefits or (Costs)	Receipts	Costs	Net Benefits or (Costs)
Amount per Year	$12,692,687	($3,488,000)	$9,204,687	$12,692,687	($14,736,796)	($2,044,109)

	Maui County					
	Actual Cost Comparison			Per Capita Allocation Comparison		
On Stabilized Basis At Build-Out	Receipts	Costs	Net Benefits or (Costs)	Receipts	Costs	Net Benefits or (Costs)
Amount per Year	$1,500,787	($992,000)	$508,787	$1,500,787	($5,833,020)	($4,332,233)

Source: The Hallstrom Group, Inc.

This is comprised of:

- Twelve miscellaneous calls per week at an average of two total officer hours each. (2 hrs. x $140/hr. x 12 x 52 = $174,720)
- Twelve "minor" incidents/traffic accidents each month requiring on average five hours of officer time. (5 hrs. x $140 x 12 x 12 = $100,800)
- Five "major" incident/traffic accidents each month requiring on average of 20 hours of officer time. (20 hrs. x $140 x 5 x 12 = $168,000)

This demand of 3,168 hours is the equivalent to 1.58 new officer positions (2,000 total hours).

Fire Protection -- Overall, Maui County fire control and emergency serviced some 4,285 responses in 2003, with a commensurate budget demand of $17,116,382. This equates to $3,994.49 per response or $97.81 per year for each person of countywide de facto population.

Application of this figure to the subject population results in an actual additional cost to the county of $261,000 annually resulting from Pulelehua.

Again, these figures can be supported by estimating specific subject direct response needs. Our forecasts are based on a crew cost of $800/hour (four to five firemen, wages, benefits, overhead and amortized equipment). Using this method, we estimate that at build-out, the yearly additional costs to Maui County resulting from the Pulelehua community is $326,400 per year.

This is comprised of:

- Six "minor" fire/rescue event per month requiring one crew for a total of three hours (response and/or clean-up). (3 hrs. x $800/hr. x 6 x 12 = $172,800)
- One "major" fire/rescue event every month requiring two crews for a total of eight hours each. (2 crews x 8 hrs. x $800/hr. x 12 = $153,600)

Emergency Medical Response -- This is based on average cost per response of $500, with an average of 12 calls per month. The total cost to the county would be $72,000 per year on a stabilized basis after build-out. ($500/response x 12 per month x 12 = $72,000)

Maintenance -- An allowance of $150,000 per year was made for this item, which includes public roads and dedicated park maintenance.

The total annual "actual" cost to the county on a stabilized basis at build out of the subject development is estimated at $992,000. This cost would be reached on an escalating basis over time, beginning in year 3 and increasing as the club is finished and populated.

State of Hawaii costs would include highway frontage work, health inspections of food service establishments and other minor oversight duties. An allowance of $200,000 per year was made for these items, increasing to the stabilized level as the community is built out.

It is estimated that 411 children from Pulelehua will attend public schools on a stabilized basis. The cost per student in public schools statewide is presently at about $7,500 per year. We have used a stabilized allowance of $8,000 per potential student, or $3,288,000 in maximum student costs to the state each year.

The total new/additional direct state costs on an "actual" stabilized basis as a result of Pulelehua would be about $3.5 million annually.

Per Capita Costs

An alternative method for determining public costs is through per capita expenditures incurred by the State of Hawaii and Maui County in accordance with the de facto population area of the jurisdiction. This is founded on the principal that each individual on the island equitably benefits from all governmental costs, regardless of type or focus throughout the day, with each new member of the community (whether resident or visitor) creating a proportionate new cost burden in their daily home and working life.

As previously noted, this is the standard method for resort and residential application as most costs are viewed as accruing to the housing or lodging aspects of a persons lifestyle and land use. We have included it as a means of demonstrating the overall public fiscal impact potential of the proposed subject project even when viewed from this maximum potential cost perspective. We consider this

approach as setting the absolute upper limit on all public costs (actual, indirect and inferred).

According to the state Department of Budget and Finance database, the state expects to spend a total of $8.0 billion on services, salaries, infrastructure, and financing in fiscal 2005. The total de facto population in the state on an average daily basis at year-end 2004 was about 1,450,000 persons, including residents, tourists, and military personnel.

The per capita expenditure by the state will thus be about $5,520 for 2005, a nominal increase from 2004. From 1979 through 2004, state government expenditures increased at a rate of just under five percent annually compounded.

The stabilized average de facto population on-site at the subject at build-out will be 2,669 persons, a figure reached in year 7 of the development model. Using the allocated state cost per de facto "resident" of $5,520 per year, the total annual "costs" to the state purse at stabilization by the project using the per capita allowance method would be $14.73 million in constant year 2005 dollars.

Analyzed on a similar basis, Maui County's budget for the local government in fiscal year 2005 is $393,312,908, which represents an escalation over time of more than four percent compounded annually since 1995.

The current de facto population in Maui County is some 180,000 persons. The resulting de facto per capita county expenditure for this year is therefore anticipated to be $2,185.

Application of this figure to the total on-site de facto population at Pulelehua at build out would be about $5.83 million annually in costs to the county government on a stabilized basis (2,669 de facto residents x $2,185).

Total Public Costs -- On a per capita allowance cost basis, the state and county expenses associated with the subject development would range from $2.9 million in year 4 of the project (the first year of unit occupancy) to a stabilized maximum of $20.6 million at build-out in year 6 and beyond in year 2003 dollars.

On an actual cost basis, which we acknowledge may be an atypical perspective and a minimized accounting of direct expenditures, the total governmental costs at build-out to the state and county would be $4.49 million annually.

Exhibit II -- Quantification of Primary Public Benefits

Local public revenues will be produced via the Pulelehua development and its long-term use. While there are a variety of direct and indirect, apparent and implied tax implications associated with residential and commercial activities, there are three primary avenues of tax payments typical of a community like the subject.

These taxes are discussed following. We note, as we are focusing on only major, substantial levys, our estimates are inherently understated.

Real Property Taxes -- Property taxes paid by landowners in the subject project were calculated using the 2005 tax rates for both land and buildings, improved or unimproved.

The assessed values for the improvements were based upon the direct costs provided by the development team, plus an allowance of 20 percent for indirect, financing, profits and other costs which would inure to the structures. This insures the assessments do not exceed affordability pricing parameters, but may understate the true long-term assessments for some of the market units.[2] The total estimated assessed values of the finished residential, commercial and mixed-use facilities upon completion is $348.8 million.

The current assessed values for the land component was estimated at $15.6 million for the site in its pre-subject developed state during years 1 through 3 of our model. This equates to an underlying assessed land value equal to $50,000 per acre.

It was assumed the land would be assessed under a variety of residential and commercial/mixed-use types, with the commercial components assessed at a rate of $5.86 per $1,000 of value.

[2] It is assumed the affordable-priced units will be assessed at levels commensurate with their trading price, which are estimated to be less than market values by 15 to 35-plus percent. Higher, market-oriented assessments will yield higher property tax revenues.

The residential components will be extensively comprised of homeowners who receive special tax rates. Based on the assumption that some 96 percent of the units will be owners receiving the exemption, the effective tax rates would be $3.59 per $1,000 in value.

All real property value of the subject holding is assumed to be vested in the completed "salable" and operating components, with no assessment placed against open spaces, roads, or other systems.

The total real property tax to be paid to Maui County in 2005 dollars ranges from $129,500 in year 1 of development, to a stabilized level of $1.5 million at build-out in year 10 and beyond. The aggregate real property taxes paid over the 10-year study time-frame will be $8.0 million.

State Income Tax -- The state will receive income taxes from four sources:

- the wages of the workers associated with the construction and maintenance of the Pulelehua components;
- the employees of the on-site commercial and mixed-use businesses;
- the household incomes of full-time residents in the community; and
- the corporate profits from contractors and suppliers serving the construction phase of the development, and as generated by on-going operations.

According to DBEDT data, individual State of Hawaii income tax liability as a ratio to gross income has ranged from 5.5 to 5.9 percent during the past decade, with the more current figures tending toward the mid to upper-end of the range. We have employed an effective tax rate of 5.80 percent of gross income for individual workers and full-time residents.

The effective tax rate for the corporate income is estimated at 2.00 percent of gross operating profits, based on available DBEDT statistics.

The total income tax revenues to be received by the state are projected at $507,132 in the first year of construction increasing to a maximum level at year 10 of $5.8 million annually in constant 2005 dollars.

On a stabilized basis, after build-out, the permanent on-site business employees, off-site workers, full-time project residents, and subject operating businesses, would pay an annual state income tax of $5.8 million. Over the 10-year modeling period, the cumulative income taxes paid are estimated at $26.8 million.

We have not included any corporate income or other taxes which will be paid by the developers as a result of their profits from undertaking the subject development, or from the secondary jobs created by the discretionary spending of workers and businesses. Such items have the potential to be substantial contributions to the state coffers.

State Gross Excise Tax -- This 4.166 percent of expenditures tax was applied against:

- the total estimated construction contract costs;
- the total gross sales of on-site commercial and mixed-use business operations; and
- the discretionary expenditures of the de facto resident and worker populations of the subject.

The anticipated state excise tax receipts arising from the subject development grow from an estimated $1.95 million in the first year of development to a peak of $6.9 million. Over the 10-year study period, the receipts total $37.7 million and stabilize at circa $6.9 million per year.

We have not included any excise tax revenues associated with the direct, local "multiplier effect" expenditures on Maui, or those created in the secondary market by the suppliers to the operating businesses or secondary worker expenditures.

Total Public Benefits (Revenues) -- In constant 2005 dollars, the aggregate annual tax revenues flowing from the subject development at full project build-out range from:

- $129,500 to $1,500,000 per year for Maui County, stabilizing over time at the higher figure, totaling $8.0 million over the 10-year development projection model;
- $2.5 million to $12.7 million annually for the State of Hawaii, stabilizing at $12.7 per year, and cumulatively at $64.4 million over the 10-year forecast period; and
- $2.6 to $14.2 million per year for total tax receipts (county and state), totaling $72.4 million for the initial 10 years of the Pulelehua community, and stabilizing at $14.2 million per year.

CERTIFICATION

The undersigned do hereby certify that, to the best of our knowledge and belief, the statements of fact contained in this report are true and correct. It is further certified that the reported analyses, opinions, and conclusions are limited only by the reported assumptions and limiting conditions, and are our personal, impartial, and unbiased professional analyses, opinions, and conclusions. We further certify that we have no present or prospective interest in the property that is the subject of this report, and have no personal interest with respect to the parties involved. We have no bias with respect to the property that is the subject of this report or the parties involved with this assignment. Our engagement in this assignment was not contingent upon developing or reporting predetermined results. Our compensation for completing this assignment is not contingent upon the development or reporting of a predetermined value or direction in value that favors the cause of the client, the amount of the value opinion, the attainment of a stipulated result, or the occurrence of a subsequent event directly related to the intended use of this appraisal. The appraisal analyses, opinions, and conclusions were developed, and this report has been prepared, in conformity with the requirements of the Code of Professional Ethics and Standards of Professional Appraisal Practice of the Appraisal Institute, and the Uniform Standards of Professional Appraisal Practice. The use of this report is subject to the requirements of the Appraisal Institute relating to review by duly authorized representatives. The undersigned certify that they have made personal inspections of the property that is the subject of this report. No other

persons provided significant real property appraisal assistance other than the undersigned.

The Appraisal Institute conducts programs of continuing education for their designated members. As of the date of this report, James E. Hallstrom, Jr. has completed the requirements of the continuing education program of the Appraisal Institute.

James E. Hallstrom, Jr., MAI, CRE
Hawaii State Certified
General Appraiser, CGA-178
Exp. Date December 31, 2005

Tom W. Holliday

/as

4521BR01

THE HALLSTROM GROUP INC.
REAL ESTATE
CONSULTANTS
& APPRAISERS

PROFESSIONAL BACKGROUND AND SERVICES

The Hallstrom Group, Inc. is a Honolulu based independent professional organization that provides a wide scope of real estate consulting services throughout the State of Hawaii with particular emphasis on valuation studies. The purpose of the firm is to assist clients in formulating realistic real estate decisions. It provides solutions to complex issues by delivering thoroughly researched, objective analyses in a timely manner. Focusing on specific client problems and needs, and employing a broad range of tools including after-tax cash flow simulations and feasibility analyses, the firm minimizes the financial risks inherent in the real estate decision making process.

The principals and associates of the firm have been professionally trained, are experienced in Hawaiian real estate, and are actively associated with the Appraisal Institute and the Counselors of Real Estate, nationally recognized real estate appraisal and counseling organizations.

The real estate appraisals prepared by The Hallstrom Group accomplish a variety of needs and function to provide professional value opinions for such purposes as mortgage loans, investment decisions, lease negotiations and arbitrations, condemnations, assessment appeals, and the formation of policy decisions. Valuation assignments cover a spectrum of property types including existing and proposed resort and residential developments, industrial properties, high-rise office buildings and condominiums, shopping centers, subdivisions, apartments, residential leased fee conversions, special purpose properties, and vacant acreage, as well as property assemblages and portfolio reviews.

Market studies are research-intensive, analytical tools oriented to provide insight into investment opportunities and development challenges, and range in focus from highest and best use determinations for a specific site or improved property, to an evaluation of multiple (present and future) demand and supply characteristics for long-term, mixed-use projects. Market studies are commissioned for a variety of purposes where timely market information, insightful trends analyses, and perceptive conceptual conclusions or recommendations are critical. Uses include the formation of development strategies, bases for capital commitment decisions, evidence of appropriateness for state and county land use classification petitions, fiscal and social impact evaluations, and the identification of alternative economic use/conversion opportunities.

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PROFESSIONAL QUALIFICATIONS OF JAMES E. HALLSTROM, JR., MAI, CRE

Business Background

President	The Hallstrom Group, Inc. Honolulu, Hawaii (1980 - Present)
Former Senior Vice President and Treasurer	Hastings, Martin, Hallstrom and Chew, Ltd., Honolulu, Hawaii (1972-1980)
Former Real Property Appraiser and Analyst	Administration, Inc., a subsidiary of C. Brewer and Company, Limited Honolulu, Hawaii (1971-1972)
Former Senior Real Property Appraiser and Analyst	Opitz Realty, Madison, Wisconsin (1969-1971)

National Designations and Memberships

- CRE Designation (1998) - The Counselors of Real Estate
- MAI Designation (1976) - American Institute of Real Estate Appraisers
- SRPA Designation (1975) - Society of Real Estate Appraisers

The American Institute of Real Estate Appraisers (AIREA) and the Society of Real Estate Appraisers (SREA) consolidated in 1991, forming the Appraisal Institute (AI).

Education

- M.S. (Real Estate Appraisal and Investment Analysis) 1971, University of Wisconsin at Madison
- B.A. (Economics) 1969, Brigham Young University at Provo
- Additional numerous specialized real estate studies in connection with qualifying for national professional designations, and uninterrupted Continuing Education.
- Completed Continuing Education requirements with the Appraisal Institute through 2004.

Professional Involvement

- Former President and Officer for Hawaii AIREA and SREA Chapters
- Instructor for Society of Real Estate Appraisers Course 101, "Introduction to Appraising Real Property" and Course 201, "Principles of Income Property Appraising"
- Contributing author to the "Hawaii Real Estate Investor"
- Lecturer at many professional seminars and clinics.
- Appointed numerous times as an Arbitrator and Mediator.

Qualified Expert Witness

Federal and State Courts
State Land Use and County Hearings
Arbitration Proceedings

State of Hawaii Certification

Certified General Appraiser, License Number CGA-178, Exp. Date December 31, 2005

Community Service

Active registered member of the Boy Scouts of America; former Director of Le Jardin Academy; former Advisory Board Member of the School of Business, Brigham Young University, Hawaii Campus; Director of Hawaii Reserves, Inc.

PROFESSIONAL QUALIFICATIONS OF THOMAS W. HOLLIDAY

Business Background

Supervisor/ Senior Analyst	The Hallstrom Group, Inc. Honolulu, Hawaii
Former Staff Appraiser	Davis-Baker Appraisal Co. Avalon, Santa Catalina Island, California

Education

- B.A. (Communications/Journalism) 1978 California State University at Fullerton
- SREA Course 201- Principles of Income Property Appraising
- Expert witness testimony before State of Hawaii Land Use Commission and various state and county boards and agencies since 1983.
- Numerous professional seminars and clinics
- Contributing author to Hawaii Real Estate Investor, Honolulu Star Bulletin

On January 1, 1991, the American Institute of Real Estate Appraisers (AIREA) and the Society of Real Estate Appraisers (SREA) consolidated, forming the Appraisal Institute (AI).

Recent Maui Assignments (since 2000)

- Market Study, Economic Impact Analyses and Public Costs/Benefits Assessments
  - -- Wailea Ranch (Master Planned Community)
  - -- Palauea Bay (Resort/Residential)
  - -- Upcountry Town Center (Mixed-Use Planned Development)
  - -- Maui Lani (Residential and Industrial Components of Master Planned Community)
  - -- Maui Business Park, Phase II (Industrial/Commercial)
  - -- Four Seasons Private Estates and Residences Club (Resort/Residential)
  - -- Kualono Subdivision (Residential)
  - -- Kapalua Mauka (Master Planned Community)
  - -- Hailiimailii (Commercial)
- Major Valuation Assignments
  - -- Sheraton Maui Hotel
  - -- Outrigger Wailea Resort Hotel
  - -- Maui Lu Hotel
  - -- Coconut Grove Condominiums
  - -- Palauea Bay Holdings
  - -- Wailea Ranch
  - -- Maui Coast Hotel
  - -- Westin Maui Hotel
  - -- Maui Marriott Hotel
  - -- Waihee Beach

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Preliminary Engineering Report

PRELIMINARY ENGINEERING REPORT

FOR

PULELEHUA

Lahaina, Maui, Hawaii

T.M.K.: (2) 4-3-001: por. of 031

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February 2005

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PRELIMINARY ENGINEERING REPORT
FOR
PULELEHUA
T.M.K.: (2) 4-3-001: por. of 031

1.0 INTRODUCTION

The purpose of this report is to provide information on the existing infrastructure which will be servicing Pulelehua. It will also evaluate the adequacy of the existing infrastructure and anticipated improvements which may be required.

The subject property is identified as T.M.K.: (2) 4-3-001: por. of 031 and contains an area of approximately 312.8 acres. The current development plan includes approximately 104.5 acres of developed area, 13.3 acres for a school, useable open space of 91.4 acres, gulch area of 33.1 acres, and street rights-of-ways of 70.5 acres. The proposed Pulelehua development plan includes 882 residential units, 318 potential ohana units, a maximum of 21,475 square feet of retail space, 75,000 square feet in specialty retail/office space, and 78,000 square feet of workplace edge. The workplace edge allows for uses in the neighborhood such as woodworking shops, offices, and storage facilities.

The project site is bordered by the Kahana Hui Subdivision, Kahana Ridge Subdivision, and Kahanaiki Gulch to the north; the Kapalua West Maui Airport and agricultural lands to the east, agricultural lands to the south, and Honoapi'ilani Highway to the west.

2.0 EXISTING INFRASTRUCTURE

2.1 ROADWAYS

Honoapi'ilani Highway is the major roadway which links Central and South Maui to West Maui. In the vicinity of the project site, it links the Lahaina area with Kapalua. It is a State-owned four lane roadway between Lahainaluna Road and the intersection of Honoapi'ilani Highway and Lower Honoapi'ilani Road. The remainder of the highway is a two lane roadway. In the vicinity of the Pulelehua site, Honoapi'ilani Highway is signalized at its intersections with Lower Honoapi'ilani Road, Akahele Street, and Hoohui Road.

Lower Honoapi'ilani Road is a two-lane roadway parallel to Honoapi'ilani Highway which runs along the coastline. It serves most of the residential and business communities west of Honoapi'ilani Highway.

Akahele Street and Hoohui Road are the two east-west roadways which connect Lower Honoapi'ilani Road to Honoapi'ilani Highway. Akahele Street also extends approximately 2,000 feet to the east of Honoapi'ilani Highway to the Kapalua West Maui Airport.

Access to Pulelehua will be from the Highway.

2.2 DRAINAGE

The elevation on the site ranges from 270 feet at the northeast corner of the site to 65 feet at Honoapi'ilani Highway, with a slope averaging approximately 8.0 percent. According to Panel No. 150003 0151B of the Flood Insurance Rate Maps, dated June 1, 1981, the Pulelehua site is situated in Flood Zone C, which is designated as an area of minimal flooding.

There are three drainageways which traverse through or bound the Pulelehua site. To the north, Kahanaiki Gulch traverses along the northern boundary of the Pulelehua site. It joins Kahana Stream before it crosses Honoapi'ilani Highway. Pohakukaanapali gulch traverses approximately midway through the site. Drainage from the upper limits of this gulch is intercepted by the Kapalua West Maui Airport. Mahinahina Gulch traverses through the Pulelehua site approximately 1,000 feet from the southern boundary.

The existing drainage pattern from the Pulelehua site is generally in the east to west direction toward Honoapi'ilani Highway. There are three existing drainage basins within or adjacent to the site which collect runoff and remove silt and debris, before the runoff discharges into the ocean. These basins include the Kahana Basin, which is located immediately to the north of the Pulelehua site. Two smaller detention basins are located to the north and south of the intersection of Akahele Street and Honoapi'ilani Highway. The Mahinahina Basin is located at the southwest corner of the site.

As part of the Kahana Ridge Subdivision, a drainage system consisting of culverts and open channels were constructed along the eastern boundary of the subdivision. The northerly 80 percent of the drainage system conveys the intercepted runoff into Kahananui Gulch. The remaining 20 percent is conveyed into the subdivisions drainage system.

According to the *Hydrology Report for Honoapi'ilani Highway (Honokowai to Kahana) F.A. Project No. RF-030-1 (7) and Kahana to Alaeloa F.A. Project No. RF-030-1 (13) Island of Maui*, prepared by Hydraulic Design Section, October 1975, there are two 144-inch culverts at Honoapi'ilani Highway with its crossing

with Mahinahina Gulch, which was designed to accommodate a 100-year flow of 4,275 cfs. A 120-inch culvert diverts runoff from Pohakukaanapali Gulch under Honoapi'ilani Highway with a 100-year design flow of 674 cfs. A bridge (Kahana Kai Bridge) along Honoapi'ilani Highway diverts the 100-year discharge of 7,540 cfs from the combined flows from Kahanaiki Stream and Kahana Stream. Runoff from all three drainageways eventually discharges into the ocean.

It is estimated that the present 50-year, 1-hour runoff from the Pulelehua site is 333.2 cfs. Of this total flow, approximately 51.1 cfs sheet flows toward the mauka boundary of the Kahana Ridge Subdivision. The drainage system installed as part of the Kahana Ridge Subdivision intercepts the runoff and conveys approximately 80 percent into Kahanaiki Gulch and the remaining 20 percent is conveyed into the subdivision's drainage system. Approximately 19.2 cfs sheet flows through the Kahana Hui Subdivision, approximately 68.1 cfs sheet flows into Pohakukaanapali Gulch and 77.7 cfs sheet flows into Mahinahina Gulch. It is estimated that 117.1 cfs sheet flows from the project site onto Honoapi'ilani Highway.

