LINDA CROCKETT LINGLE
Mayor

DAVID W. BLANE
Director

GWEN OHASHI HIRAGA
Deputy Director

COUNTY OF MAUI
PLANNING DEPARTMENT
250 S. HIGH STREET
WAILUKU, MAUI, HAWAII 96793

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OFC. OF ENVIRONMENTAL QUALITY CONTROL

July 25, 1997

Mr. Gary Gill, Director
Office of Environmental Quality Control
235 South Beretania Street
Suite 702
Honolulu, Hawaii 96813

Dear Mr. Gill:

Subject: Final Environmental Assessment (EA) And Finding of No Significant Impact for the Kulamalu Project, a Development of 53.67 Acres of Property in Pukalani, Maui, Hawaii TMK 2-3-008:por. 5, por. 38, por. 39, Island of Maui, Hawaii

The Planning Department has reviewed the comments received during the 30-day public comment period which began on May 23, 1997. The Planning Department has determined that this project will not have a significant environmental effect and has issued a negative declaration. Please publish this notice in the August 8, 1997 Office of Environmental Quality Control (OEQC) Bulletin.

We have enclosed a completed OEQC Bulletin Publication Form and four copies of the Final EA. Please contact Don Schneider, Staff Plannner, at 243-7735 if you have any questions.

Very truly yours,

Lisa M. Nuyen
for DAVID W. BLANE
Planning Director

DWB:DAS
Enclosures
cc: Clayton Yoshida, AICP, Planning Program Administrator
Project File
General File
Milton Arakawa
Don Fujimoto
Don Schneider, Staff Planner
(C:oeqckulu.fin)

83

1997-08-08-MA-FEA-Kulamalu Project

Final
Environmental Assessment

Kulamalu Project

July 1997

Prepared for:

Kulamalu Limited Partnership

MUNEKIYO & ARAKAWA, INC.

Final
Environmental Assessment

Kulamalu Project

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Prepared for:

Kulamalu Limited Partnership

MUNEKIYO & ARAKAWA, INC.

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Preface

The applicant, Kulamalu Limited Partnership, proposes to construct the Kulamalu Project, located in Pukalani, Maui, Hawaii (TMK 2-3-8:por. 5, por. 38, por. 39). Pursuant to Chapter 343, Hawaii Revised Statutes, and Chapter 200 of Title 11, Hawaii Administrative Rules, this Environmental Assessment documents the project's technical characteristics, environmental impacts and alternatives, and advances findings and conclusions relative to the significance of the project.

Chapter I

Project Overview

I. PROJECT OVERVIEW

A. PROPERTY LOCATION AND EXISTING USE

The applicant, Kulamalu Limited Partnership, proposes to develop the Kulamalu Project on approximately 53.67 acres of property in Pukalani, Maui, Hawaii (TMK 2-3-8:por. 5, por. 38, por. 39). See Figure 1.

The subject property is bounded by Kula Highway, Kaluapulani Gulch, and an unnamed tributary to Kaluapulani Gulch. The subject property is being used as pasture. Vegetation includes grasses and low-growing shrubs such as guinea grass, lantana, sensitive plant, prickly pear, and koa-haole.

Most of the subject property is owned by Kulamalu Limited Partnership (TMK 2-3-8:5, 38). A portion is owned by Kamehameha Schools/Bishop Estate (TMK 2-3-8:39).