2.3 SEWER

All of the existing County wastewater facilities in the vicinity of the Pulelehua site are located along Lower Honoapi'ilani Road. These facilities include gravity sewer lines, sewer force mains and sewer pump stations. In addition to the County sewer system, there is a private wastewater collection for the Kahana Ridge subdivision, which is located to the north of the project site. The Kahana Ridge wastewater system connects to the County's sewer system at Hoohui Road. All sewerage from the area is transported to the Lahaina Wastewater Reclamation Plant in Honokowai. It is located approximately 3,500 feet south from the southern boundary of the project site.

The wastewater system for the Kahana Ridge Subdivision is privately owned and maintained. A series of sewer mains and a sewer pump station collects the wastewater generated from the subdivision and conveys it to an 8-inch sewerline on the east side of the Hoohui Road-Honoapi'ilani Highway intersection. The sewerline continues down Hoohui Road to a 21-inch sewerline at Lower Honoapi'ilani Road.

According to the Wastewater Reclamation Division, County of Maui, the Lahaina Wastewater Reclamation Plant has a design capacity of 9 million gallons per day (mgd). Currently, it is processing approximately an average daily flow of

4 mgd of sewerage. Of the remaining capacity, approximately 1.38 mgd is allocated to AMFAC, 1.80 mgd is allocated to the Housing Finance Development Corporation and 303,350 gpd is allocated to Kapalua Land Company, Ltd. including purchasable capacity.. The County has retained the services of a consultant to do a dynamic study of the existing wastewater facilities. However, it is estimated that the study will take 12 months to complete.

The existing wastewater facilities along Lower Honoapi'ilani Road were not designed to accommodate sewage flows from development mauka of Honoapi'ilani Highway.

2.4 WATER

There are two existing water sources which serve the area. The first is surface water from the Honokohau Ditch which collects water from Honokohau Stream and Honolua Stream. The surface water from the Honokohau Ditch is then diverted to the Mahinahina Water Treatment Plant which was designed to process 2.5 mgd. Presently, the treatment plant is processing an average of approximately 2.4 mgd. The second source is groundwater from the Honokahua wells and Napili wells. The capacities of the wells are 700 gpm from Honokahua Well A, 1,250 gpm from Honokahua Well B, 700 gpm from Napili Well A, 700 gpm from Napili Well B, and 1,000 gpm from Napili Well C. According to the Department of Water Supply, Honokahua Well A, Napili Well A, and Napili Well C are currently not in use. All wells are owned and operated by the Department of Water Supply, County of Maui.

The storage for the area is the existing 2.0 million gallon Honokowai reservoir and the 1.0 million gallon Kahana Ridge reservoir. The 2.0 million gallon reservoir is located at an elevation of 250 feet approximately 1,000 feet south of the southern boundary of the Pulelehua site. The 1.0 million gallon reservoir is also located at an elevation of 250 feet approximately 3,000 feet to the north of the site. Both reservoirs are owned and operated by the Department of Water Supply, County of Maui.

The 2.0 million gallon reservoir is filled from the Mahinahina Water Treatment Plant. The 1.0 million gallon reservoir is filled from the Honokahua and Napili wells. There is a 16-inch waterline which was constructed along Honoapi'ilani Highway from the Maui Land & Pine baseyard area to the Kahana Ridge subdivision from the 1.0 million gallon reservoir. There are no other waterlines along Honoapi'ilani Highway in the vicinity of the Pulelehua site.

2.5 ELECTRIC, TELEPHONE AND CABLE TV

There are existing overhead electrical and telephone facilities along the mauka side of Honoapi'ilani Highway and along Lower Honoapi'ilani Road. Maui Electric Company also has an electric substation above the Kapalua West Maui Airport.

3.0 ANTICIPATED INFRASTRUCTURE IMPROVEMENTS

3.1 ROADWAYS

Both pedestrian and vehicular circulation are important components of Pulelehua. The interior streets will be designed for lower vehicle speeds and pedestrians by utilizing narrow travel lanes, sidewalks, street trees, and buildings located close to the street using Traditional Neighborhood Design (TND) principles. The developer will work with the Department of Public Works and Environmental Management during the plan review process. Five connection points to Honoapi'ilani Highway are being proposed, including Akahele Street, which will allow a series of options to enter and exit the proposed development. A roundabout may be proposed at the intersection of Akahele Street and Honoapi'ilani Highway in the future but is not part of the current plan. The developer is working with the State Department of Transportation to implement a proper design at this and all intersections at Honoapi'ilani Highway.

All street section diagrams are attached as Exhibit 5. The Main Streets will have a 64-foot right-of-way, two 10 foot travel lanes, 7 feet parallel parking on both sides of the street, 6 foot planters on both sides, and a 9-foot sidewalk area on both sides. Avenues will have a 60-foot right-of-way, two 10 foot travel lanes, a 14 feet planting median in the center of the roadway, 7 foot planters on both sides, and a 6-foot sidewalk area on both sides. Streets will have a 44-foot right-of-way, two 9 foot travel lanes, 7 feet planting/parking strips on both sides, and 6 foot sidewalk areas on both sides. One type of Green Street will have a 35-foot right-of-way, two 10 foot travel lanes, a 7-foot planting/parking strip on one side with an adjacent 8-foot sidewalk area. It is proposed that the opposite end of the Green Street have a variable width green space. Another type of Green Street will have a variable open space within the center of the roadway,10 foot travel lanes, 7 feet planting /parking on both sides, and an 8-foot sidewalk area on both sides of the Green Street. A Drive will have a two 8-foot green swale on one side of the roadway, two 8 foot travel lanes, 7 feet on-street parking, 8 feet planting strip, and a 6-foot sidewalk area on one side. A Road will have a 50-foot right-of-

way, two 10 foot travel lanes, and 15 foot green swales on both sides. Alleys will have a 20-foot travel lane. Rear Lanes will have a 20 feet right-of-way with 10 feet of pavement and 5 feet swales on both sides.

Trails, which will be used for walking and biking will have a 16-foot right-of-way, 8 to 10 feet of pavement, and 4 foot swales on both ends. Paths that will be used for walking will have a 14-foot right-of-way with a 6 feet paved path and 4 foot swales on both sides. Pedestrian Streets will have a 30-foot right-of-way will have 16 feet of walkable area with planter boxes located throughout, and a 7-foot swale area on both sides.

A roadway is proposed along the northern boundary of the Kahana Ridge subdivision which will connect the Pulelehua community with lands owned by Maui Land and Pineapple Company (ML&P) to the north. It will traverse to the south of the existing earth dam near the Kahana Stream-Kahanaiki Stream intersection and connect to the existing bridge immediately east of Honoapi'ilani Highway. The bridge was built by the State for ML&P when an existing bridge was demolished for the construction of Honoapi'ilani Highway. Said roadway will connect to Honoapi'ilani Highway. Eventally this roadway will also provide connectivity with other properties without creating a need to enter onto Honoapi'ilani Highway.

All roadway crossings with major gulches such as Kahanaiki Gulch and Mahinahina Gulch will be designed with drainage improvements. Said improvements will be designed to accommodate runoff from a 100-year storm.

The Traffic Impact Report for Pulelehua, prepared by Hall Planning and Engineering, Inc., concluded the following:

> The traffic analysis indicates that the peak hour traffic will continue to operate at acceptable levels of service, as long as the following improvements are made:
>
> - Maui Land & Pineapple Company will add four additional, well-spaced intersections along Honoapi'ilani Highway to adequately distribute in and outbound trips. These intersections are in the Pulelehua plan and vital to proper operation of both the traditional town street system and Honoapi'ilani Highway.

- The existing intersection at Honoapi'ilani Highway and Akahele Street is recommended as either a double-lane roundabout or a standard signalized intersection. The roundabout is more pedestrian-friendly and would provide greater walkability in the area.

- If PM traffic reaches projected levels, the intersection of Lower Honoapi'ilani Road will require an added left turn lane on the south approach. To receive the two lanes of turning traffic, an additional lane would be needed on the west leg.

The Pulelehua community will change area traffic flow. However, estimates of future effects indicate the community will not create adverse traffic conditions. To the contrary, the walkable community design pattern established for Pulelehua will encourage walking, biking and transit as supporting modes of travel. This increase in travel choices will increase overall mobility in this sector of West Maui.

3.2 DRAINAGE

The post development runoff from the Pulelehua site is estimated to be 878.0 cfs, an increase of 544.8 cfs over existing conditions. Onsite runoff will be collected by catch basins located at appropriate intervals along the community roadways and diverted by drainlines to onsite detention basins. The detention basins will be located within the proposed greenway mauka of Honoapi'ilani Highway and sized to accommodate the increase in runoff from Pulelehua. The greenway will be approximately 150 feet wide and serve as a landscape buffer as well as a detention basin area to mitigate the increase in runoff from the Pulelehua site. Additional detention basins can also be constructed in park and open space areas if necessary.

Offsite detention basins will be constructed mauka of the Kapalua Airport to reduce the offsite runoff onto the Pulelehua site.

No additional runoff will be released into the existing drainageways or onto Honoapi'ilani Highway. The net result of the proposed drainage improvements will be no increase in runoff from the Pulelehua site to the downstream properties. Exhibit 1 contains the drainage plan.

3.3 SEWER

The build out of Pulelehua consists of 13.3 acres of school (estimated enrollment of 650 elementary school students), 21,475 square feet of retail space, 75,000 square feet of retail/office space, 78,000 square feet of workplace edge, 882 residential units (442 multi-family and 440 single family units) and 318 potential ohana units. Based on this development mix, it is estimated that Pulelehua will generate 345,688 gallons per day of wastewater.

The onsite sewer collection system will be designed to accommodate this flow, and will consist of a gravity sewer system and sewer pump stations which will ultimately connect to an offsite sewer system to be located on the east side of Honoapi'ilani Highway. The offsite sewer system will connect directly to the Lahaina Wastewater Reclamation Plant (LWRP).

The onsite collection system will incorporate a sewer pump station at the northerly limit of the Pulelehua site to a gravity flow system which will connect to the Countys sewer pump station Napili No. 1, which will transport wastewater into the LWRP. Pump station No. 1 is located on the northerly side of the LWRP and pumps wastewater directly into the headworks at the plant.

The proposed sewer system will not connect to the existing County wastewater facilities on Lower Honoapi'ilani Road. Therefore, the capacity of the existing sewer piping system will not be affected by the Pulelehua project and there would be no requirements on the project to upgrade that section of the existing sewer piping system.

The developer will work with the Wastewater Reclamation Division to determine the capacity of the existing facilities to confirm that the LWRP can accommodate the wastewater generated from the project. The wastewater plan is shown in Exhibit 3.

3.4 WATER

In accordance with the Department of Water Supply's Domestic Consumption Guidelines, the average daily demand for Pulelehua is approximately 719,507 gallons per day. Fire flow demand for single family residential development is 1,000 gallons per minute for 2-hour duration and 2,000 gallons per minute for 2-hour duration for A-2 apartment, schools, and neighborhood businesses and light industrial. Fire hydrants will be installed with a maximum spacing of 350 feet

within the single family residential area and at 250 feet spacing within all other areas.

Currently, reclaimed (R-1) water is being pumped from the Lahaina Wastewater Treatment Plant to a Maui Land and Pine (ML&P) tank at an elevation of approximately 300 feet. ML&P then mixes the reclaimed water with their surface water, which is used for irrigation. The common landscaped areas of the project site and the elementary school yard will be irrigated with this mixed water. The non-potable water consumption is estimated at 199,747 gallons per day.

Two additional water wells will be drilled in the vicinity of the project site to provide a new source of water for Pulelehua. The developer will work with the Department of Water Supply (DWS) for the development and construction of the wells, which will be built in accordance with DWS standards. The proposed wells will be dedicated to the DWS.

A 1.0 million gallon water storage tank will be required at an elevation of approximately 375 feet to accommodate the domestic water and fire flow requirements for Pulelehua. The tank will also be constructed to DWS standards and dedicated to the DWS. Exhibit 2 contains the water plan.

3.5 ELECTRIC, TELEPHONE AND CABLE TV

The proposed electrical, telephone and cable TV distribution systems in Pulelehua will be installed underground from the existing facilities. The service for Pulelehua will probably be served by the electrical substation above the Kapalua West Maui Airport. The developer will coordinate any facility expansion requirements with Maui Electric Company, Verizon Hawaii, Oceanic Time Warner Cable. Street lights will be installed along the subdivision streets at intervals to be determined by the electrical engineer.

Based on a build out of 442 multi-family units, 440 single family units and 318 ohana units, the estimated monthly residential electrical demand is 838,800 kilowatt-hours. The estimate is based on the use of solar water heaters and room air conditioners.

EXHIBITS

1 **EXISTING DRAINAGE PLAN**

2 **EXISTING WATER PLAN**

3 **EXISTING WASTEWATER PLAN**

4 **PROPOSED ONSITE AND OFFSITE DRAINAGE DETENTION BASIN PLAN**

5 **TYPICAL ROADWAY SECTIONS**

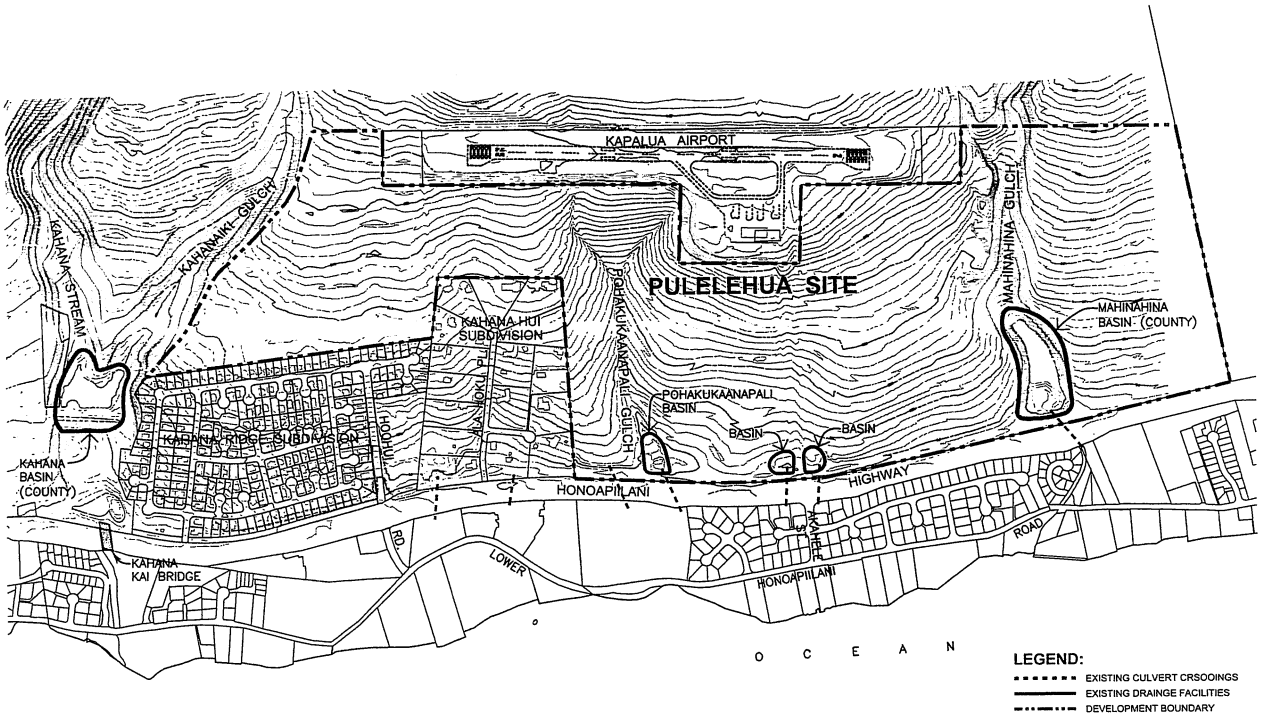


EXHIBIT 1
EXISTING DRAINAGE PLAN

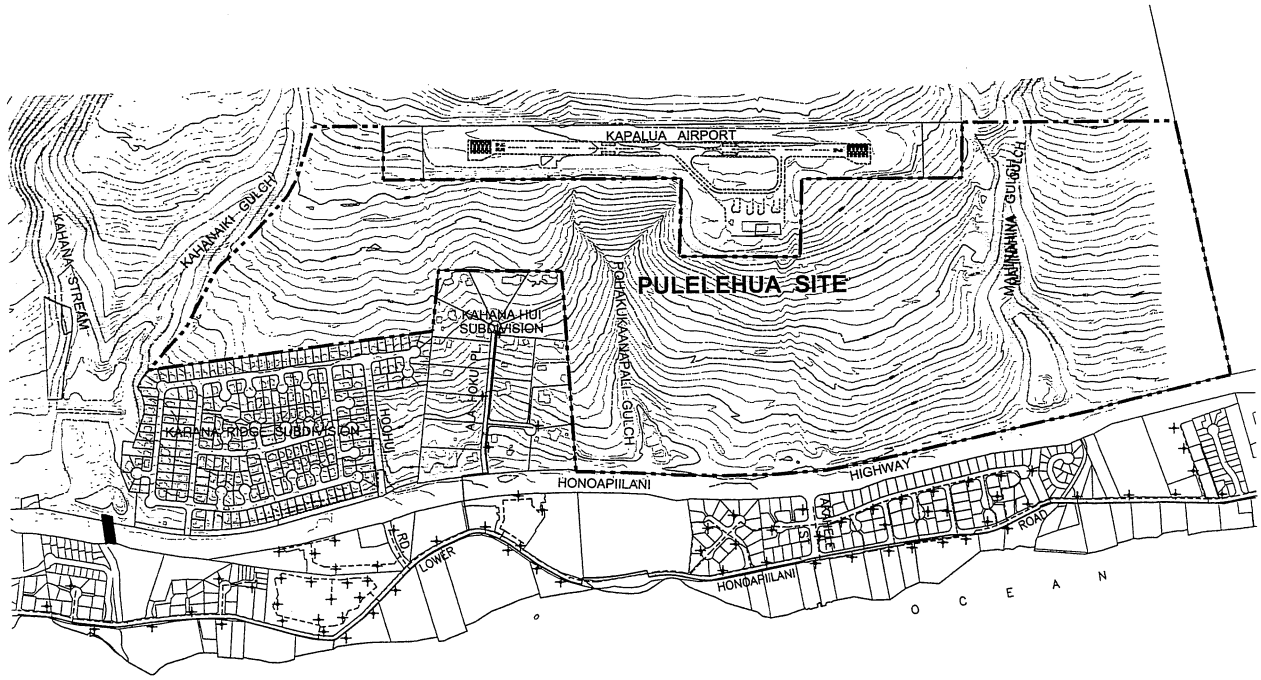
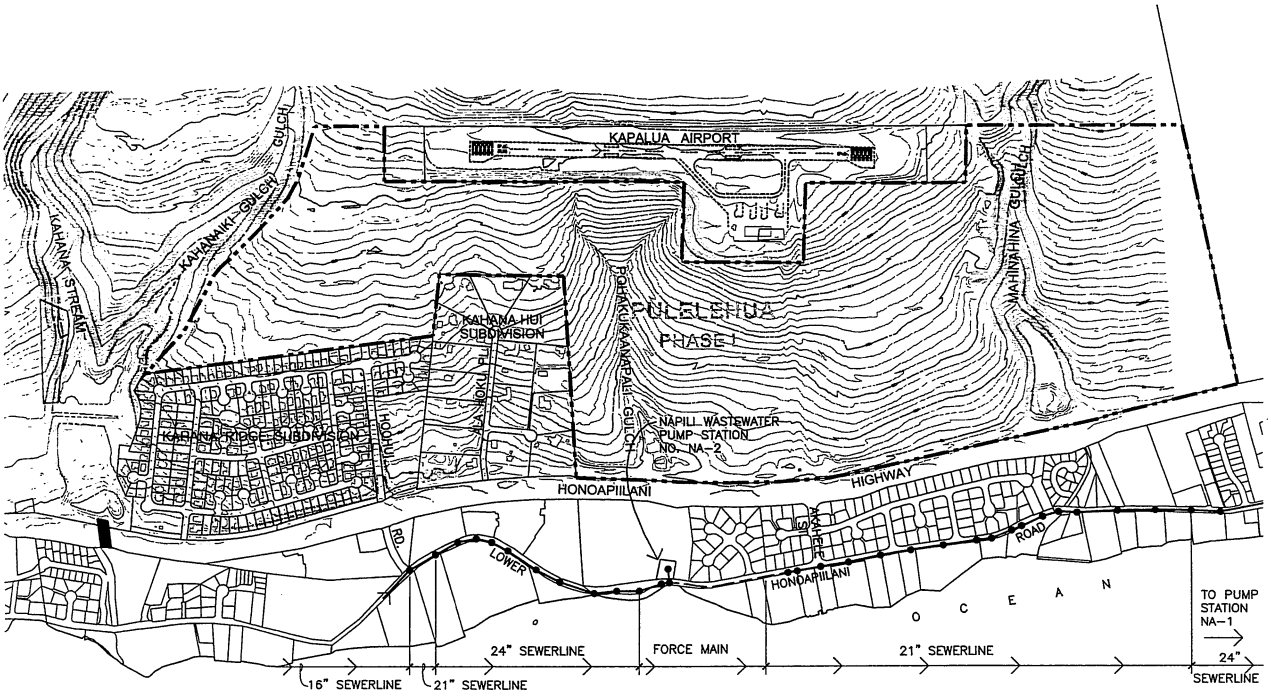


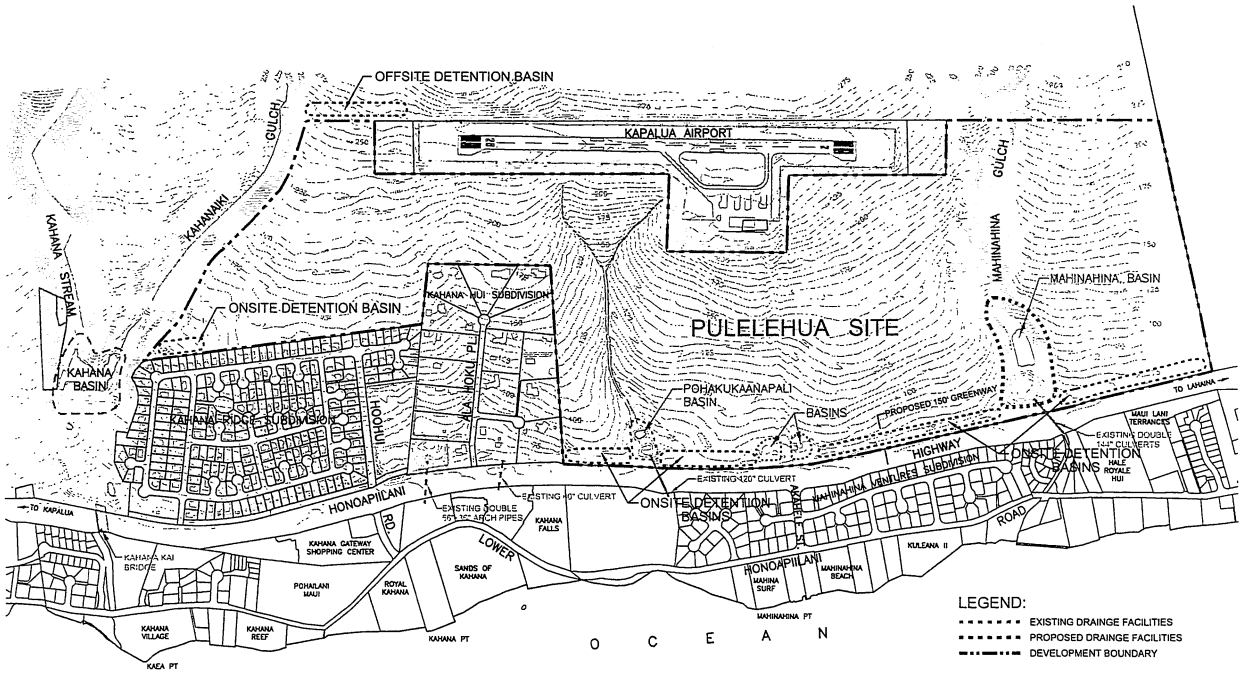
EXHIBIT 2
EXISTING WATER PLAN



LEGEND:

- SEWER MANHOLE
- GRAVITY SEWERLINE
- FORCE MAIN SEWERLINE
- DEVELOPMENT BOUNDARY

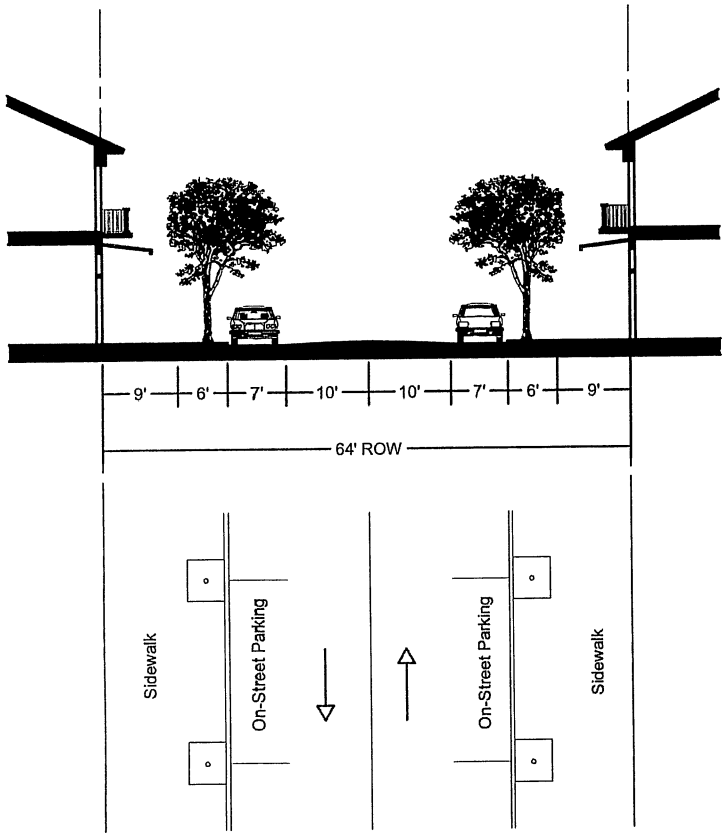
EXHIBIT 3
EXISTING WASTEWATER PLAN



LEGEND:

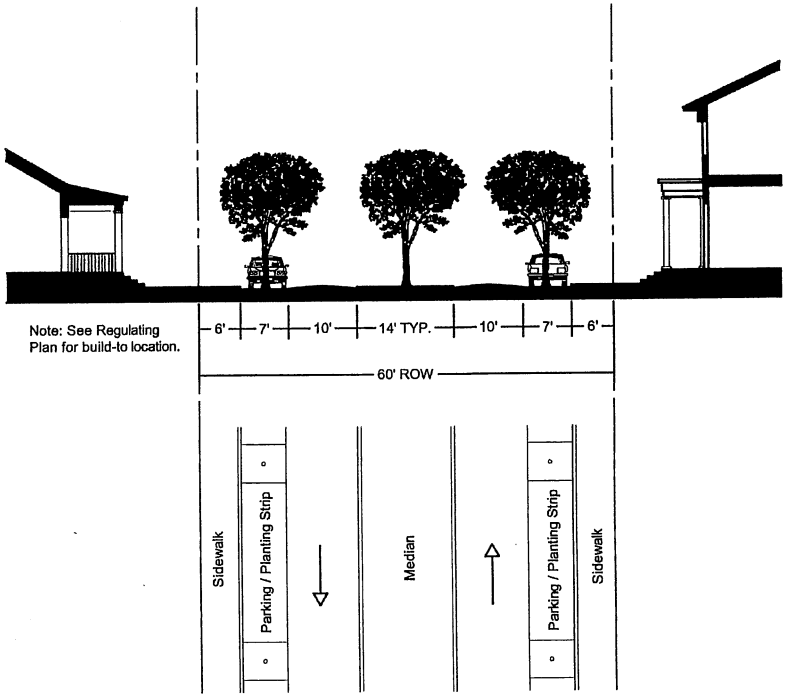
- EXISTING DRAINGE FACILITIES
- PROPOSED DRAINGE FACILITIES
- DEVELOPMENT BOUNDARY

EXHIBIT 4
PROPOSED ONSITE AND OFFSITE
DETENTION BASIN PLAN



MAIN STREET MS 64 7/10/10/7
Street = 2 Lane, Urban

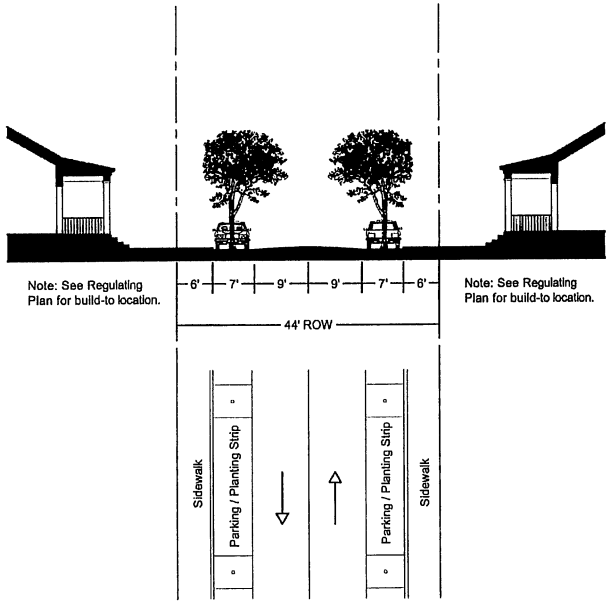
Drainage = Curb & Gutter



AVENUE AV 60 7/10/10/7

Avenue = Main Axis, Terminated Vistas (w/ median)

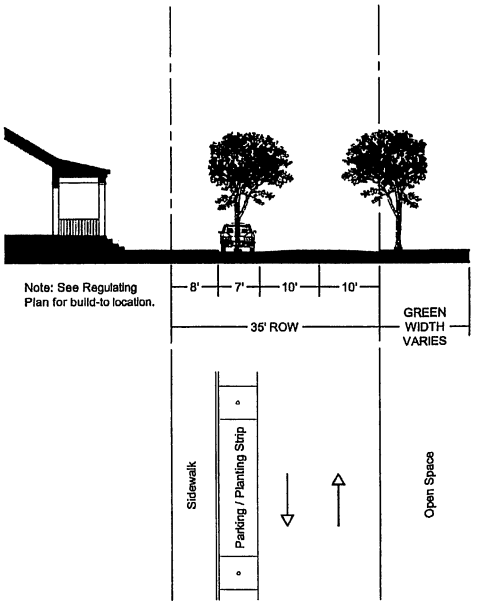
Drainage = Curb & Gutter



STREET ST 44 7/9/9/7
Street = 2 Lane, Urban

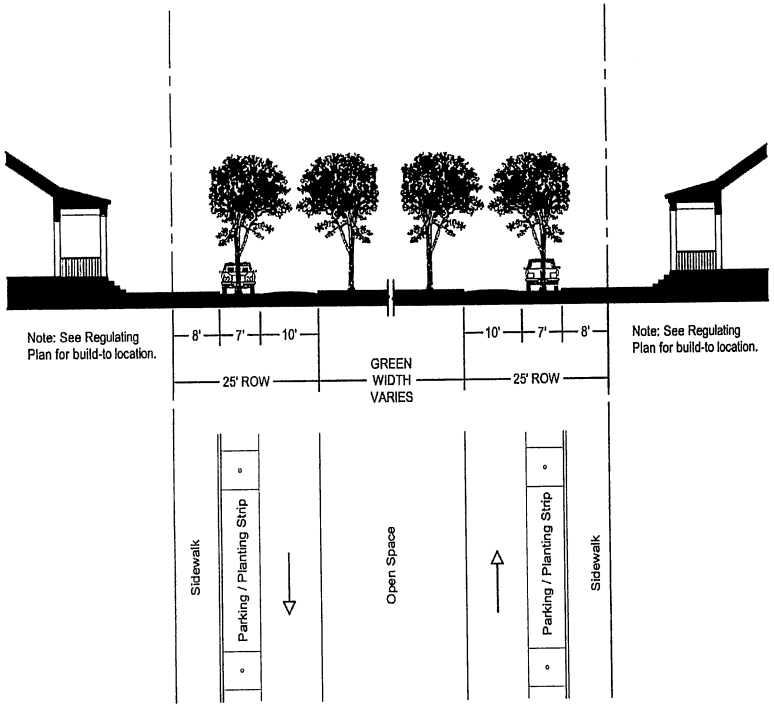
Drainage = Curb & Gutter

i. ST 35 7/10/10 (Green Street)



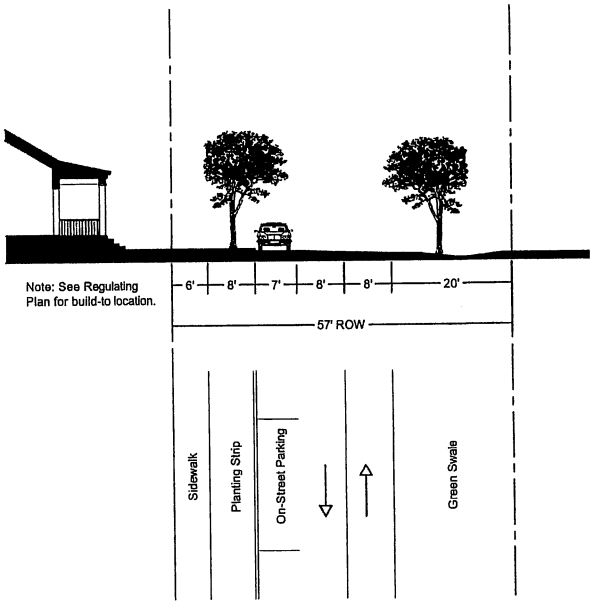
GREEN STREET ST 35 7/10/10
Street = 2 Lane, Urban

Drainage = Curb & Gutter



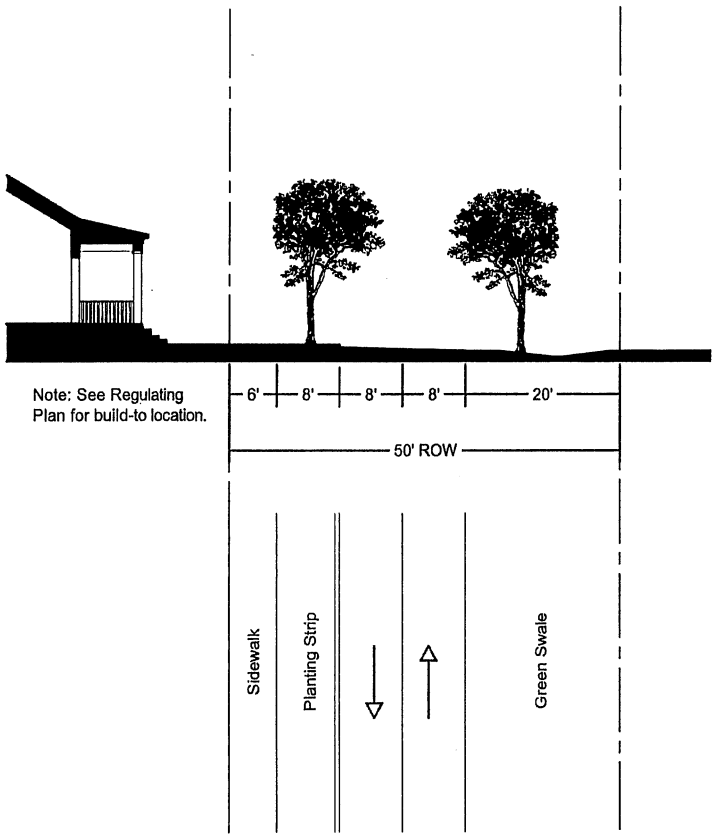
GREEN STREET ST 25 7/10
Street = 1 Lane, Urban

Drainage = Curb & Gutter



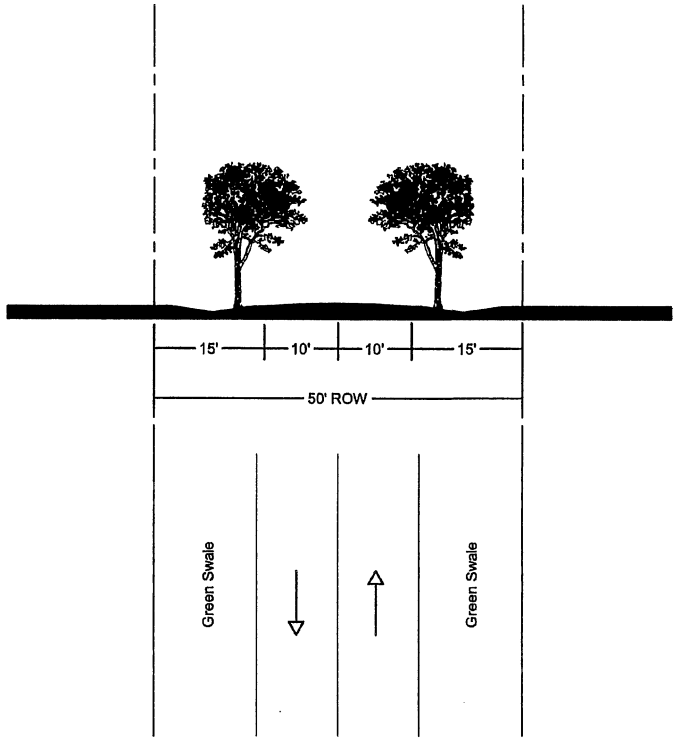
DRIVE DR 57 7/8/8
Drive = Nature on One Side (w/ parking)

Drainage = Curb & Gutter / Open Swale



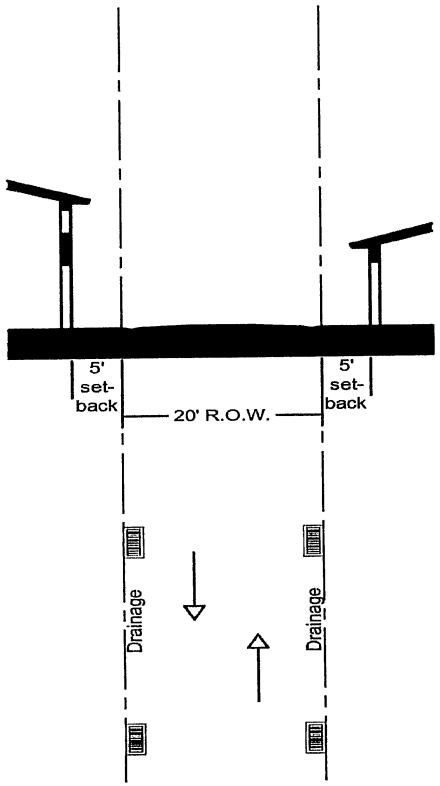
DRIVE DR 50 8/8
Drive = Nature on One Side (w/out parking)

Drainage = Curb & Gutter / Open Swale



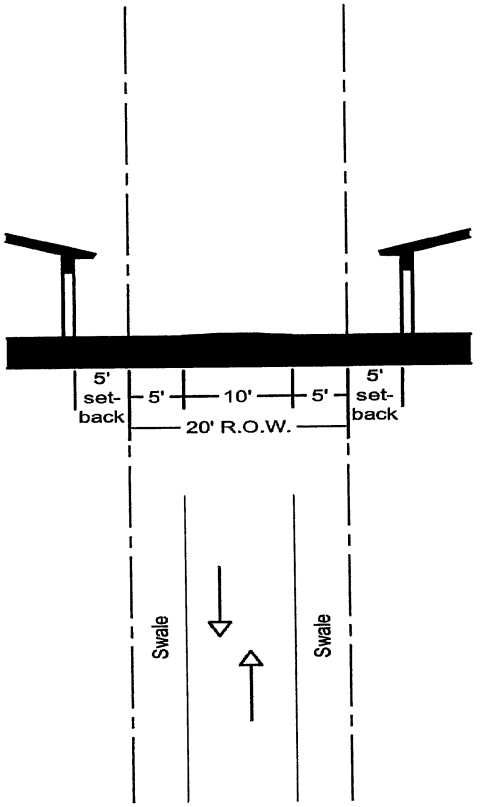
ROAD RD 50 10/10
Road = Rural, 2 Lane

Drainage = Open Swale



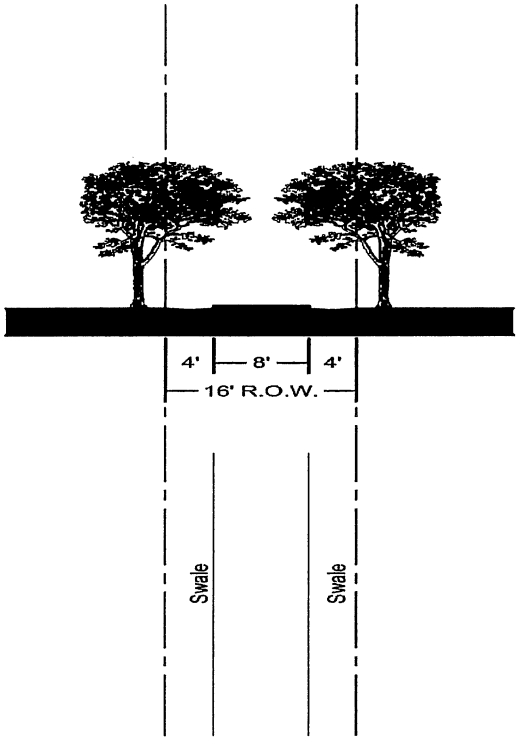
ALLEY A 20-20
Alley = Commercial Rear Access

Drainage = W Section Gutter + Inlet



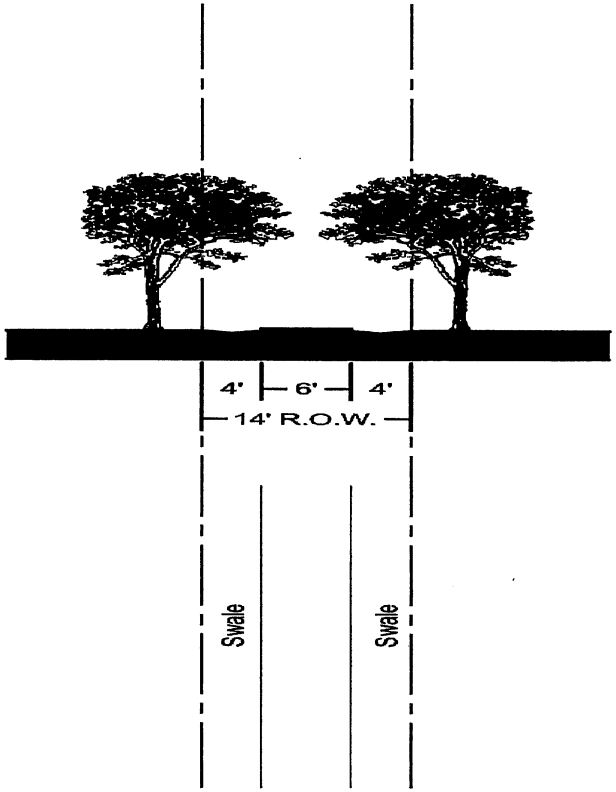
REAR LANE LA 20-10
Rear Lane = Residential Rear Access

Drainage = Open Swale



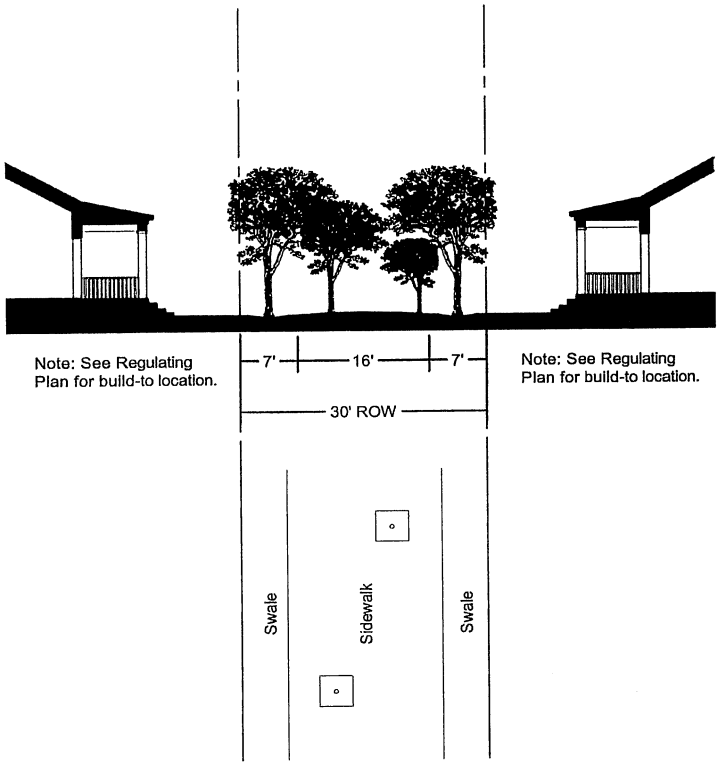
TRAIL TR 16-8
Trail = Pedestrian / Bicyclist

Drainage = Swale



PATH PA 14-6
Path = Pedestrian Only

Drainage = Swale



PEDESTRIAN STREET PED 30
Street = Pedestrian / Bicyclist

Drainage = Swale

M

Preliminary Drainage Report

PRELIMINARY DRAINAGE REPORT

FOR

PULELEHUA

Lahaina, Maui, Hawaii

T.M.K.: (2) 4-3-001: por. of 031

Prepared for:

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Lahaina, Hawaii 96761

Prepared by:

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CONSULTING CIVIL ENGINEERS
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February 2005

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A Hydrologic Calculations

PRELIMINARY DRAINAGE REPORT
FOR
PULELEHUA
Lahaina, Maui, Hawaii

I. INTRODUCTION

The purpose of this report is to examine both the existing and proposed drainage conditions for Pulelehua.