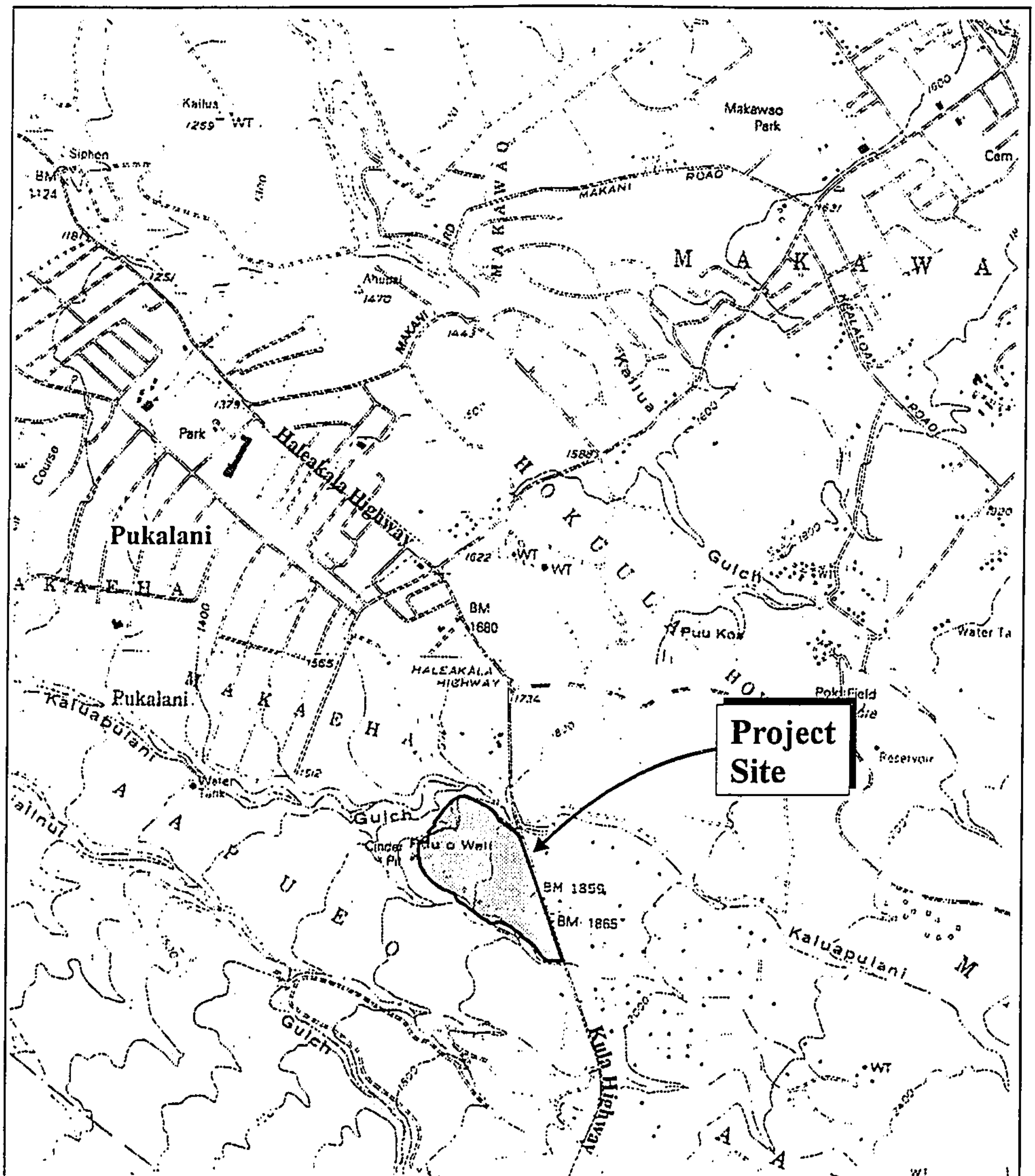
B. PROPOSED ACTION

The applicant is proposing a mix of business, multi-family residential, single-family residential, park, and public/quasi-public uses within the upper Pukalani area. See Figure 2 and Figure 3. The components for the Kulamalu Project are as follows:

1. Approximately 4.88 acres overlooking Kaluapulani Gulch is proposed as a multi-family elderly housing complex. Approximately 50 units are proposed in this area.

2. To the west of the multi-family use, a 5.03 acre area is set aside for a learning center pertaining to hula, Hawaiian chants and songs, history and genealogy.

3. Commercial areas abut one side of a through roadway extending to Kula Highway. The proposed business area encompasses 19.41 acres. A neighborhood commercial center, complying with