II. SITE LOCATION AND PROJECT DESCRIPTION

The Pulelehua property is identified as T.M.K.: (2) 4-3-001: por. of 031 and contains an area of approximately 312.8 acres. The current development plan includes approximately 104.5 acres of developed area, 13.3 acres for a school, useable open space of 91.4 acres, gulch area of 33.1 acres, and street rights-of-ways of 70.5 acres. The proposed Pulelehua development plan includes 882 residential units, 318 potential ohana units, a maximum of 21,475 square feet of retail space, 75,000 square feet in specialty retail/office space, and 78,000 square feet of workplace edge. The workplace edge allows for uses in the neighborhood like wood working shops, offices, and storage facilities.

The project site is bordered by the Kahana Hui Subdivision, Kahana Ridge Subdivision, and Kahanaiki Gulch to the north; Kapalua Airport and agricultural lands to the east, agricultural lands to the south, and Honoapiilani Highway to the west.

Proposed improvements include single and multi-family homes, shops, paved roadways and parking areas, concrete sidewalks, parks, and landscaping. The vision for Pulelehua is to build a traditional mixed-use neighborhood. Associated improvements include underground water, sewer, drainage, electrical, telephone, and cable television systems will also be constructed.

III. EXISTING TOPOGRAPHY AND SOIL CONDITIONS

The majority of the project site is cultivated and fallow pineapple fields. The elevation on the site ranges from 270 feet at the northeast corner of the site to 65 feet at Honoapiilani Highway, averaging approximately 8.0%.

According to the "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii (August, 1972)," prepared by the United States Department of Agriculture Soil Conservation Service, the soils within the project site are classified as Rough Broken and Stony Land (rRS), Lahaina silty clay, 3 to

7 percent (LaB), and Lahaina silty clay, 7 to 15 percent (LaC). Rough Broken and Stony Land is found in the existing drainageways and characterized as having rapid runoff and geologic erosion is active. Lahaina silty clay, 3 to 7 percent is characterized as having moderate permeability, slow runoff and a slight erosion hazard. Lahaina silty clay, 7 to 15 percent, is characterized as having medium runoff and moderate erosion hazard.

IV. EXISTING DRAINAGE CONDITIONS

There are three drainageways which traverse through or bound the Pulelehua site. To the north, Kahanaiki Gulch traverses along the northern boundary of the project site. It joins Kahana Stream before it crosses Honoapiilani Highway. Pohakukaanapali gulch traverses approximately midway through the project site. Drainage from the upper limits of this gulch is intercepted by the Kapalua Airport. Mahinahina Gulch traverses through the project site approximately 1,000 feet from the southern boundary.

The existing drainage pattern from the Pulelehua site is generally in the east to west direction toward Honoapiilani Highway. There are three existing drainage basins within or adjacent to the project site which collect runoff and remove silt and debris, before the runoff discharges into the ocean. These basins include the Kahana Basin, which is located immediately to the north of the Pulelehua site. The Pohakukaanapali Basin is located approximately in the middle of the Pulelehua site. The Mahinahina Basin is located at the southwest corner of the Pulelehua site. Two smaller detention basins are located to the north and south of the intersection of Akahele Street and Honoapiilani Highway.

As part of the Kahana Ridge Subdivision, a drainage system consisting of culverts and open channels was constructed along the eastern boundary of the subdivision. The northerly 80 percent of the drainage system conveys the intercepted runoff into Kahananui Gulch. The remaining 20 percent is conveyed into the subdivision's drainage system.

According to the "Hydrology Report for Honoapiilani Highway (Honokowai to Kahana) F.A. Project No. RF-030-1 (7) and Kahana to Alaeloa F.A. Project No. RF-030-1 (13) Island of Maui, prepared by Hydraulic Design Section, October 1975, there are two 144-inch culverts at Honoapiilani Highway at the Mahinahina Gulch crossing, which was designed to accommodate a 100-year flow of 4,275 cfs. A 120-inch culvert diverts runoff from Pohakukaanapali Gulch under Honoapiilani with a 100-year design flow of 674 cfs. A bridge (Kahana Kai Bridge) along Honoapiilani Highway diverts the 100year discharge of 7,540 cfs from the combined flows from Kahanaiki Stream and Kahana Stream. Runoff from all three drainageways eventually discharges into the ocean.

It is estimated that the present 50-year, 1-hour runoff from the Pulelehua site is 333.2 cfs. Of this total flow, approximately 51.1 cfs sheet flows toward the mauka boundary of the Kahana Ridge Subdivision (Drainage Area 1). The drainage system installed as part of the Kahana Ridge Subdivision intercepts the runoff and conveys approximately 80 percent into Kahanaiki Gulch and the remaining 20 percent is conveyed into the subdivision's drainage system. Approximately 19.2 cfs sheet flows through the Kahana Hui Subdivision (Drainage Area 2), approximately 68.1 cfs sheet flows into Pohakukaanapali Gulch (Drainage Area 4) and 77.7 cfs sheet flows into Mahinahina Gulch (Drainage Area 6). It is estimated that 117.1 cfs sheet flows from the project site onto Honoapiilani Highway (Drainage Areas 3, 5 and 7).

V. FLOOD AND TSUNAMI ZONE

According to Panel No. 150003 0151B of the Flood Insurance Rate Maps, dated June 1, 1981, the Pulelehua site is situated in Flood Zone C, which is designated as areas of minimal flooding. The site is located outside of the tsunami zone.

VI. PROPOSED DRAINAGE PLAN

The post development runoff from the Pulelehua site is estimated to be 878.0 cfs, an increase of 544.8 cfs over existing conditions. Onsite runoff will be collected by catch basins located at appropriate intervals along roadways and diverted by drainlines to the onsite detention basins. The detention basins will be located within the proposed greenway mauka of Honoapiilani Highway and sized to accommodate the increase in runoff from the development of the project. The greenway will be approximately 150 feet wide and serve as a landscape buffer as well as a detention basin area to mitigate the increase in runoff from the project site. Additional detention basins can also be constructed in park and open space areas.

Offsite detention basins will be constructed mauka of the Kapalua Airport to reduce the offsite runoff onto the project site. These basins will also reduce the runoff sheet flowing onto the project site.

No additional runoff will be released into the existing drainageways or onto Honoapiilani Highway. The net result of the proposed drainage improvements will be no increase in runoff from the project site to the downstream properties.

VII. HYDROLOGIC CALCULATIONS

The hydrologic calculations are based on the "Drainage Master Plan for the County of Maui," and the "Rainfall Frequency Atlas of the Hawaiian Islands," Technical Paper No. 43, U.S. Department of Commerce, Weather Bureau.

Rational Formula Used: $Q = CIA$

Where Q = rate of flow (cfs)

C = rainfall coefficient

I = rainfall intensity for a duration equal to the time of concentration (inches/hour)

A = drainage area (Acres)

See Appendix A for Hydrologic Calculations

VIII. CONCLUSION

The Pulelehua Community is expected to generate a 50-year storm runoff of 878.0 cfs, an increase of 544.8 cfs over existing conditions. The increase in onsite runoff will be diverted to onsite detention basins located within the greenway, which will be located mauka of Honoapiilani Highway. The greenway will also serve as a landscape buffer between Honoapiilani Highway and the Pulelehua site. The greenway will also contain walking paths for the project.

In addition, offsite detention basins will be constructed mauka of the Kapalua Airport, which will reduce the offsite runoff sheet flowing onto the Pulelehua site toward the downstream properties.

Onsite runoff will be intercepted by onsite grated and curb-inlet type catch basins and conveyed to the onsite detention basins, which will be sized to accommodate the increase in runoff from the development. There will be no increase in runoff from the Pulelehua site sheet flowing toward the makai properties or onto Honoapiilani Highway. This is in accordance with Chapter 4, Rules for the Design of Storm Drainage Facilities in the County of Maui.

Therefore, it is our professional opinion that the proposed development will not have an adverse effect on the adjoining or downstream properties.

IX. REFERENCES

A. Soil Survey of Islands of Kauai, Oahu, Maui, Molokai and Lanai, State of Hawaii, prepared by U.S. Department of Agriculture, Soil Conservation Service, August, 1972.

B. Erosion and Sediment Control Guide for Hawaii, prepared by U.S. Department of Agriculture, Soil Conservation Service, March, 1981.

C. Rainfall-Frequency Atlas of the Hawaiian Islands, Technical Paper No. 43, U.S. Department of Commerce, Weather Bureau, 1962.

D. Flood Insurance Rate Maps of the County of Maui, June, 1981.

E. Chapter 4, Rules for the Design of Storm Drainage Facilities in the County of Maui, prepared by the Department of Public Works and Waste Management, County of Maui, 1995.

F. Watershed Work Plan for Honolua Watershed, Maui County, March 1976.

G. Hydrology Report for Honoapiilani Highway (Honokowai to Kahana) F.A. Project No. RF-030-1 (7) and Kahana to Alaeloa F.A. Project No. RF-030-1 (13) Island of Maui, prepared by the Hydraulic Design Section, State Department of Transportation, Highways Division, October , 1975.

EXHIBITS

1 Location Map

2 Vicinity Map

3 Soil Survey Map

4 Flood Insurance Rate Map

5 Proposed Onsite and Offsite Drainage Detention Basin Plan

APPENDIX A

HYDROLOGIC CALCULATIONS

Hydrologic Calculations

Purpose: Determine the existing runoff from the project site sheet flowing into the existing drainageways and determine the increase in surface runoff from the development of the proposed project based on a 50-year storm.

A. Determine the Runoff Coefficient (C):

EXISTING CONDITIONS:

Infiltration (Medium)	= 0.07
Relief (Rolling)	= 0.03
Vegetal Cover (Good)	= 0.03
Development Type (Ag)	= 0.15
	C = 0.28

DEVELOPED CONDITIONS:

Infiltration (Slow)	= 0.14
Relief (Rolling)	= 0.03
Vegetal Cover (Good)	= 0.03
Development Type (Residential)	= 0.40
	C = 0.60

B. Determine the 50-year 1-hour rainfall:

i_{50} = 2.8 inches

Adjust for time of concentration to compute Rainfall Intensity (I):

Existing Condition:

T_c = 35 minutes
I = 3.8 inches/hour

Developed Conditions:

Drainage Area 1:
T_c = 19 minutes
I = 4.8 inches/hour

Drainage Area 2:
T_c = 17 minutes
I = 4.9 inches/hour

Drainage Area 3:
T_c = 13 minutes
I = 5.5 inches/hour

Drainage Area 4:
T_c = 23 minutes
I = 4.4 inches/hour

Drainage Area 5:
T_c = 19 minutes
I = 4.8 inches/hour

Drainage Area 6:
T_c = 21 minutes
I = 4.6 inches/hour

Drainage Area 7:
T_c = 200 minutes
I = 4.7 inches/hour

C. Drainage Area (A):

Total Area = 313 Acres

Drainage Area 1 = 48 Acres

Drainage Area 2 = 18 Acres

Drainage Area 3 = 5 Acres

Drainage Area 4 = 64 Acres

Drainage Area 5 = 62 Acres

Drainage Area 6 = 73 Acres

Drainage Area 7 = 43 Acres

D. Compute the 50-year storm runoff volume (Q):

Q = CIA

Existing Conditions:

Drainage Area 1: Q = (0.28)(3.8)(48) = 51.1 cfs

Drainage Area 2: Q = (0.28)(3.8)(18) = 19.2 cfs

Drainage Area 3: Q = (0.28)(3.8)(5) = 5.3 cfs

Drainage Area 4: Q = (0.28)(3.8)(64) = 68.1 cfs

Drainage Area 5: Q = (0.28)(3.8)(62) = 66.0 cfs

Drainage Area 6: Q = (0.28)(3.8)(73) = 77.7 cfs

Drainage Area 7: Q = (0.28)(3.8)(43) = 45.8 cfs

Total Existing Onsite Runoff = 333.2 cfs

Developed Conditions:

Drainage Area 1: Q = (0.60)(4.8)(48) = 138.2 cfs

Drainage Area 2: Q = (0.60)(4.9)(18) = 52.9 cfs

Drainage Area 3: Q = (0.60)(5.5)(5) = 16.5 cfs

Drainage Area 4: Q = (0.60)(4.4)(64) = 169.0 cfs

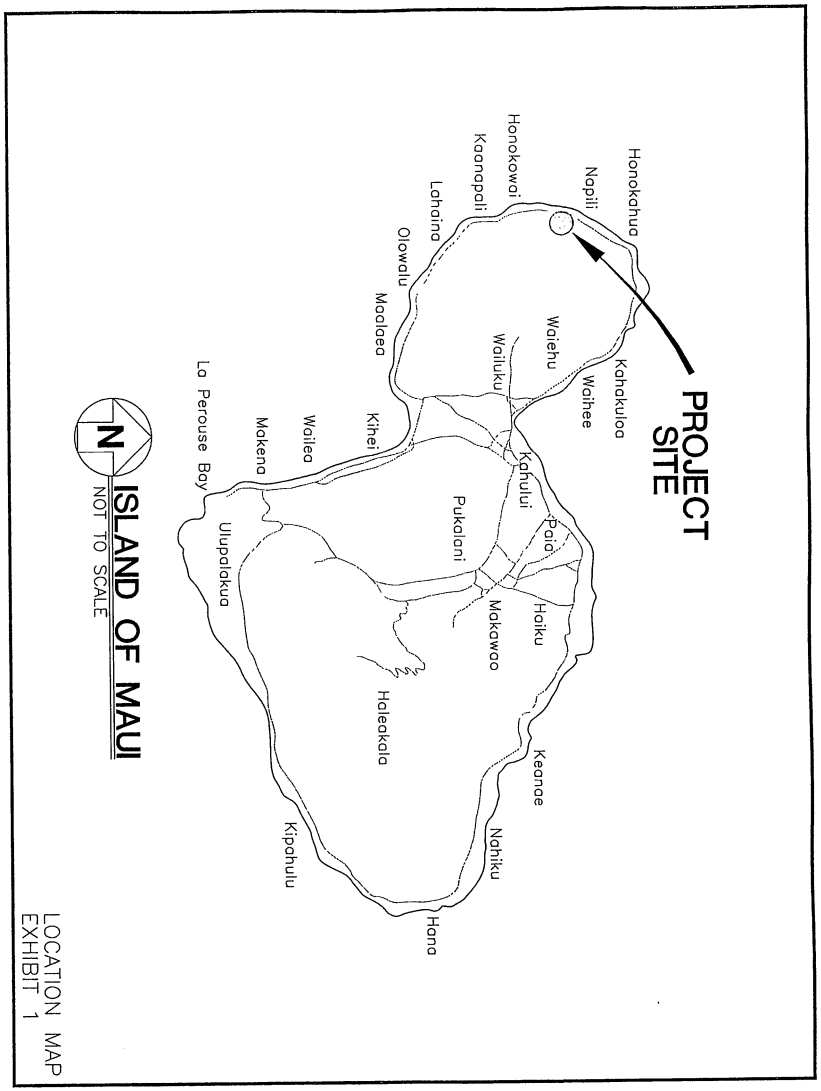
Drainage Area 5: Q = (0.60)(4.8)(62) = 178.6 cfs

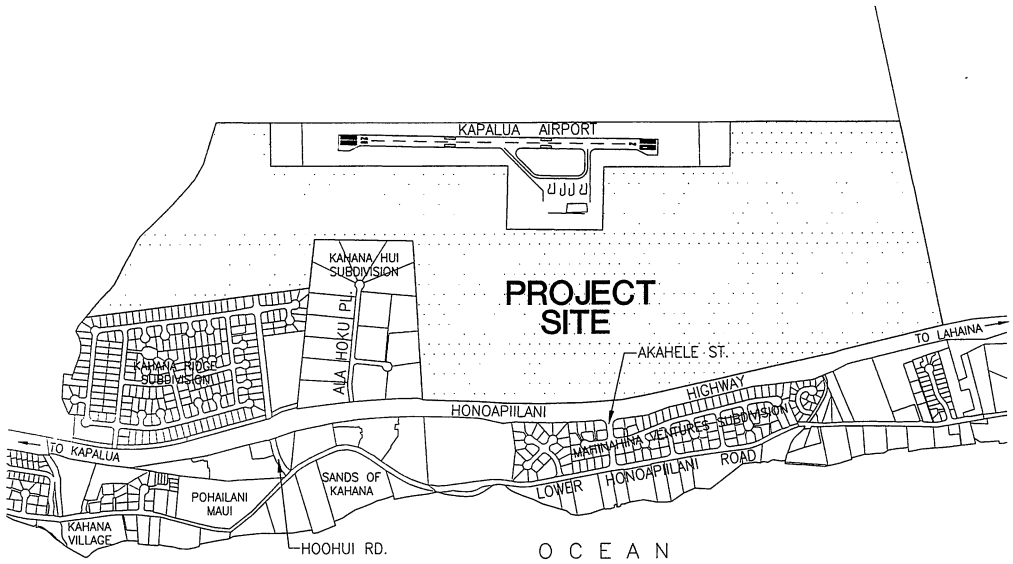
Drainage Area 6: Q = (0.60)(4.6)(73) = 201.5 cfs

Drainage Area 7: Q = (0.60)(4.7)(43) = 121.3 cfs

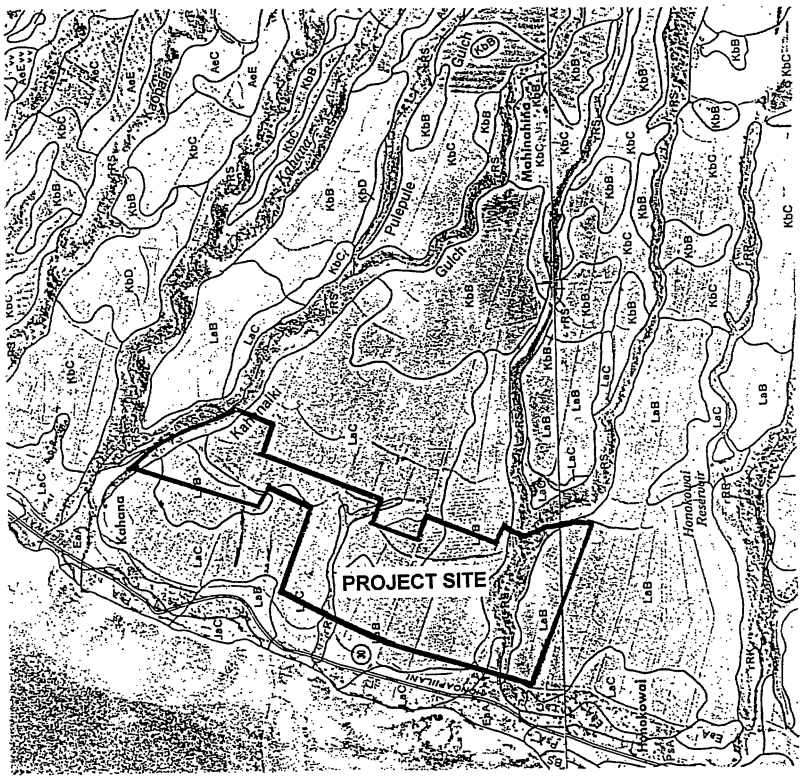
Total Developed Onsite Runoff = 878.0 cfs

The increase in runoff due to the proposed development is 878.0 - 333.2 = 544.8 cfs.

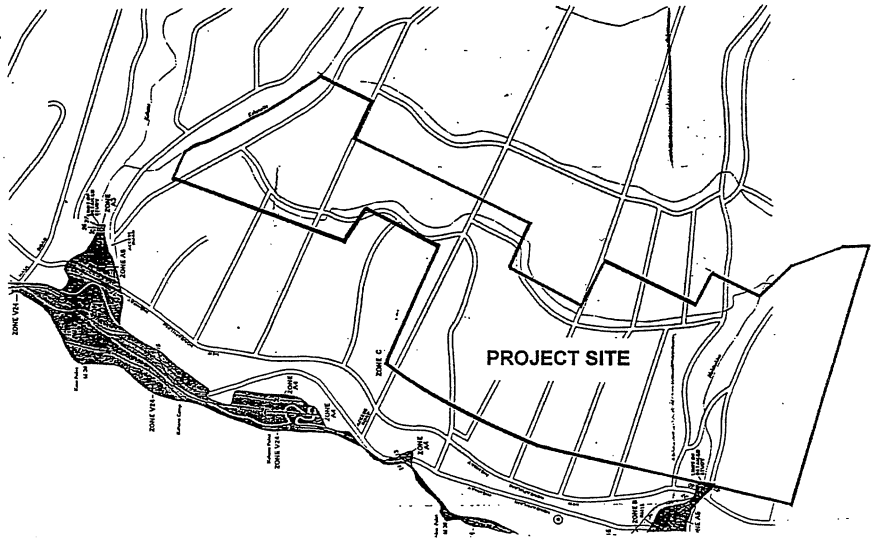




VICINITY MAP
EXHIBIT 2



SOIL SURVEY MAP
EXHIBIT 3



FLOOD INSURANCE
RATE MAP
EXHIBIT 4

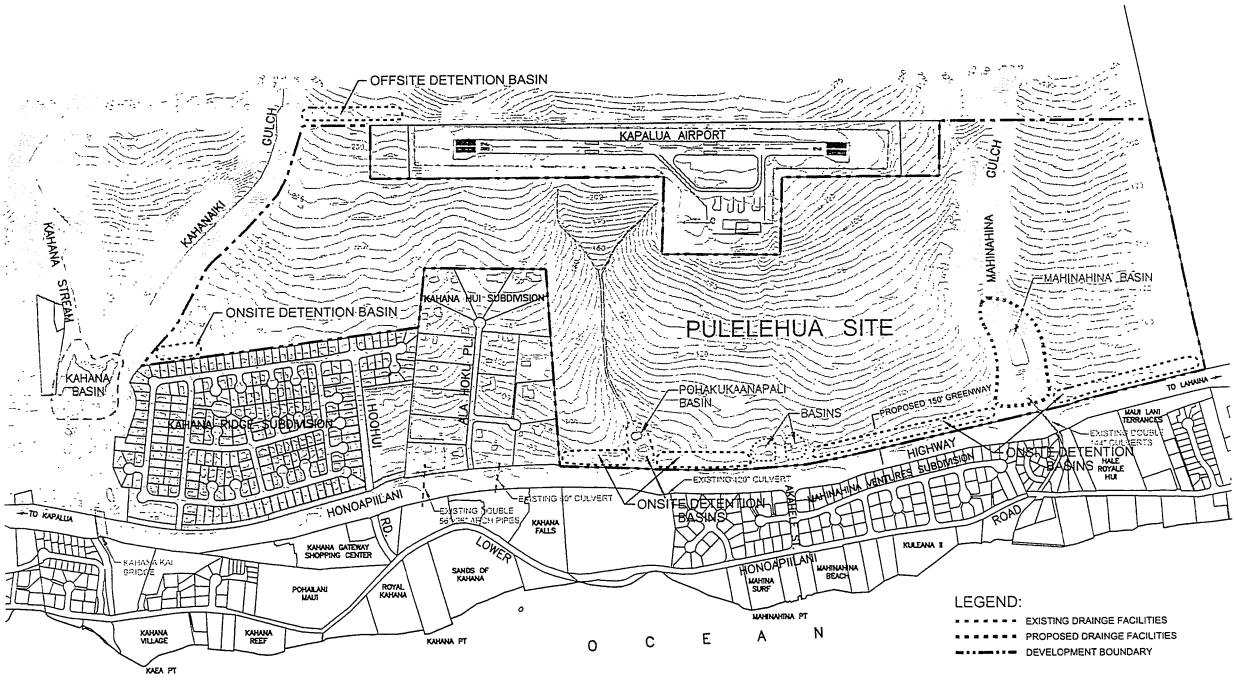


EXHIBIT 5
PROPOSED ONSITE AND OFFSITE
DETENTION BASIN PLAN

N

Airport Noise Report

Day Night Noise Level Contours
Kapalua West Maui Airport

FINAL REPORT
Janaury 26, 2005

Prepared for:

Kapalua Land Co., Ltd.