Source: United States Geological Survey Maps

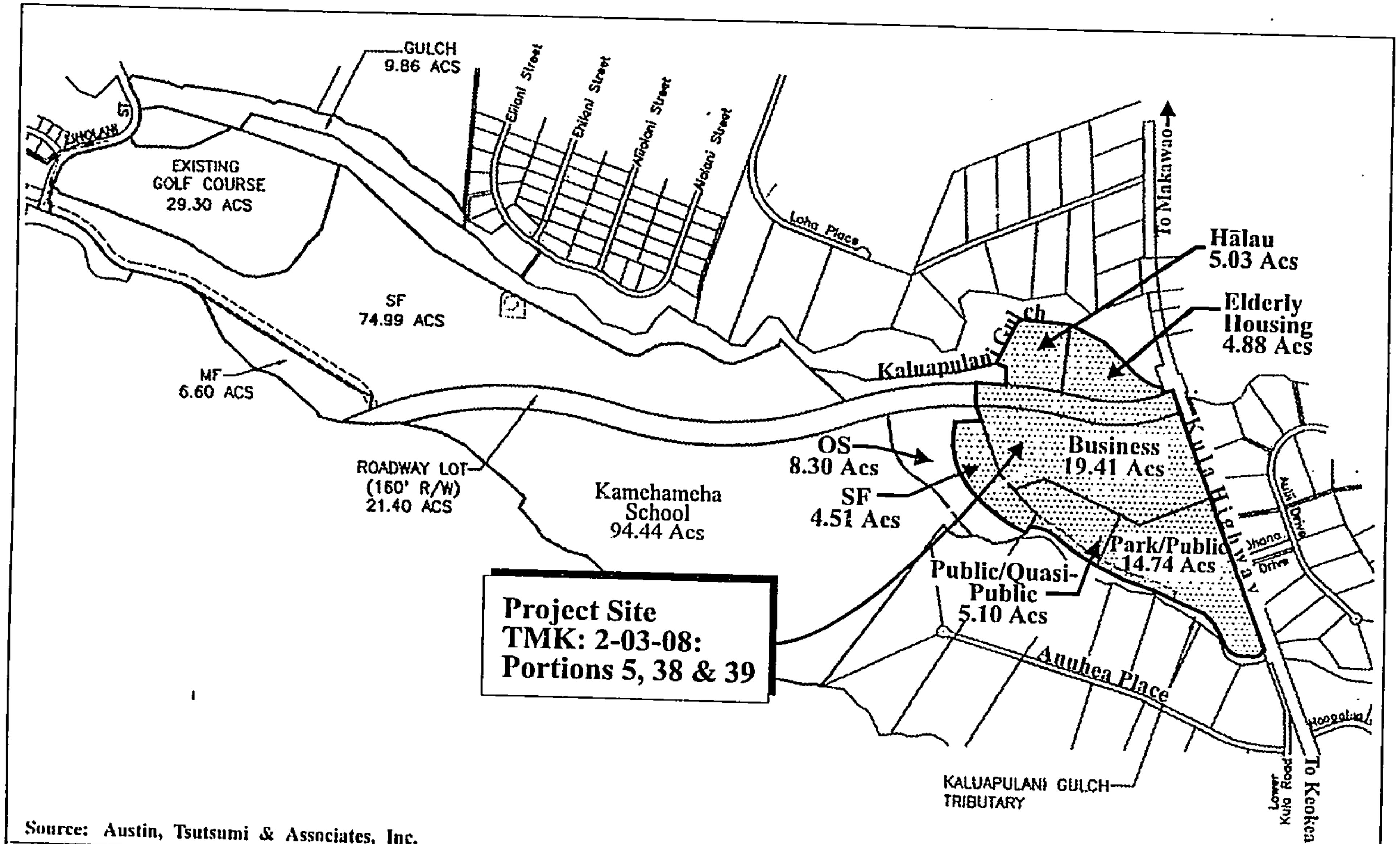
Figure 1

Kulamalu Project
Regional Location Map

MUNEKIYO & ARAKAWA, INC.