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APPENDIX 1: LETTERS FROM THE FAA REGARDING NOISE RULES

EXECUTIVE SUMMARY AND GLOSSARY OF TERMS

The West Maui Airport currently has approximately 25 operations per day. Using the FAA approved and developed computer noise model, Day Night Noise Level (DNL) contours were developed for the airport. The airport is subject to strict limits on the number of operations and type of aircraft. These limits include that jet and helicopter operations are not permitted and night operations are prohibited.

Under the rules in effect, the airport could grow to 140 operations per day. However, the three aviation forecasts that have been prepared for the airport predict that the airport will never achieve this level of operations. In fact, the most recent forecast predicts that the airport will reach only about 28 operations per day by the year 2025.

Using the maximum number of possible operations (140 per day) a set of DNL contours were developed using the FAA noise model. The results show that Pulelehua will not be significantly impacted by aircraft noise now or in the future. Mitigation will include buyer notification and no single wall construction will used in the residential portion of the project.

Definition of Important Terms:

Day Night Noise Level: Abbreviated as DNL and sometime L_{dn}. This is a description of noise that is based on the exposure of noise over a 24 hour period. Any noise that occurs at night is penalized by a factor of 10. An aircraft operation at night counts as much as 10 operations during the day.

Integrated Noise Model: Abbreviated INM. This is the computer noise model developed by the Federal Aviation Administration (FAA) and required for use in FAA sponsored noise and environmental studies.

Operation: An aircraft operation is either a takeoff or a landing. An aircraft that lands at an airport and then departs that airport counts as 2 operations.

Flight: The arrival and departure of an aircraft at an airport (2 operations).

Airport Noise and Capacity Act: Abbreviated ANCA. A law passed by Congress in 1990 prohibiting airports from adopting access restrictions unless those restrictions are approved by the FAA. Rules adopted before 1990 are 'grandfathered.'

1.0 OUTLINE OF NOISE ANALYSIS

Day-Night Noise Level (DNL) contours were developed using the year 2004 (January 1 to December 6, 2004) operations data for the airport. In addition, a set of contours based on

increased operating levels was also generated. The contour methodology used here is identical to that required by the FAA in FAR Part 150 studies and EIS studies. [1,2]

This report contains three major sections including this introduction. Section 2 describes the methodology used for this study. Section 3 describes the existing noise in the environs of West Maui Airport including the 2004 DNL contours. Section 4 presents DNL contours for a scenario of substantial increase to the maximum allowable level of airport operations.

2.0 METHODOLOGY

2.1 BACKGROUND

The method used here for describing the existing noise environment in terms of DNL relys on computer noise modeling. The noise environment is commonly depicted in terms of lines of equal noise levels, or noise contours. The computer noise model used here is described below.

2.2 COMPUTER MODELING

Noise contour modeling is a key element of creating noise contours. Generating accurate noise contours is largely dependent on the use of a reliable, validated, and updated noise model. It is imperative that these contours be accurate for the meaningful analysis of airport noise.

West Maui Airport noise contours were generated using the Integrated Noise Model INM Version 6.1. [3,4] The original INM was released in 1977. The latest version, INM Version 6.1, is the current version of INM used in FAA required noise studies and is the state-of-the-art in airport noise modeling. The INM is a comprehensive computer program developed to plot noise contours for airports. The program is provided with standard aircraft noise and performance data for over 100 civilian aircraft types that can be tailored to the characteristics of the airport in question, as well as a database of military aircraft types. Version 6.1 includes an updated data base that includes some newer aircraft, the ability to include run-ups in the computations, and improved computational methodologies.

One of the most important factors in generating accurate noise contours is the collection of accurate operational data. The INM program requires the input of the physical and operational characteristics of the airport. Physical characteristics include runway coordinates, airport altitude, and temperature. Operational characteristics include aircraft types and flight tracks, departure and arrival procedures that are specific to the operations at the airport. Aircraft data needed to generate noise contours include:

- Number of aircraft operations by type
- Types of aircraft
- Day/Night time distribution by type
- Flight tracks
- Flight track utilization by type

- Flight profiles
- Typical operational procedures
- Average Meteorological Conditions

3.0 EXISTING NOISE ENVIRONMENT

3.1 EXISTING WEST MAUI AIRPORT NOISE

3.1.1 BACKGROUND

Kapalua West Maui Airport serves a unique purpose on the island of Maui. The airport was privately built but later acquired by the State of Hawaii. It is restricted to commercial use only. The state acquired the airport prior to Congress adopting the Airport Noise and Capacity Act (ANCA) of 1990. The FAA wrote two letters in response to the State of Hawaii request for clarification of the operating rules at West Maui Airport. The two letters clearly indicated that the operating restrictions in place at West Maui are grandfathered under ANCA. These letters are attached to this report as an appendix.

The importance of the FAA letters clarifying the status of the airport rules under ANCA is significant. ANCA was passed by Congress in 1990 with the express purpose of preventing airports from adopting access restrictions like the ones in place at the Kapalua West Maui Airport. The 1990 Act prohibits airports from adopting such rules unless a very rigorous and exhaustive cost-benefit analysis shows that the rules will have a cost benefit. The requirements of such a study (called an FAR Part 161 study) are quite onerous and in the 14 years since the 1990 Act was passed, no airport has ever had such a study or restriction approved (there is a limited exception at Naples airport in Florida). One important aspect of the 1990 Act is that any rules that were in effect prior to the adoption of ANCA are grandfathered in under the Act. Therefore, the rules in effect at Kapalua West Maui Airport are permitted under the 1990 Act and remain in effect. The airport operator cannot adopt any rule changes that modify access to the airport without doing the exhaustive cost-benefit analysis. Therefore, the fact that these rules are in place provides a significant limit on growth at the airport.

The operating restrictions at West Maui Airport are very restrictive and quite unusual. The following are the rules in effect that affect noise:

1. The types of aircraft utilizing the airstrip shall be limited to a maximum seating capacity of 50 passengers.
2. Jet powered aircraft shall not be allowed regardless of seating capacity or STOL capabilities.
3. Daily flights shall not exceed 35 aircraft with a passenger seating capacity of 25 passengers or less and 35 aircraft with a passenger seating capacity between 26 and 50 passengers.
4. The lessee shall take all reasonable actions to operate the airstrip in such a manner as to minimize the noise generated by such aircraft operations at and in the airspace of the airstrip. Lessee shall take all reasonable actions required to insure that the noise standard set forth [*below*] is complied with at all times by lessee and all others operating aircraft to and from the airstrip.
5. All aircraft operated at the airstrip...shall have a current aircraft type or airworthiness certificate or its equivalent issued by the FAA certifying that such aircraft generates noise levels no greater than the following (note the following is quoted directly from the August 4, 1992 letter from the FAA to the State of Hawaii DOT and is provided here in Appendix 1):

   (1) "For propeller-driven aircraft of 12,500 pounds or less maximum FAA certificated takeoff weight only: the maximum allowable noise levels for "propeller-driven small airplanes" under Appendix F to Part 36...as the same may be amended from time to time, with noise levels measured and corrected as provided in such appendix, but in no event in excess of a noise level of 82 dB(A) measured pursuant to said appendix F; [*this noise level varies from that contained in the 1986 ordinance and in your March 1992 letter. As stated in our July 6 letter, the ANCA provisions covering noise and access restrictions do not apply to aircraft not specifically identified as stage 2 or stage 3 aircraft.]* and

   (2) For all other aircraft: The "Effective Perceived Noise Levels," as that term is defined in said Part 36...as follows: (a) for takeoff: 93 EPNdB; (b) for sideline: 102 EPNdB; and (c) for approach: 102 EPNdB. [*These levels are also at variance from those contained in the 1986 ordinance and in your March 13 letter. If formal agreement was issued subsequent to the 1987 lease which restated the 1986 limits, this information would need to be provided.]"*

6. That notwithstanding any other provisions in the lease to the contrary, no helicopter operations shall be permitted at the airstrip.
7. The limitation on hours of operation is included in paragraph 8 of the lease agreement and is also not subject to ANCA. [*daytime only operations are permitted*].
8. General aviation operations are not permitted.

3.1.2 EXISTING WEST MAUI AIRPORT OPERATIONS DATA

The existing West Maui Airport operations data were obtained from the Universal Integrated Communication (UNICOM) operated at the airport. It is a non-governmental air/ground radio communication station which provides airport advisories. The UNICOM at West Maui keeps a log of all operations. For the period of January 1, 2004 through December 6,.2004 (the date of this analysis), the UNICOM recorded 8,512 operations. Estimating a full year of data from these data results in an estimated year 2004 annual operations of 9,138 operations. The average daily number of operations is 25 operations per day, or 12.5 departures and 12.5 arrivals per day.

3.1.3 Existing West Maui Airport Fleet Mix Data

The type of aircraft using West Maui Airport during the year 2004 is shown in Table 1. These data were taken from the UNICOM logs and shown as a percentage of the fleet. The majority of operations are Dash 8 commuter turboprops.

Table 1
Fleet Mix For Year 2004

Aircraft	Annualized 2004 Operations	Percent of Fleet
Cessna 208 Caravan	38	0.41
Cessna 402	79	0.86
Cessna 414	10	0.11
DHC 8-100	5793	63.39
P68C Partenavia	736	8.06
PA-31-250	31	0.34
PA-31-350	2451	26.83
Total:	9138	100.00

The INM database contains a wide variety of aircraft noise data and profiles. However not all aircraft in the civilian fleet are included in the model. To cover that case the FAA provides within the INM a 'substitution list' for aircraft not included in the model. The FAA provided substitutions were used exactly as provided in the INM. The P68C Partenavia is not in the INM, nor is it given a substitution. Based on its engines, size and performance, the P68C was modeled as a DHC 8-100. This should overestimate the noise from the P68C for modeling purposes. The following are the FAA approved INM substitutions:

Aircraft	Substitution
Cessna 208	GASEPF
Cessna 401	BEC58P
Cessna 414	BEC58P
PA-31-250	BEC58P
PA-31-350	BEC58P

3.1.4 West Maui Airport Runway and Flight Track Utilization

The flight tracks at West Maui Airport are established to take advantage of the runway configuration and prevailing wind conditions. Runway 2/20 is approximately 3,000 feet long and is the only runway at the airport. Tradewinds are the predominate wind resulting in about

80% of all operations on Runway 20. Kona winds result in approximately 20% of the operations on Runway 02.

Flight tracks are shown on Exhibit 3-1. These tracks were drawn based on information from the UNICOM. It should be noted that the turns shown are estimates only and occur well

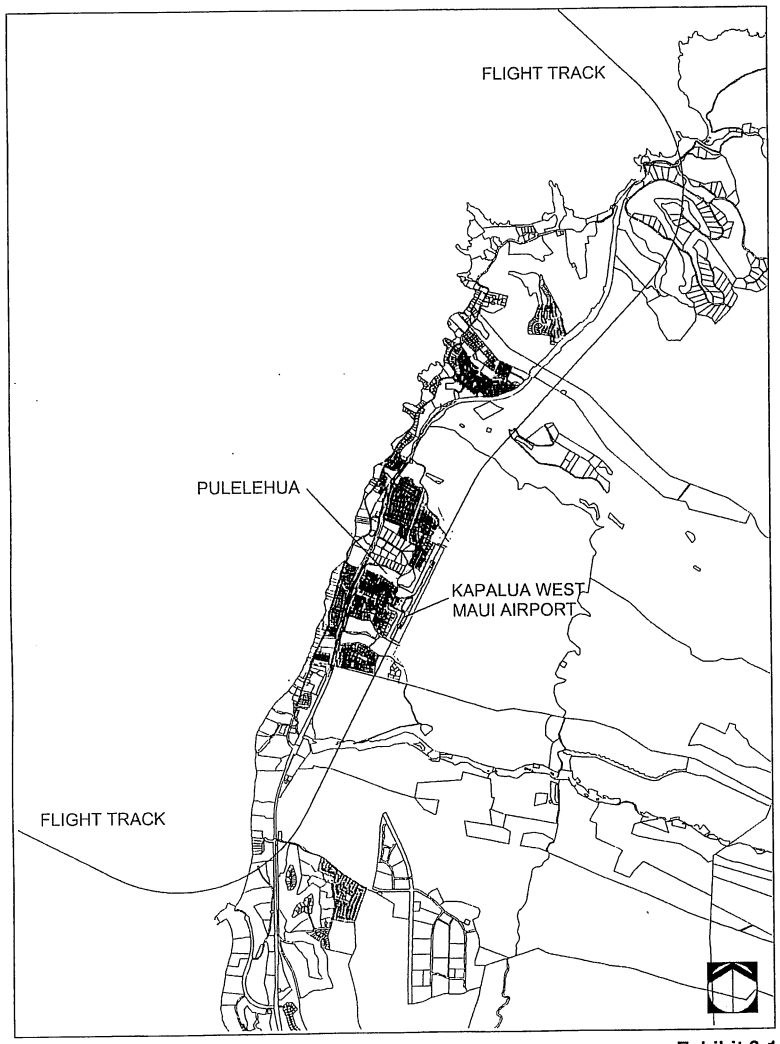

Exhibit 3-1
Flight Tracks Kapalua West Maui Airport

outside the study area and outside the noise contours, so no effort was made to refine the turn locations based on field observations.

3.1.5 West Maui Airport Year 2004 DNL Contours

The DNL contours used to depict existing noise exposure at West Maui Airport were developed using the INM Version 6.1. The elevation of the airport is 256 feet. The average daytime temperature used was 81.5 degrees F. The data files used to generate the contours are available on CD. The INM computes noise contours by computing the noise level at a very large number of grid points and uses a contouring algorithm to estimate the location of the contours through these grid points. The default grid point settings and contouring algorithms are based on a medium size commercial air carrier airport. When used at West Maui the INM contours showed only one point in the study area above 55 DNL and could only draw a contour about that one point (a circle). In order to get better resolution the contour parameters were adjusted to get a finer resolution and smooth contours. The contour parameters were set to Tension 3, Degrees 5 and Meters 50. This produced a smooth contour plot for the airport.

The 55 and 60 dB DNL contours are depicted on Exhibit 3-2.

4.0 FUTURE POTENTIAL LARGEST POSSIBLE NOISE CONTOURS

4.1 History of Operations at West Maui Airport

The State of Hawaii has published three aviation forecasts that include forecasts for West Maui Airport. [5, 6, 7] The range of forecasts shown in these three planning studies is quite large and is shown in Exhibit 4-1. The 1990 plan forecast about 37,000 annual operations for the year 2010. The 1994 plan forecast about 25,000 operations for the year 2020, and the current 2004 plan forecasts about 10,000 annual operations for the year 2025. If the 1990 and 1994 plans were linearly extrapolated to the year 2025, they would show about 47,000 annual operations for the 1990 plan and 23,000 annual operations for the 1994 plan. That compares to 10,000 annual operations that is forecast in the 2004 plan. It is interesting to note that in 1989 the airport reported 23,000 annual operations, while in 2004 the airport had just over 9,000 annual operations.

The historical forecasts do not converge to a common prediction of future operations. It is interesting to note that the access rules enforced at the airport allow a maximum of 35 daily departures of aircraft with capacity of 25 passengers or less and 35 daily departures of aircraft with between 26 and 50 passengers. Assuming the maximum were reached every day of the year, the airport could reach 51,000 annual operations. This number of annual operations is greater than any of the forecasts that have been made (just greater than the 1990 plan extrapolated out to 2025, and five times the forecast for 2025 that is shown in the 2004 plan).

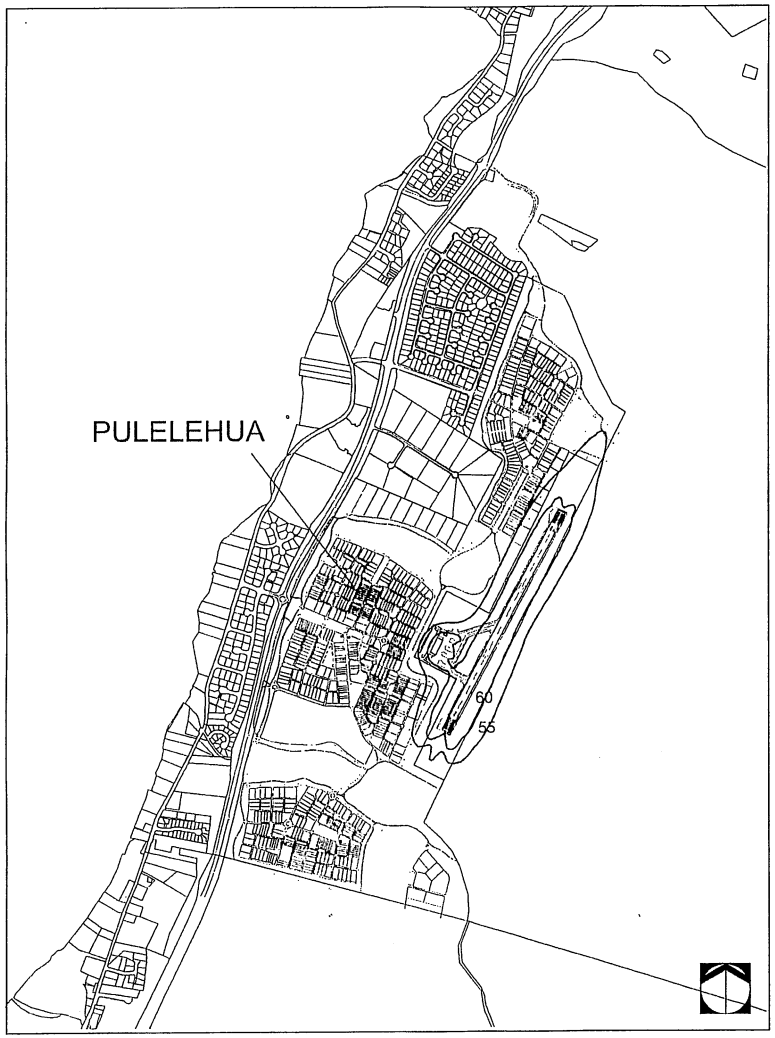

Exhibit 3-2
Existing DNL Contours, Year 2004

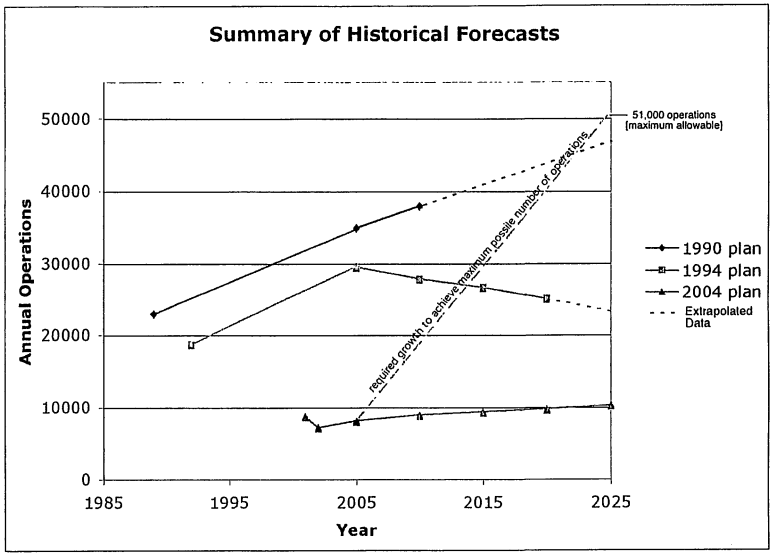

Exhibit 4-1
Aviation Forecasts For Kapalua West Maui Airport

It is not the purpose of this study to make a forecast or prediction of future operations levels. Rather, the purpose is to ensure that future land use development around the airport can accommodate the airport in the future. One approach to ensuring compatibility between the land development and the airport is to base the land use planning on the largest set of noise contours conceivable for the airport, even though it is not forecast to occur. Such an approach would ensure land use compatibility with a margin of safety to account for uncertainty in the future. However, it is important to note that this assumption is based on the current restrictions from the County of Maui Ordinance No. 1535 (1986) of runway length remaining constant and that jet aircraft, general aviation aircraft, and helicopters that are currently prohibited remain prohibited at the airport. Note that due to gulches near both ends of the runway, extension of the runway would be very difficult. In addition, the likelihood of achieving 51,000 annual operations at the

airport is very small given the current level of operations, the current forecast of operations, and the very limited terminal and apron space at the airport.

4.2 Largest Possible Contours With Current Restrictions

A set of noise contours were generated with INM 6.1 using the same fleet mix and assumptions described above for existing operations, except the number of operations was increased from 25 per day to 140 operations per day. The increase to 140 represents the maximum number of operations per day. These noise contours are shown in Exhibit 4 -2.

5.0 State of Hawaii Land Use Guidelines

The State of Hawaii Department of Transportation has adopted land use compatibility guidelines that are unique to the State of Hawaii. These guidelines are shown in Table 5-1. The State DOT guidelines show that residential uses with noise exposure less than 60 dB DNL are permitted in the airport environs. In addition to the State DOT land use guidelines, the State of Hawaii has adopted a buyer notification requirement for residential properties with noise exposure over 55 dB DNL. This buyer notification requirement is intended to ensure that prospective buyers of properties near airports are aware of aircraft noise and potential annoyance due to aircraft noise in vicinity of that property.