0 1000 2000 4000 Feet

Prepared for: Kulamalu Limited Partnership



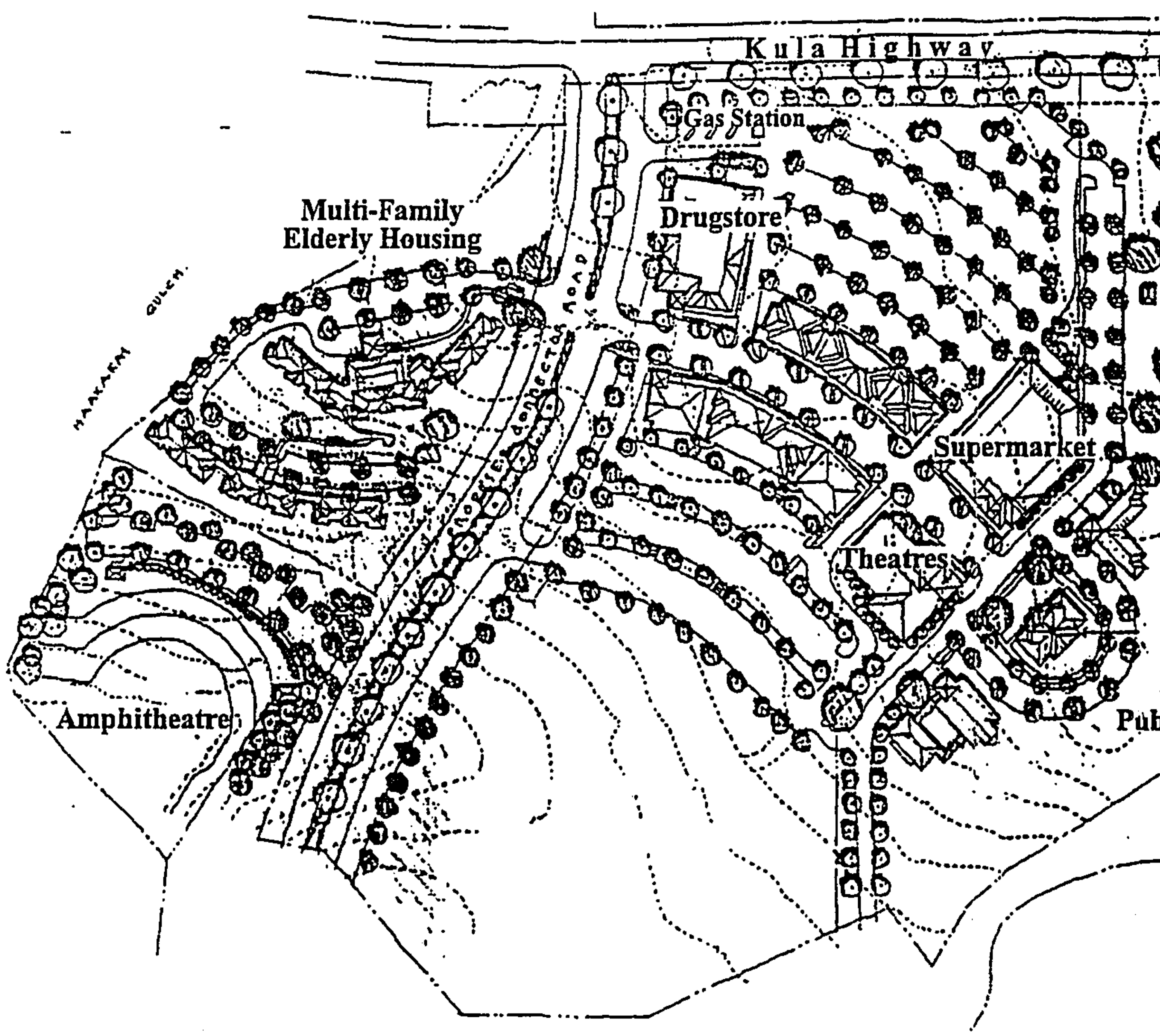
Source: Austin, Tsutsumi & Associates, Inc.