The mitigation measures that will ensure compatibility of the residential portion of the project with the airport include the following:

- Notification to buyers of the proximity of airport and the presence of aircraft noise
- No homes will be located within the 65 DNL contour (existing or maximum operations)
- The residential lots that are within the maximum operations 60 DNL contour are lots where the 60 DNL contour cuts through those lots and therefore are barely at 60 DNL for the maximum operations level at the airport (an unlikely operations level)
- No single wall residential construction

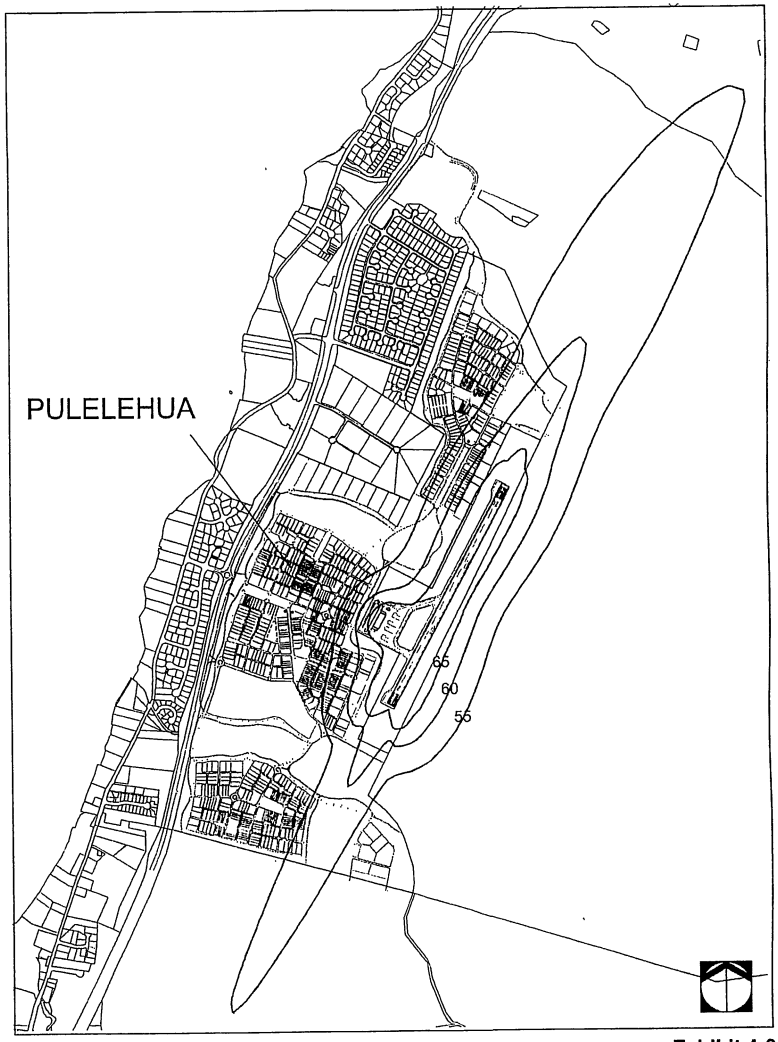

Exhibit 4-2
Largest Possible DNL Contours With Existing Restrictions

Table 5-1
STATE OF HAWAII DEPARTMENT OF TRANSPORTATION
LAND USE COMPATIBILITY WITH YEARLY DAY-NIGHT AVERAGE SOUND LEVELS

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 with extensive outdoor use	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 service 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 equip.	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 trade, 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 playground, 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

Key to Table 5-1

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

(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.

This table has been adapted from the Federal Aviation Administration Land Use Compatibility Table, Advisory Circular 150/5020-1 (dated August 5, 1983). This table is for land use planning purposes only.

Fair disclosure of aviation noise impacts for real estate transactions are required for properties within the boundaries of the noise exposure area shown on maps prepared by DOT (Hawaii Revised Statutes, 508D-15).

6.0 REFERENCES

1. Federal Air Regulation (FAR) Part 150, Airport Noise Compatibility Planning.
2. Order 1050.1E, Environmental Impacts; Policies and Procedures, FAA, June 8, 2004.
3. U.S. Department of Transportation, Federal Aviation Administration, "Integrated Noise Model (INM) Version 6.0 User's Guide," September 1999. [note: Version 6.1 still uses the Version 6.0 Users Manual].
4. U.S. Department of Transportation, Federal Aviation Administration, "Integrated Noise Model (INM) Technical Manual," January 2002.
5. Hawaii Statewide Airport System Plan, DOT Airports Division, Wilson Okomoto and Associates and Aries Consultants Ltd., December 1990.
6. Update of Hawaii Aviation Demand Forecasts, DOT Airports Division, Aries Consultants Ltd. And Pacific Management Associates, October 1994.
7. Hawaii Aviation Demand Forecasts Update, DOT Airports Division, 2004.

Appendix 1

FAA Letters Confirming Grandfather Status Under 1990 Airport Noise and Capacity Act

[note: these letters were copied from the FAA Website in HTML format and do not include the FAA letterhead logo and did not preserve all of the letter formatting, http://www.faa.gov/arp/app600/14cfr161/MAUI792.htm]

US Department of Transportation
Federal Aviation Administration
800 Independence Ave. SW
Washington. DC 20591

AUG 4 1992

Mr. Rex D. Johnson
Director
Hawaii Department of Transportation
869 Punchbowl street
Honolulu, Hawaii 96813-5097

Dear Mr. Johnson:

In response to our July 6 letter requesting additional information regarding restrictions at West Maui Airport, we have received a copy of the lease agreement signed in 1987.

The Federal Aviation Administration (FAA) has reviewed this information and concludes that this additional evidence supports the position that the restrictions agreed to in 1987 need not undergo the process established under the Airport Noise and Capacity Act (ANCA). We note, however, discrepancies in the information provided in your March 13, 1992, letter and in the 1987 lease which was submitted by West Maui Airport. The zoning ordinance which you quote pre-dated the lease agreement. The restrictions issued in 1987 would be considered to supersede those issued in 1986 and hence constitute those which need not undergo ANCA review. The special conditions paragraph 46 in the February 26, 1987 lease states:

> that the types of aircraft utilizing the airstrip shall be limited to a maximum seating capacity of 50 passengers. In addition, jet powered aircraft shall not be allowed regardless of seating capacity or STOL capabilities.
>
> that daily flights shall not exceed 35 aircraft with a passenger seating capacity of 25 passengers or less and 35 aircraft with a passenger seating capacity between 26 and 50 passengers.
>
> that lessee shall take all reasonable actions to operate the airstrip in such a manner as to minimize the noise generated by such aircraft operations at and in the airspace of the airstrip Lessee shall take all reasonable actions required to insure that the noise standard set forth [below] is complied with at all times by lessee and all others operating aircraft to and from the airstrip.
>
> All aircraft operated at the airstrip...shall have a current aircraft type or airworthiness certificate or its equivalent issued by the FAA certifying that such aircraft generates noise levels no greater than the following:
>
> (1) for propeller-driven aircraft of 12,500 pounds or less maximum FAA

certificated takeoff weight only: the maximum allowable noise levels for "propeller-driven small airplanes" under Appendix F to Part 36...as the same may be amended from time to time, with noise levels measured and corrected as provided in such appendix, but in no event in excess of a noise level of 82 dB(A) measured pursuant to said appendix F; [this noise level varies from that contained in the 1986 ordinance and in your March 1992 letter. As stated in our July 6 letter, the ANCA provisions covering noise and access restrictions do not apply to aircraft not specifically identified as stage 2 or stage 3 aircraft.] and

(2) for all other aircraft: The "Effective Perceived Noise Levels," as that term is defined in said Part 36...as follows: (a) for takeoff: 93 EPNdB; (b) for sideline: 102 EPNdB; and (c) for approach: 102 EPNdB. [These levels are also at variance from those contained in the 1986 ordinance and in your March 13 letter. If formal agreement was issued subsequent to the 1987 lease which restated the 1986 limits, this information would need to be provided.]

that notwithstanding any other provisions in the lease to the contrary, no helicopter operations shall be permitted at the airstrip, and all references herein to helicopter operations are hereby deleted and shall be of no force or effect.

The limitation on hours of operation is included in paragraph 8 of the lease agreement and is also not subject to ANCA.

The factors relevant to this determination on applicability of ANCA to each of the restrictions are the same as those set forth in our July 6 letter, to wit: (1) the airport is currently privately-owned and private use, (2) the restrictions were adopted well before the transfer of ownership and do not appear to have been put into effect with the intent of circumventing ANCA, and (3), in these circumstances, the transfer of ownership will make the airport available for public use for the first time. We restate our position that we do not here address the applicability of ANCA to use restrictions under other circumstances and that this letter is intended only as a response to your concerns about compliance with ANCA requirements.

I believe that this resolves the outstanding ANCA questions. If you need additional information or have any further questions, please feel free to contact me.

Sincerely,

Leonard L. Griggs, Jr.
Assistant Administrator for Airports

US Department of Transportation
Federal Aviation Administration
800 Independence Ave. SW
Washington. DC 20591

Mr. Rex D. Johnson
Director
Hawaii Department of Transportation
869 Punchbowl street
Honolulu, Hawaii 96813-5097

Dear Mr. Johnson:

This is in response to your March 13 letter to Mr. Jeffrey Shane and his reply to you of April 3 in which he indicated that the Federal Aviation Administration (FAA) would review the questions you raised regarding the State's ability to maintain the existing limitations on West Maui Airport if the airport is purchased by the state. We have reviewed the limitations in light of existing law, particularly the Airport Noise and Capacity Act of 1990, 49 U.S.C. App. sec. 2151 et. seg., (ANCA) and airport grant compliance requirements under the Airport and Airway Improvement Act, as amended (Airport Act).

Regarding applicability of ANCA, only two of the existing restrictions that the state proposes to maintain at West Maui are contained in 1986 zoning ordinance No. 1535: (1) the noise level limit on operations by propeller-driven aircraft of 12,500 pounds or less and (2) the EPNdB limits for takeoff, sideline, and approach noise.

ANCA does not apply to restrictions on operations by propeller driven aircraft weighing 12,500 pounds or less because none of these aircraft are classified as stage 2 or 3, and ANCA governs restrictions on operations by stage 2 and 3 aircraft.

The previously-adopted EPNdB limits need not undergo the process established under the Airport Noise and capacity Act. The factors relevant to our determination on West Maui include:

(1) the airport is currently privately-owned and private use, (2) the restriction was adopted well before the transfer of ownership and does not appear to have been put into effect with the intent of circumventing ANCA, and (3), in these circumstances, the transfer of ownership will make the airport available for public use for the first time. A major purpose of ANCA is to prevent the proliferation of uncoordinated and inconsistent restrictions on aviation that could impede the natl0nal air transportation system. The relaxation of existing restrictions and improvement of the availability of airports for public use is consistent with this purpose. In these circumstances, it would not serve the purpose of ANCA to interpret ANCA to apply because the transfer, even with the existing restriction in place, represents an overall improvement in airport access. We do not here address the applicability of ANCA to use restrictions under other circumstances.

If these same factors can be demonstrated regarding the remaining restrictions, ANCA also would not apply to them. FAA requires evidence that they have been implemented and we welcome any additional information that you may be able to provide. We have also contacted the airport manager for further documentation.

We also wish to point out that, if the state proposes to implement new restrictions or to tighten existing ones, it will be required to comply with ANCA and 14 CFR Part 161.

As to the Federal grant assurances, they are not applicable to West Maui provided that no Federal funds are used to purchase or improve the airport. However, if the state applies for Federal grant funds in the future for use at West Maui Airport, then it must comply with the applicable grant assurances. Any ban on helicopter or jet operations would appear to violate Federal grant agreement Assurance No. 22, that the airport operator "will make its airport available as an airport for public use on fair and reasonable terms and without unjust discrimination, to all types, kinds, and classes of aeronautical uses." (Also see section 511{a) (l) of the Airport and Airway Improvement Act, as amended). The state may use airport-generated revenues from other state-owned airports for capital improvements and maintenance expenses at West Maui Airport without violating the revenue use limitation under the Federal grant assurances (see section 511{a) (12) of the Airport and Airway Improvement Act, as amended). The revenue use limitation permits use of airport-generated revenues for capital and operating costs of the local airport system.

This letter pertains solely to the Department of Transportation/FAA interests in the airport's compliance with ANCA and the Federal grant assurances. It is intended only as a response to your concerns about compliance with those requirements.

I hope that this addresses your basic questions. We will provide you with further FAA decisions on ANCA applicabiLity as soon as we have received and reviewed documentation implementing the restrictions.

Sincerely,

Leonard L. Griggs,
Assistant Administrator for Airports

O

Consultation

Kapalua

April 27, 2004

Ms. Heidi Meeker
Land Use Planner
Facilities & Support Services Branch
Office of Business Services
809 8th Avenue Building J Room 15
Honolulu, Hawaii 96816

Re: Proposed Pulelehua Project and Elementary School

Dear Heidi,

It was a pleasure meeting with you last week to discuss Maui Land & Pineapple Company's proposed Pulelehua Project and Elementary School. Enclosed is the map I referenced and a Pulelehua newsletter.

We look forward to working with you, the Department of Education, and the Legislature in making a new elementary school at Mahinahina a reality.

Sincerely,

Ryan Churchill
Development Manager

RC/at

enclosures

Kapalua Land Company, Ltd. • 1000 Kapalua Drive • Kapalua, Maui, Hawaii 96761 • www.kapaluamaui.com
(808) 669-5625 • Fax (808) 669-5454

Kapalua

May 10, 2004

Mr. Jon Benson
President
Kahana Ridge Association
c/o Nai'a Properties, Inc.
4260 Lower Honoapiilani Road
Lahaina, Hawaii 96761

Dear Mr. Benson:

Thank you for your feedback on the planning of Pulelehua. The Community's vision for Pulelehua is a cluster of neighborhoods using Traditional Neighborhood Design (TND) principles. A large part of TND is a walkable community with a mix of uses. Providing opportunities for people to live close to where they work and go to school is an important feature of sustainable design – increasing quality of life by decreasing time lost during a daily commute and decreasing traffic congestion.

The community charrette participants intended to create genuine neighborhoods at Pulelehua. It will contain a mix of uses and housing types, accommodating a wide variety of people and activities. They also intended to incorporate a network of green space, streets and trails to allow for multiple types of circulation, especially walkability and connectivity. Several of your association members attended the charrette and a greenbelt was incorporated into the plan next to Kahana Ridge because of their participation.

The work-in-progress design of Pulelehua shows a street connection to Hoohui Road, however, we will change that to a walking path to encourage neighboring and the ability for Kahana Ridges' children to walk or bike to the new school. If at a later time, your community decides that the street should be connected, you will be able to do so. It will be your decision, and perhaps the County's, not ours.

We welcome your participation and your home owners' participation in the design process. Updated plans are posted at the www.pulelehua.com website. We would also be glad to meet with you and/or your board of directors to review the design. Thank you again for your feedback and please call me at 669-5622 if you would like to meet.

Mahalo,

Bob McNatt
Vice President/Land Planning & Development

/lp/dm

Kapalua Land Company, Ltd. • 1000 Kapalua Drive • Kapalua, Maui, Hawaii 96761 • www.kapaluamaui.com
(808) 669-5625 • Fax (808) 669-5454

ALAN M. ARAKAWA
MAYOR

CARL M. KAUPALOLO
CHIEF

NEAL A. BAL
DEPUTY CHIEF

COUNTY OF MAUI
DEPARTMENT OF FIRE AND PUBLIC SAFETY

200 DAIRY ROAD
KAHULUI, MAUI, HAWAII 96732
(808) 270-7561
FAX (808) 270-7919
July 26, 2004

Ms. Leilani Pulmano
Development Coordinator
Kapalua Land company, LTD
1000 Kapalua Drive
Kapalua, Maui, Hawaii 96761

Subject: Street Review for Pulelehua Project

Dear Ms. Pulmano,

Thank you for the opportunity to once again review some of the details concerning the Pulelehua project. During our last meeting, we concentrated on street designs that were available in the Development Standards booklet. Generally, our office was very please in the design details and see no major hurdles with what has been proposed. The following street designs will be approved: (MS 64 7/10/10/7), (AV 60 7/10/10/7), (ST 44 7/9/9/7), (ST 35 7/10/10), (ST 25 7/10), (RD 50 10/10), (A 20-20).

Some of the access designs are for trails and rear alley ways. We generally will not be concerned with these because they will not be required for fire department access. (DR 57 7/8/8) & (DR 50 8/8) will be required to provide an all-weather terrain surface for a minimum of 20 feet. This may be accomplished even if grass is planted. Please see a professional who may be able to provide options to accommodate a 25 ton fire truck..

We would like to commend the design committee for the multiple access options that the residents & emergency responders will have. Please feel free to contact me at 270-7568 if there are any questions.

Sincerely,

Valeriano F. Martin
Captain
Fire Prevention Bureau

RECEIVED
JUL 28 2004
EXECUTIVE OFFICE

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COUNTY COUNCIL
COUNTY OF MAUI
200 S. HIGH STREET
WAILUKU, MAUI, HAWAII 96793
www.co.maui.hi.us/council/

August 18, 2004

Mr. Robert McNatt, Senior Vice President
of Planning and Development
Maui Land & Pineapple Co., Inc./Kapalua Land Company, Ltd.
1000 Kapalua Drive
Lahaina, Hawaii 96761

Dear Mr. McNatt:

SUBJECT: **PRESENTATION ON THE PROPOSED PULELEHUA HOUSING DEVELOPMENT (WEST MAUI)** (HHS-12)

Thank you for your presentation on the proposed Pulelehua Housing Development in West Maui at the Maui County Council's Housing and Human Services Committee meeting of August 16, 2004.

Although the Committee has recommended that this matter be filed, I would like to offer you an opportunity to make a second presentation before the Committee once more details about the proposed project are available. If Maui Land & Pineapple Co., Inc. (MLP)/Kapalua Land Company, Ltd. (KLC) decides to pursue approval of the affordable housing portion of the project pursuant to Section 201G-118, Hawaii Revised Statutes, it may be beneficial to you to meet with the Committee prior to the submittal of your 201G application to the County.

Should MLP/KLC decide to make a second presentation, I would recommend that you consider including the following elements in your presentation, even if only tentative information is available:

1. Acreage of the entire project;
2. Approximate acreage of the affordable housing portion, if included;
3. Approximate percentage amounts of the multi-family or single-family mix within the affordable housing portion of the project;
4. Approximate pricing ranges for affordable units, along with corresponding percentage ranges in accordance with Housing and Urban Development's average median income guidelines;
5. Approximate lot size ranges for single family units;

Mr. Robert McNatt, Senior Vice President
of Planning and Development
August 18, 2004
Page 2

6. Approximate size ranges for single family home units;
7. Approximate size ranges for multi-family home units;
8. Draft CC&Rs, if available;
9. Summary of initial discussions with various County Departments;
10. Summary of initial discussions with various State Departments; and
11. Other related information.

To ensure efficient processing, please include the relevant committee item number in the subject line of your response.

Thank you for your attention in this matter. Should you have any questions, please contact me or the Committee staff (Shannon Alueta at 270-7687, or Clarita Balala at 270-7668).

Sincerely,

JOSEPH PONTANILLA, Chair
Housing and Human Services Committee

hhs:ltr:0412a01:ssa

cc: Alice L. Lee, Director, Department of Housing and Human Concerns

October 12, 2004

OTOMO ENGINEERING, INC.
CONSULTING CIVIL ENGINEERS
305 SOUTH HIGH STREET, SUITE 102
WAILUKU, MAUI, HAWAII 96793
PHONE: (808) 242-0032
FAX: (808) 242-5779

Mr. Gilbert Coloma-Agaran, Director
Department of Public Works and
Environmental Management
County of Maui
200 South High Street
Wailuku, Hawaii 96793

Dear Mr. Coloma-Agaran:

Subject: Sewer System Alternatives for Pulelehua
T.M.K.: (2) 4-3-001: por. 031
Lahaina, Maui, Hawaii

After reviewing alternatives to providing sewer facilities to Pulelehua, Kapalua Land Company, Ltd. (KLC) is considering a system located mauka of Honoapiilani Highway. Said system will consist of a sewer pump station at the northerly limit of the project site to a gravity flow system from Akahele Street to the Lahaina Wastewater Reclamation Plant. The gravity flow system will connect to the County's Pump Station No.1, which will transport the wastewater into the reclamation plant. Said pump station is located on the southerly side of the reclamation plant and pumps wastewater directly into the headworks at the plant. Attached is a sketch showing the onsite portion of the proposed system.

To the south of the Pulelehua project, the proposed sewerline will traverse lands owned by the Department of Hawaiian Home Lands (DHHL). KLC will negotiate the required easements from the DHHL.

The proposed sewer system will not connect to the existing County system on Lower Honoapiilani Road. In view of the foregoing, the proposed sewer system will not affect the capacity of the existing sewer system along Lower Honoapiilani Road and would not need to participate in upgrading that portion of the system.

The build out of Pulelehua is planned to consist of 13.3 acres of school (estimated enrollment of 650 elementary school students), 21,475 square feet of retail space, 75,000 square feet of retail/office space, 78,000 square feet of workplace edge, 882 residential units (442 multi-family and 440 single family units), 318 potential ohana units. Based on this development mix, it is estimated that the total project will generate 345,688 gallons of wastewater daily. These areas and unit counts are subject to change based on final design.

We would appreciate any comments on KLC's proposal. In addition, please advise us on what improvements the Pulelehua project will be required to undertake at the reclamation plant and Pump Station No. 1.

Thank you for your assistance on this project. Should you have any questions or need additional information, please call me.

Sincerely,

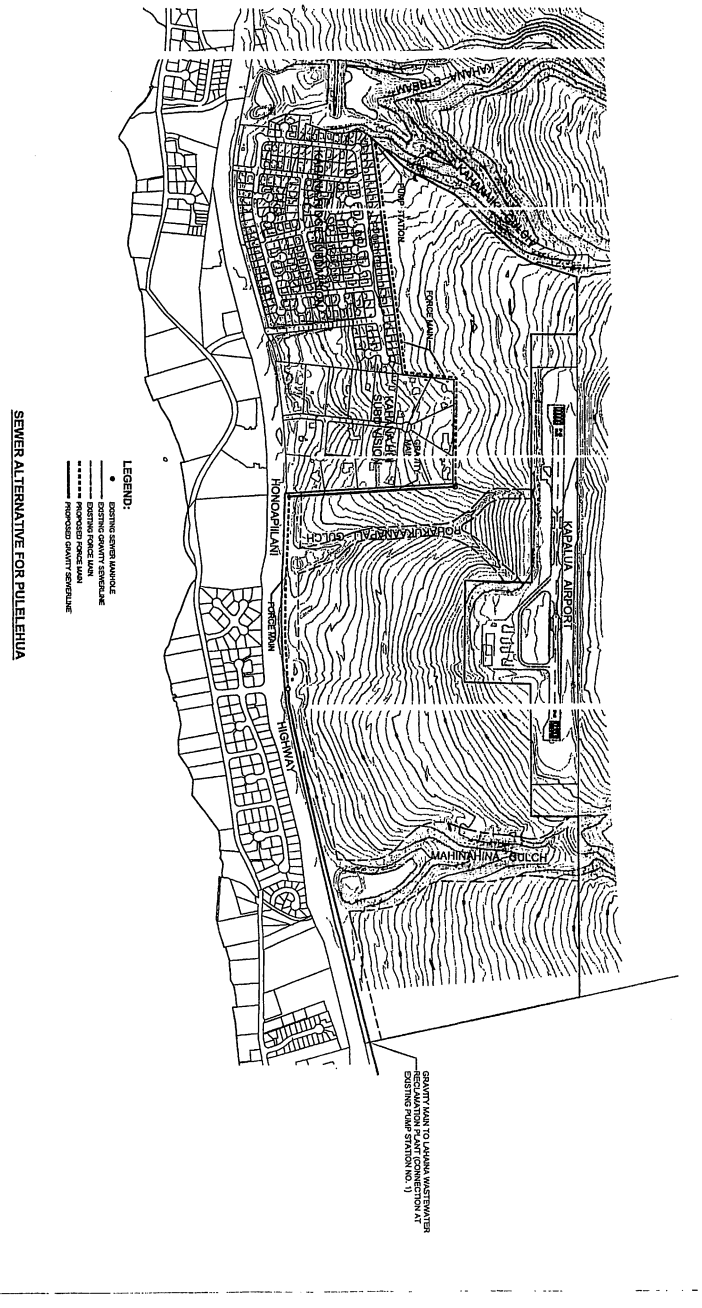
OTOMO ENGINEERING, INC.

Stacy A. Otomo

Stacy A. Otomo, P.E.
President

Enclosure

c: Mayor Alan Arakawa w/ Enclosure
Keith Regan w/ Enclosure
Herman Andaya w/ Enclosure
Bob McNatt w/ Enclosure
Karl Bossert w/ Enclosure
Leilani Pulmano w/ Enclosure
Tom Schnell w/ Enclosure



Kapalua

November 29, 2004

Mr. Glenn Correa
Director
Department of Parks and Recreation
County of Maui
700 Hali'a Nakoa Street Unit 2
Wailuku, Hawaii 96793

Aloha Mr. Correa,

We appreciate your time reviewing Pulelehua's proposed park plan. At this level of planning, we would like to incorporate your feedback on the planned parks. At your request at our last meeting on May 24th, plans were dropped off to Pat Matsui for review.

Attached is a drawing showing the park locations and associated acreage. We intend to provide the following park acreage:

Approximate Park Acreage

Trails	67
Gulches	33
Neighborhood Parks	6
Ball fields	10
Community Gardens	6
Total	**123 acres**

As detailed in our letter dated July 17th, Maui Land & Pineapple is proposing to dedicate improved parks to meet the County's park requirements. In fact, over 90 acres of useable parks, trails and community gardens will be provided. It is estimated that 10 acres are required by code. Ordinance 3158 includes a provision to "receive credit for lands dedicated or provided for park and playground purposes in excess of what is required to be dedicated or provided." We are requesting park credits for any additional park area not required for Pulelehua.

Kapalua Land Company, Ltd. • 1000 Kapalua Drive • Kapalua, Maui, Hawaii 96761 • www.kapaluamaui.com
(808) 669-5625 • Fax (808) 669-5454

As we discussed, we propose that Pulelehua's Homeowner Association maintain the pocket parks and the trails; and the County maintain the neighborhood parks and ball fields. The proposed parks will be open to the public. And, the park rules will follow the County's rules.

We are also seeking your support on offering many smaller, more useable parks scattered throughout the neighborhoods, as opposed to the West Maui Community Plan Land Use Map that shows approximately 50 acres of the Pulelehua site as a regional park.

We would appreciate any comments on our proposal. Thank you again for your assistance with the proposed park plan. Should you have any questions or need additional information, please contact me.

Mahalo,

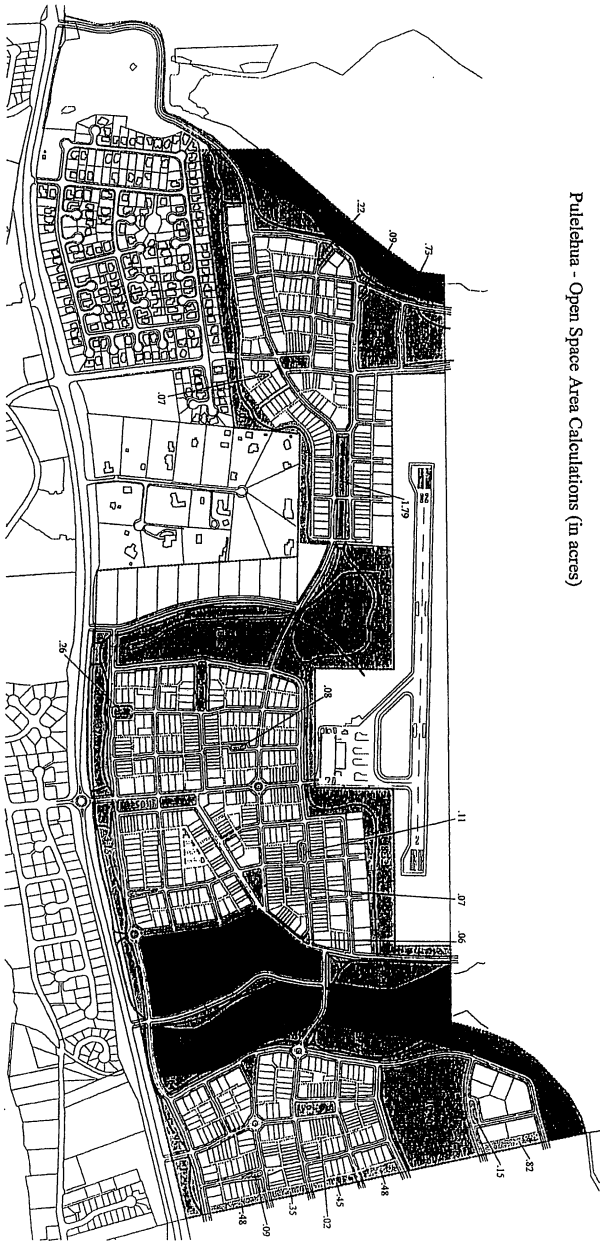
Leilani Pulmano
Development Coordinator

/lp

Enclosure

cc: John Buck, Deputy Director, Department of Parks and Recreation
Patrick Matsui, Chief of Planning and Development, Department of Parks and Recreation
Tom Schnell, PBR Hawaii

Kapalua



Pulelehua - Open Space Area Calculations (in acres)

Kapalua

December 30, 2004

Mr. Gilbert Coloma-Agaran
Director
Department of Public Works &
Environmental Management
County of Maui
200 S. High Street
Wailuku, Hawaii 96793

Aloha Mr. Coloma-Agaran,

As you are aware, we have had several meetings with your team to review the street sections for Pulelehua (see enclosure). We are scheduled to meet with the Mayor and the Housing Technical Review Committee on February 25 to ensure all open issues have been addressed.

As designed, the street sections will maintain lower speeds enhancing pedestrian walkability and safety, while providing adequate access for emergency vehicles. The Fire Department has given their approval of the streets sections (see enclosure).

We would like to work out any outstanding issues concerning the street sections with your department prior to the 25th. Should you have any questions or need additional information, please contact me at your earliest convenience.

Mahalo,

Karl Bossert
Development Manager

/lp:kpb

Enclosures

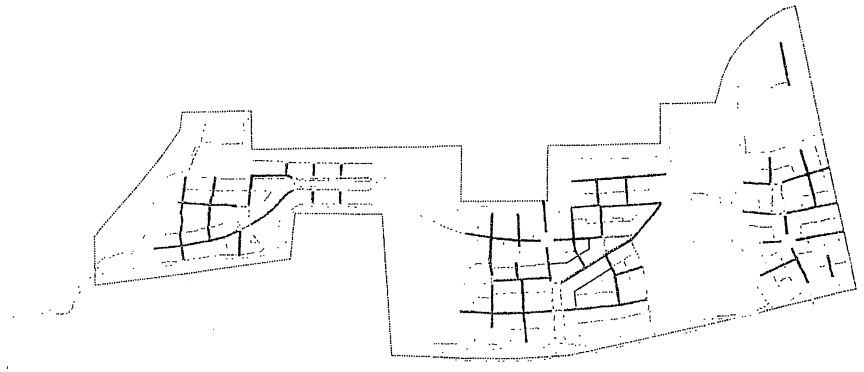
cc:

Kapalua Land Company, Ltd. • 1000 Kapalua Drive • Kapalua, Maui, Hawaii 96761 • www.kapaluamaui.com
(808) 669-5622 • Fax (808) 669-5454

Milton Arakawa -	Deputy Director, Department of Public Works and Environmental Management
Cary Yamashita -	Division Chief, Department of Public Works & Environmental Management
Mike Foley -	Director, Planning Department
Herman Andaya -	Deputy Director, Department of Housing & Human Concerns
Tom Schnell-	PBR Hawaii
Bob McNatt -	Kapalua Land Co., Ltd.
Leilani Pulmano -	Kapalua Land Co., Ltd.

Kapalua

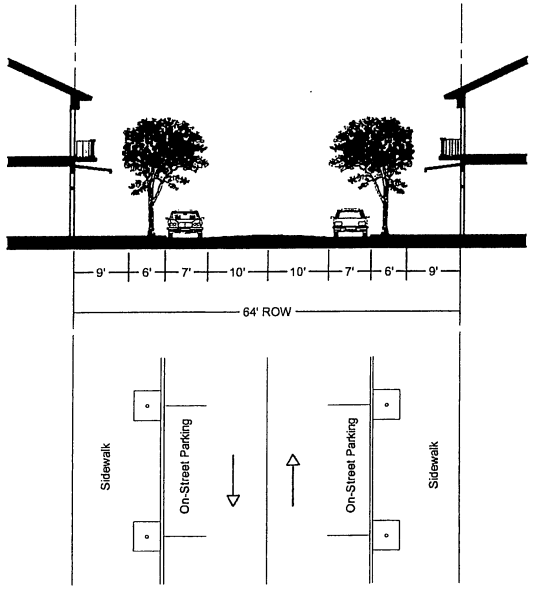
Street Type Locator Diagram



- Main Street (MS 64)
- Avenue (AV 60)
- Green Street (ST 35)
- Green Street (ST 25)
- Street (ST 44)
- Drive (DR 57)
- Drive (DR 50)
- Road (RD 50)
- Alley (A 20-20)
- Rear Lane (LA 20-10)
- Trail (TR 16-8)
- Pedestrian Street (PED 30)

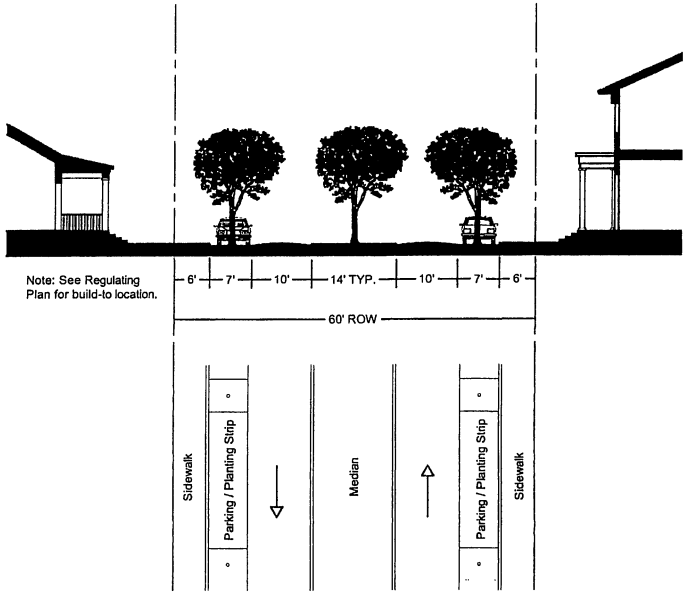
**Note: The above diagram illustrates where each of the street types occur in the plan. Refer also to the Regulating Plan drawing, which regulates which street types are assigned to each segment of roadway in the plan.*

(MS 64 7/10/10/7): Main Street



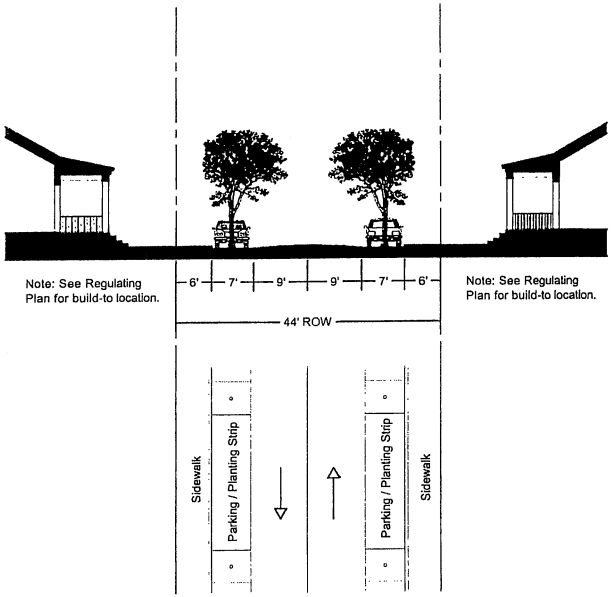
Travel Lane(s): 20'
On-Street Parking: Yes
Sidewalk with tree wells: 15'

(AV 60 7/10/10/7): Avenue



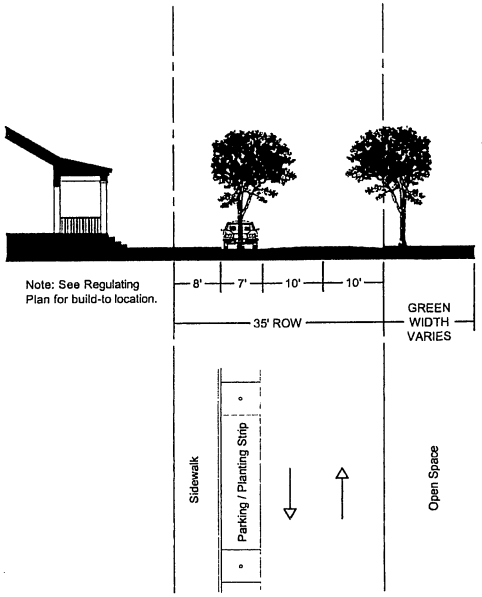
Travel Lane(s): 20'
On-Street Parking: Yes
Median: 14'
Planting/ Parking Strip: 7'
Sidewalk: 6'

(ST 44 7/9/9/7): Street



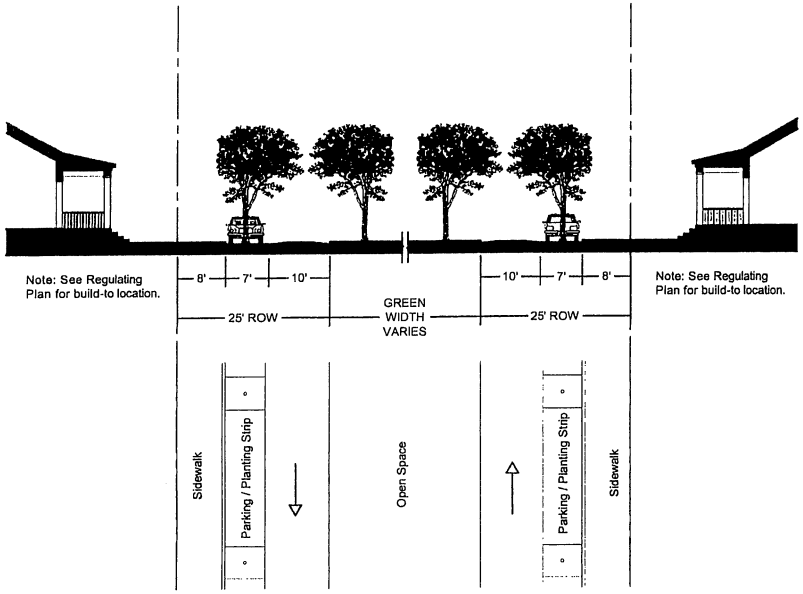
Travel Lane(s): 18'
On-Street Parking: Yes
Planting/ Parking Strip: 7'
Sidewalk: 6'

(ST 35 7/10/10): Green Street



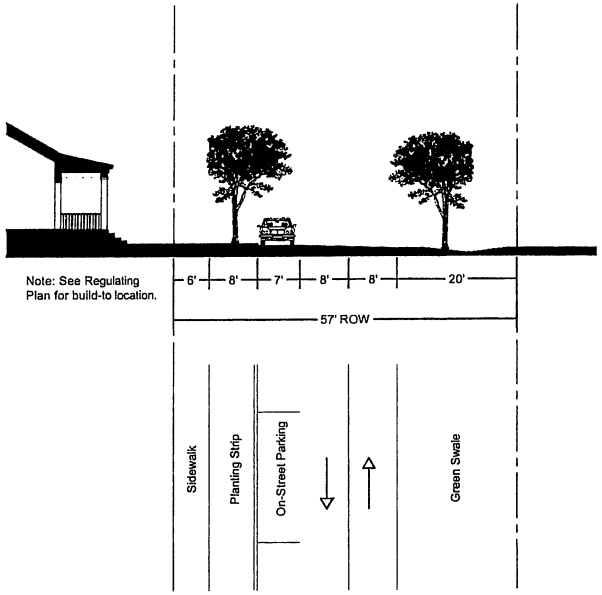
Travel Lane(s): 20'
On-Street Parking: Yes
Planting/ Parking Strip: 7'
Sidewalk: 8'

(ST 25 7/10): Green Street



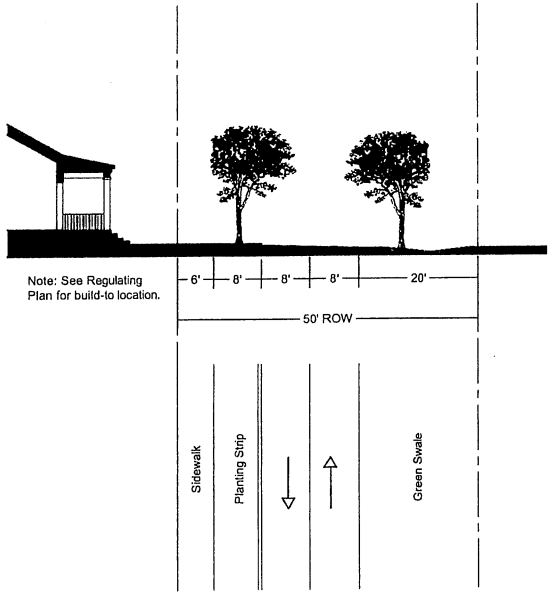
Travel Lane(s): 20'
On-Street Parking: Yes
Planting/ Parking Strip: 7'
Sidewalk: 8'

(DR 57 7/8/8): Drive



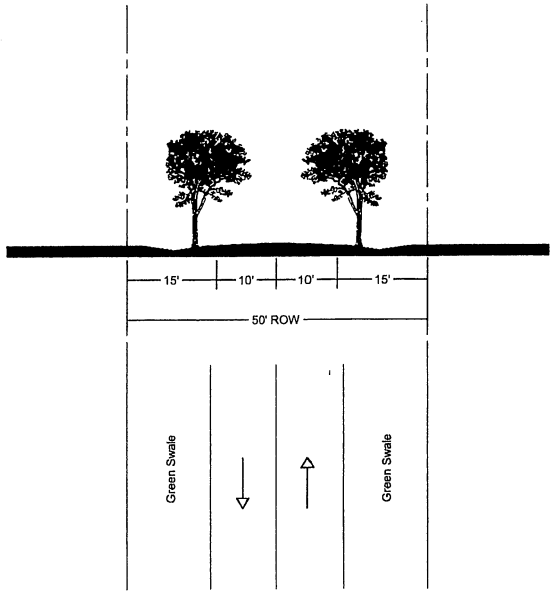
Travel Lane(s): 16'
On-Street Parking: Yes
Planting Strip: 8'
Sidewalk: 6'

(DR 50 8/8): Drive



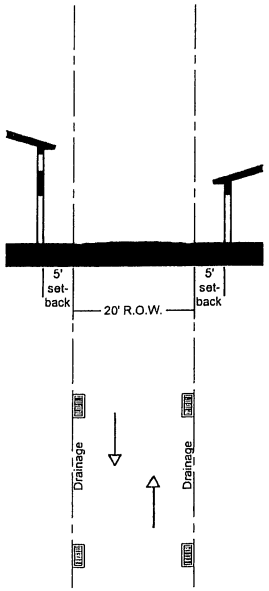
Travel Lane(s): 16'
On-Street Parking: No
Planting Strip: 8'
Sidewalk: 6'

(RD 50 10/10): Road



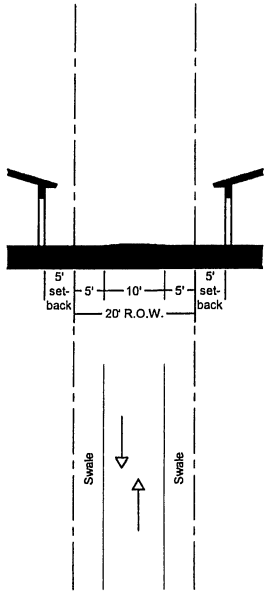
Travel Lane(s): 20'
On-Street Parking: No
Planting Strip: 15' swale
Sidewalk: No

(A 20-20): Alley



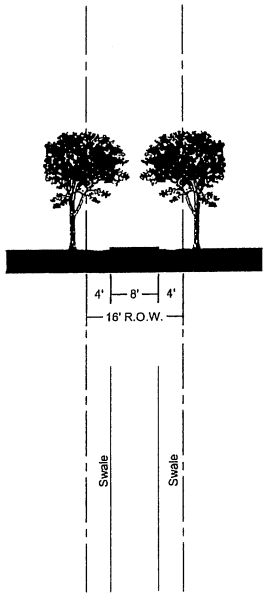
Travel Lane(s): 20'
On-Street Parking: No
Planting Strip: N/A
Sidewalk: N/A

(LA 20-10): Rear Lane



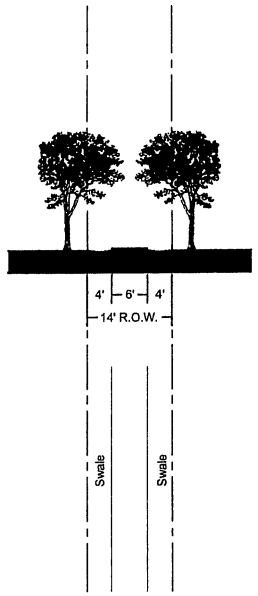
Travel Lane(s): 10'
On-Street Parking: No
Planting Strip: 5' swale
Sidewalk: N/A

(TR 16-8): Trail



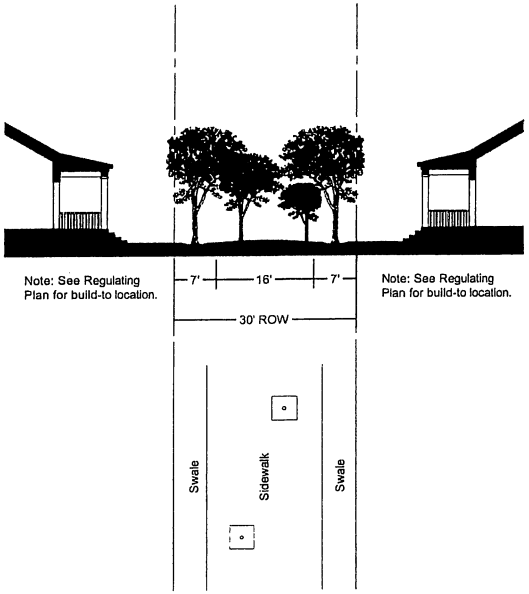
Walking and Biking Way: 8'
On-Street Parking: N/A
Planting Strip: 4' swale
Sidewalk: N/A

(PA 14-6): Path



Walkway: 6'
On-Street Parking: N/A
Planting Strip: 4' swale
Sidewalk: N/A

(PED 30): Pedestrian Street



Walking and Biking Way: 16'
On-Street Parking: N/A
Planting Strip: 7' swale
Sidewalk: N/A

ALAN M. ARAKAWA
Mayor

MILTON M. ARAKAWA, A.I.C.P.
Director

MICHAEL M. MIYAMOTO
Deputy Director

Telephone: (808) 270-7745
Fax: (808) 270-7975

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
AND ENVIRONMENTAL MANAGEMENT
ENGINEERING DIVISION
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

RALPH NAGAMINE, L.S., P.E.
Development Services Administration

TRACY TAKAMINE, P.E.
Wastewater Reclamation Division

CARY YAMASHITA, P.E.
Engineering Division

BRIAN HASHIRO, P.E.
Highways Division

Solid Waste Division

February 1, 2005

Mr. Karl Bossert
Kapalua Land Company, Ltd.
1000 Kapalua Drive
Kapalua, HI 96761

SUBJECT: PULELEHUA DEVELOPMENT
STREET SECTIONS

Dear Mr. Bossert:

Thank you for your letter dated December 30, 2004 regarding the street sections proposed for the Pulelehua Development in Kapalua Maui. Upon review of the submitted documents, we offer the following comments:

1. As discussed in previous meetings with project staff, consultants, and County of Maui personnel, although we understand that it is the intent of the developers to eventually dedicate the roadways to the County of Maui, the proposed street sections are non-standard and it is recommended that they remain under private ownership. If dedication is still the intent, for timely progression of this project we recommend that other avenues toward dedication be pursued aside from "standardizing" the proposed sections.

2. Are all roadway sections provided for review intended for dedication? Please confirm.

3. Per previous meetings, project consultants have stated that the street sections under review are a result of research and similar sections have been used in locations in the United States however, no documents supporting the proposed roadway sections have been presented in the meetings. Please provide us with reports and/or documents as a result of this research supporting the use of the proposed sections.

4. On the drawing provided for the "LA 20-10: Rear Lane," the section calls for two-way traffic within a ten-foot wide pavement section. Is it intended that the drainage swales act also to provide passing space should larger vehicle's approach from oncoming directions?

Thank you once again for the opportunity to comment on this project. If you have any questions, please contact the department at 270-7845.

Sincerely,

for MILTON M. ARAKAWA, A.I.C.P.
Director of Public Works
and Environmental Management

CY/NY:c(ED05-107)
S:\ENG\ENGTRAF\05 Response Letters\ltr-Pulelehua-KBossert-02105.wpd

xc: Engineering Division - Traffic Section

February 18, 2005

Milton M. Arakawa, A.I.C.P., Director
Department of Public Works and Environmental Management, County of Maui
Engineering Division
200 South High Street
Wailuku, Hawaii 96793

Re: Pulelehua Development TMK (2) 4-3-01: 31 (portion)
Department of Public Works and Env. Mgmt Letter (date 2-1-05)

Dear Director Arakawa:

Thank you for your letter dated February 1, 2005 responding to our correspondence of December 30, 2004 concerning street sections. Maui Land and Pineapple Company (MLP) has worked closely with planners and traffic engineers to develop a street section design standard that provides a balance between traffic calming and functionality. MLP would like to response to your letter and address some additional outstanding areas with your department.

MLP would like to respond to the comments in your correspondence concerning street sections as follows:

1. MLP has visited many developments where these types of street sections function very well. We feel confident that we can demonstrate that the County can service and maintain these street sections without any negative impact. Further we feel that these street sections represent the most current design practices in addressing pedestrian and vehicular safety.

2. It is our intent to dedicate all of the roadway systems within Pulelehua to the County with two exceptions. MLP plans to retain

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ownership of the network of Alleys and Rear Lanes that are distributed throughout Pulelehua.

3. MLP will provide the County, a list of several developments which currently utilize similar street sections as those proposed in Pulelehua. We will also attempt to provide statements from representatives of the municipalities and developers for each of the developments.

   We would encourage the Engineering Division to contact these developers and municipal representatives to discuss the details of the street sections in question once the list is available.

   MLP will also compile a list of studies, journal articles and reports that address street sections such as those proposed by MLP. The list will also support the contention that the street sections in question provide maintainability and access for emergency vehicles while enhancing safety for pedestrians as well as drivers and passengers in vehicles. We hope to provide some information as soon as February 25th.

4. MLP intends to retain possession of all Alley and Rear Lane systems. The design for the Rear Lanes street section is based on a two-way traffic design that allows give-way access by utilizing the five foot swales on each side of the travel lane.

In addition to the street sections, there are a few other areas that MLP would like review with your department through this correspondence.

Waste Water -
During several meetings with the Public Works staff, MLP articulated its plans to address waste water treatment for the Pulelehua development. Further, MLP presented its plan to your predecessor, Mr. Gil Coloma-Agaran, in writing through our engineering firm (Otomo Engineering) see attached letter.

The plan consists of constructing gravity sewer lines and pump stations, as needed, along the mauka side of Honoapi`ilani Highway. This system would bring waste water from the Pulelehua to the Lahaina Waster Water Reclamation Plant. All offsite distribution system costs between Pulelehua and the reclamation plant would be absorbed by MLP.

Mr. Agaran expressed verbal agreement with this planned approach as it provided additional infrastructure over a distance of approximately 3,500 feet along the mauka side of the highway. MLP agreed the infrastructure could also be used to support other future developments in the area. While emails were sent to Mr. Coloma-Agaran requesting formal concurrence with this approach, he left office prior to providing the department's agreement. MLP continues to seek written acceptance of this plan from Public Works.

Solid Waste
During conversations with Mr. Mike Souza, Solid Waste Division Chief, MLP requested concurrence with the proposed street sections. Mr. Souza indicated that the Alley and Rear Lane street sections could accommodate Solid Waste Division's equipment. MLP seeks written acceptance of this plan from Public Works.

R-1 Water
MLP's plan is to use R-1 water for irrigation of all common areas within Pulelehua. This includes apartment buildings, commercial retail areas, parks, trails and the school playground. This approach was verbally confirmed in December 2004 as consistent with County standards by Mr. Steve Prabacoli who manages the R-1 Water Program on Maui.

Let me express my thanks to you and your staff for all their help on the many issues related to the Pulelehua. As you know we are currently scheduled to meet with the Affordable Housing Technical Review Committee next week on February 25th at 9:30 am. We hope to gain your department's concurrence on as many topics as possible prior to the meeting. This will allow for a very productive meeting where we can focus more closely on any unresolved issues.

I am sure that working together with your staff we can resolve any residual concerns you may have.

Sincerely,

Karl Bossert
Development Manager
Community Development

cc: Cary Yamashita, Public Works, Engineering Division, County of Maui
Herman Andaya, Housing and Human Concern
Mike Foley, Department of Planning, County of Maui
Bob McNatt, Maui Land and Pineapple Company, Inc.
Randy Endo, Maui Land and Pineapple Company, Inc.
Leilani Pulmano, Maui Land and Pineapple Company, Inc.
Tom Schnell, PBR Hawaii

October 12, 2004

OTOMO
ENGINEERING, INC.
CONSULTING CIVIL ENGINEERS
305 SOUTH HIGH STREET, SUITE 102
WAILUKU, MAUI, HAWAII 96793
PHONE: (808) 242-0032
FAX: (808) 242-5779

Mr. Gilbert Coloma-Agaran, Director
Department of Public Works and
Environmental Management
County of Maui
200 South High Street
Wailuku, Hawaii 96793

Dear Mr. Coloma-Agaran:

Subject: Sewer System Alternatives for Pulelehua
T.M.K.: (2) 4-3-001: por. 031
Lahaina, Maui, Hawaii

After reviewing alternatives to providing sewer facilities to Pulelehua, Kapalua Land Company, Ltd. (KLC) is considering a system located mauka of Honoapiilani Highway. Said system will consist of a sewer pump station at the northerly limit of the project site to a gravity flow system from Akahele Street to the Lahaina Wastewater Reclamation Plant. The gravity flow system will connect to the County's Pump Station No.1, which will transport the wastewater into the reclamation plant. Said pump station is located on the southerly side of the reclamation plant and pumps wastewater directly into the headworks at the plant. Attached is a sketch showing the onsite portion of the proposed system.

To the south of the Pulelehua project, the proposed sewerline will traverse lands owned by the Department of Hawaiian Home Lands (DHHL). KLC will negotiate the required easements from the DHHL.

The proposed sewer system will not connect to the existing County system on Lower Honoapiilani Road. In view of the foregoing, the proposed sewer system will not affect the capacity of the existing sewer system along Lower Honoapiilani Road and would not need to participate in upgrading that portion of the system.

The build out of Pulelehua is planned to consist of 13.3 acres of school (estimated enrollment of 650 elementary school students), 21,475 square feet of retail space, 75,000 square feet of retail/office space, 78,000 square feet of workplace edge, 882 residential units (442 multi-family and 440 single family units), 318 potential ohana units. Based on this development mix, it is estimated that the total project will generate 345,688 gallons of wastewater daily. These areas and unit counts are subject to change based on final design.

We would appreciate any comments on KLC's proposal. In addition, please advise us on what improvements the Pulelehua project will be required to undertake at the reclamation plant and Pump Station No. 1.

Thank you for your assistance on this project. Should you have any questions or need additional information, please call me.

Sincerely,

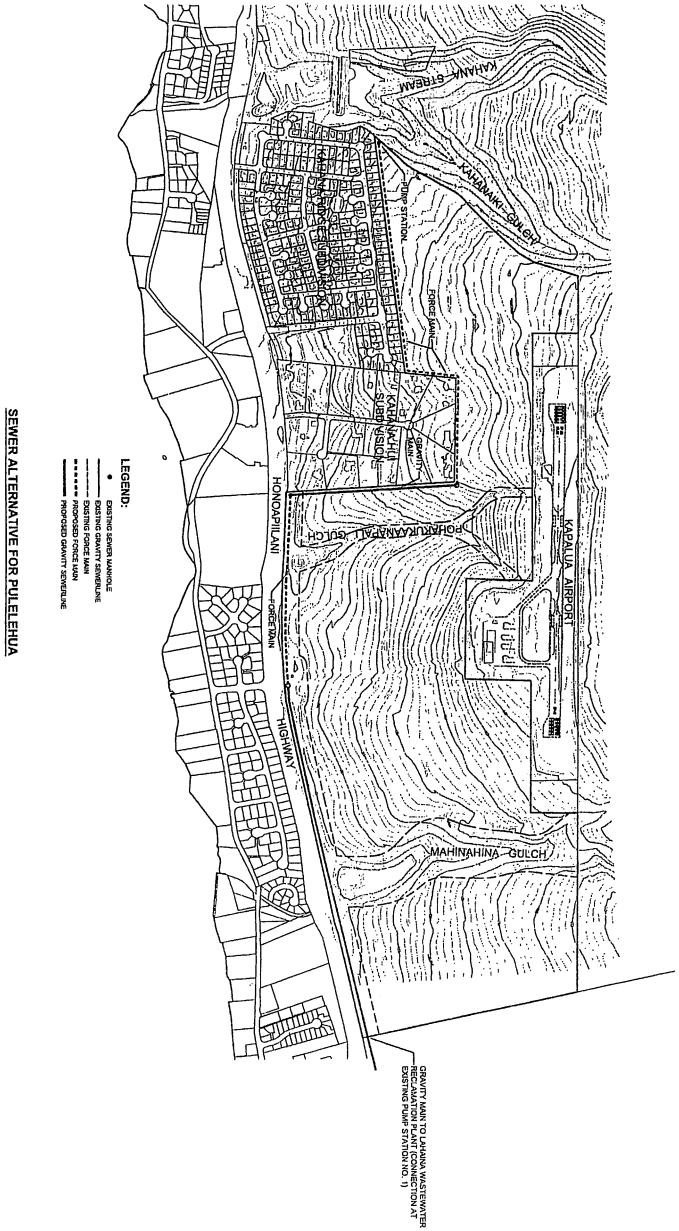
OTOMO ENGINEERING, INC.

Stacy A. Otomo

Stacy A. Otomo, P.E.
President

Enclosure

c: Mayor Alan Arakawa w/ Enclosure
Keith Regan w/ Enclosure
Herman Andaya w/ Enclosure
Bob McNatt w/ Enclosure
Karl Bossert w/ Enclosure
Leilani Pulmano w/ Enclosure
Tom Schnell w/ Enclosure



SEWER ALTERNATIVE FOR PULELEHUA

ALAN M. ARAKAWA
Mayor

GLENN T. CORREA
Director

JOHN L. BUCK III
Deputy Director

(808) 270-7230
Fax (808) 270-793

DEPARTMENT OF PARKS & RECREATION

700 Hali'a Nakoa Street, Unit 2 , Wailuku, Hawaii 96793

February 4, 2005

RECEIVED
FEB 09 2005
DEVELOPMENT OFFICE

Ms. Leilani Pulmano, Development Coordinator
Kapalua Land Company, Ltd.
1000 Kapalua Dr.
Lahaina, Hi 96761

Dear Ms. Pulmano:

SUBJECT: PULELEHUA DEVELOPMENT

Thank you for the information provided concerning park development for the Pulelehua Development. From the map that was transmitted, we were unable to distinguish the park lands designated for trails, neighborhood parks, and community gardens. However, we are submitting the following comments:

1. We are in support of the 10.4 acre active recreational fields at the south end of the project. We would be willing to accept dedication of the land and maintenance by the County.
2. All of the other parks acreage, including the neighborhood parks, should remain privately owned and maintained.
3. Regarding your request to receive future credit for lands dedicated in excess of the required acreage, we are not in favor of this. The approximately 90 acres of park lands in excess of the requirements for the project is equivalent to a waiver of the approximately 7,840 residential units from future park dedication. In addition, the 90 acres of park lands will be used primarily by the residents of Pulelehua and not so much by the general public.
4. We would be amenable to giving excess credits if the 10.4 acre active fields were expanded.
5. For your information, the park dedication ordinance requires a restroom and parking for each park unless waived by the Maui County Council. We would be in favor of supporting this waiver for all parks serving the immediate neighborhood.

Please feel free to contact me or Mr. Patrick Matsui, Chief of Parks Planning and Development at 270-7387 should you have any other questions on this matter.

Sincerely,

GLENN T. CORREA
Director

c: Patrick Matsui, Chief of Parks Planning and Development
Mayor Alan Arakawa

March 1, 2005

Rodney K. Haraga, Director
Department of Transportation, State of Hawaii
Statewide Transportation Planning Office
869 Punchbowl Street, Room 404
Honolulu, Hawaii 96813-5097

Re: Pulelehua TMK (2) 4-3-01: 31 (portion)
DOT Response to EIS Preparation Notice (STP 8.1335)
PBR Hawaii Response to DOT Letter 10/6/04 (STP 8.1335)

Dear Director Haraga:

Thank you for your letter dated August 26, 2005 responding to our Pulelehua Environmental Impact Statement Preparation Notice. Maui Land & Pineapple Company (MLP) has worked in conjunction with the DOT and federal agencies, as well as outside consultants, to review and address the points raised in your correspondence.

The following outlines the detailed steps taken to identify the specific requirements and address the specific concerns of DOT regarding MLP's proposed Pulelehua community. Also attached for your review are selected draft versions of studies that have been performed and maps which illustrate information relevant to Pulelehua. The final versions of these reports will be included in our draft EIS. The foregoing follows the format of the DOT response letter.

A. HIGHWAY ISSUES

1. Traffic Impact Analysis Report (TIAR) – A comprehensive TIAR has been commissioned and prepared for the Pulelehua community. This report covers a total of 10 miles along Honoapi`ilani Highway (approximately three miles north and seven miles south of Akahele Street), which parallels the Pulelehua. The draft version of the report, including all appendices, is attached for your review.

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The report is based on actual vehicle counts performed during peak AM and PM hours at several intersections along Honoapi`ilani Highway plus historical data (which was adjusted to 2004 levels). In addition, current road conditions, such as the number of lanes, signal locations and signal light timing were also accounted for in the report.

This data was used to model future conditions along the Honoapi`ilani Highway using the Arterial Level of Service methodology. The software used (Synhro and ARTPLAN) modeled additional trips generated by the Pulelehua community. The trip generation numbers were based on total residential unit counts, potential ohana counts (assumed all 318 ohanas would be built), as well as total commercial and retail space included in the development.

The TIAR also modeled all known or planned development along the Honoapi`ilani Highway projected to be built by the Pulelehua build out date of 2011 (see paragraph 4). The results of the TIAR, as well as the mitigation measures are contained in the report.

2. Potential Improvements
   a. A traffic engineer was consulted to determine the optimum number of access points along Honoapi`ilani Highway. The current design provides for the least impact to overall highway traffic while providing a reasonable the number of access points. The current design provides a balance of good highway throughput along the entire community while not overloading the intersection at Honoapi`ilani Highway and Akahele Street.

   b. Improvements to Honoapi`ilani Highway were evaluated in the mitigation section of the TIAR and include adjustments to traffic signal timing. The TIAR results did not indicate the need for widening Honoapi`ilani Highway due to the Pulelehua community alone or in conjunction with impact from other future potential developments (see paragraph 4).

3. The TIAR Level of Service (LOS) model results show a slightly better LOS using a roundabout at the intersection of Honoapi`ilani Highway and Akahele Street, and an improvement in safety would also be expected. Not withstanding these results, MLP has taken into consideration your department's reservations and has eliminated the roundabout from the Pulelehua design.

4. In addition, 24 other developments were modeled using the same software to evaluate the total impact to Honoapi`ilani Highway over the same 10 mile report coverage area. The list of developments used constitutes all current and known planned developments projected to be built over the next seven years.

5. The TIAR took into consideration the local internal roadway that runs along the entire length of the Pulelehua development parallel to Honoapi`ilani Highway. This parallel roadway system, along with a complete grid system of internal roads, mitigates the impact to the State system.

6. A Preliminary Drainage Report has been developed for Pulelehua and includes a proposed drainage plan. MLP has no current plans to extend Pulelehua mauka of the airport. The proposed drainage plan includes a design whereby all additional runoff generated by the Pulelehua community will be retained on site. This is being accomplished by a greenbelt that runs mauka along Honoapi`ilani Highway and other measures internal to the community. This area will serve as a landscape buffer as well as a retention / detention basin to mitigate increased runoff.

   Offsite retention / detention basins will be constructed mauka of the airport (but outside the airport approach slope mauka of the runway). These basins will reduce the runoff sheet flowing mauka into Pulelehua from current MLP agricultural operations.

7. MLP agrees to contribute its fair share to regional and local transportation improvements. Meetings should be scheduled between the DOT and MLP to determine an agreed to basis for this contribution.

B. AIRPORT ISSUES

1. MLP has taken into consideration possible requirements in the event TSA initiates security screening activities at West Maui Airport. The TSA requirement for security screening calls for an access buffer of 300 feet from any edge of the terminal building. The current Pulelehua design provides for this access buffer.

Additionally, a large level intersection on Akahele Street has been designed to allow an area for TSA personnel to establish a security screening checkpoint in the event one would be needed. The location of this checkpoint is outside the 300 foot buffer and provides queuing of vehicles makai on Akahele Street. Currently the only level area outside the 300 foot buffer is at the intersection of Akahele Street and Honoapi`ilani Highway where queuing would occur along the highway itself.

2. Lands adjacent to the Airport-MLP does not have any plans to develop its property mauka of the airport at this time (during the design charrette, members of the public suggested future development in that area but that is not included in our current proposal).

   a. The Pulelehua development plan has been modified to address the Runway Protection Zone (RPZ). MLP has used the FAA Design Group III design criteria based on the Dash 8 aircraft for the sizing of the RPZ. The Type III design designation calls for a trapezoid RPZ of 1,000 feet long by 500 feet (narrow end) and 700 feet (wide end). This RPZ starts 200 feet from the end of the runway threshold (see attached map).

      (1) MLP is open to discussing options to sell or trade lands in exchange for the land currently covered by the RPZ.

      (2) MLP agrees to move the recreational field on the south end of Runway 2 (see attached map). The Pulelehua community plan shows an open area directly under the flight path. This area could contain acceptable uses such as parking lots, cemeteries or agricultural activities, including ag roads (provided the agricultural activity is not an attractant to birds or other wildlife that may be hazardous to flight operations).

      (3) The community gardens have been relocated away from the flight path of Runway 20 (see attached map) as requested. The Pulelehua plan shows open space directly under the flight path. This area could contain acceptable uses such as parking lots or agricultural activities, including ag roads (provided the agricultural activity is not an attractant to birds or other wildlife

that may be hazardous to flight operations).

(4) The roadways that were connecting Pulelehua with lands mauka of the airport have been removed (see attached map).

b. The Pulelehua plan does not show any development within the 300 foot Runway Safety Area (RSA) on either end of the runway (see attached map).

c. The Pulelehua plan does not show any development within the 800 foot wide Runway Obstacle Free Area (ROFA) which is centered on the runway (see attached map). MLP is open to discussing options to sell or trade lands in exchange for the land currently covered by the ROFA.

d. MLP contracted and funded an airport noise consultant to prepare a noise study for the Pulelehua development with the concurrence of your staff. The resulting report is attached for your review. The study used the Integrated Noise Model methodology and was conducted by recognized expert, Vincent Mestre, who has previously provided these services to the DOT. Actual noise readings were taken and matched to the flight logs to determine the airframe for each noise event. Two sets of noise contours were developed from this data.

The first set of noise contours modeled the L_{DN} based on current annual level of flight operations. This represented the current number of flights assuming a take off and landing for each fight (approximately 15 flights per day).

The second set of noise contours assumed the maximum number of flights allowed per day. This represents 75 flights per day or 140 flight operations (one take off and one landing for each flight).

Using the maximum number of flight operations per day, all residential units were outside the L_{DN} noise contours where residential units were prohibited, in compliance with FAA and State of Hawaii DOT (Airports Division) requirements. The elementary school is located in an area below the 55 L_{DN} noise

contour, also in compliance with FAA and State of Hawaii DOT (Airports Division) requirements.

e. MLP agrees to identify and submit for approval any impact to existing infrastructure lines, equipment and facilities.

f. MLP agrees to complete and submit for approval all applicable FAA forms and documents to both the Airport Division and the FAA before any work is to commence. Please inform us if the criteria for the State approval of FAA forms differ from the FAA criteria. This will ensure MLP satisfies both sets of requirements.

MLP believes that we have addressed all the concerns that have been raised by the DOT to date including a detailed review of Pulelehua with Brian Sekiguchi on February 9, 2005, who you appointed as the point of contact for the department.

We look forward to working with you and your staff in the completion of this extremely important community for the citizens of West Maui.

Sincerely,

Bob McNatt
General Manager, Community Development

cc: Mayor Alan Arakawa, Mayor's Office, County of Maui
Brian Sekiguchi, Department of Transportation, Airports Division
Steve Wong, Federal Aviation Administration
Mike Foley, Department of Planning, County of Maui
Milton Arakawa, Dept. of Public Works & Environmental Mgmt.
Anthony Ching, Land Use Commission
Genevieve Salmonson, Office of Environmental Quality Control
Randy Endo, Maui Land and Pineapple Company, Inc.
Karl Bossert, Maui Land and Pineapple Company, Inc.
Leilani Pulmano, Maui Land and Pineapple Company, Inc.
Tom Schnell, PBR Hawaii

Attachments: Traffic Impact Analysis Report (full report to R. Haraga only)
Airport Noise Report
Development Map (including airport restriction areas)