Figure 2

Kulamalu Project
Proposed Land Use Plan

Prepared for: Kulamalu Limited Partnership

0 500 1000 2000 Feet

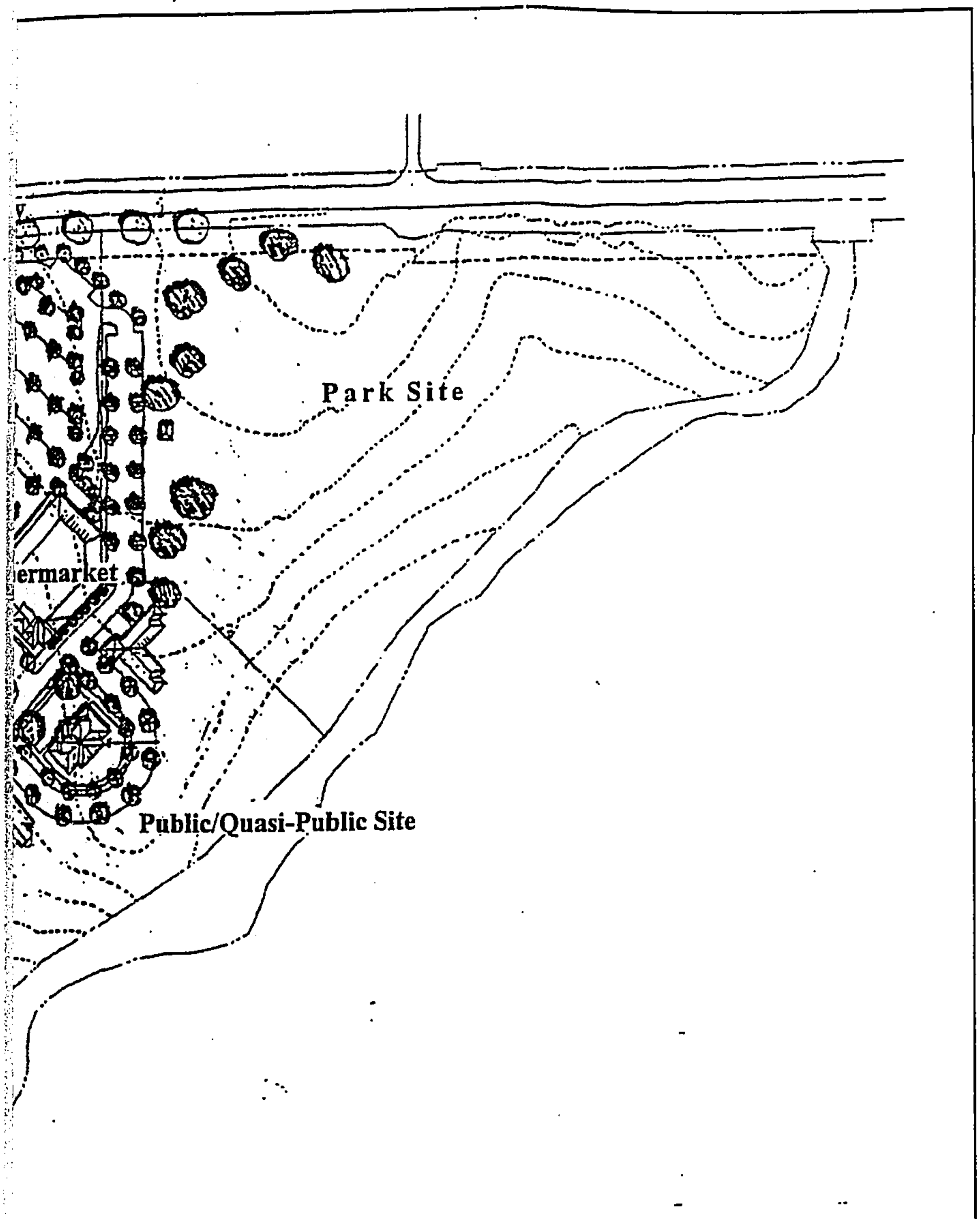


Source: Group 70

Figure 3

Kulamalu Project
Conceptual Site Plan

Prepared for: Kulamalu Limited Partnership



ι Project
Site Plan

MUNEKIYO & ARAKAWA, INC.

NOT TO SCALE

Business Country Town design guidelines, is proposed to consist of establishments such as the following:

a. A drug store of approximately 25,000 square feet;

b. A supermarket of approximately 15,000 square feet;

c. A theater of approximately 20,000 square feet;

d. Other commercial areas totalling approximately 75,000 square feet which could include restaurants, gas station, other personal services such as hair styling or dry cleaning, and entertainment such as video, records, or electronic/computer games; and

e. Medical/dental offices and other office uses may also be supported by the development.

4. A park of approximately 14.74 acres would abut Kula Highway. This is intended to be a neighborhood park containing facilities for active recreation.

5. To the west of the park is an approximately 5.10 acre public/quasi-public area. Possible uses for this public/quasi-public area include a church, day care center, and/or other public uses.

6. Approximately 4.51 acres of single-family residential areas are located to the west of the business area. This involves a reconfiguration of existing single-family residential areas. No additional acreages of single-family residential are proposed to be added.

A full-size site plan and site section of the project is shown in Appendix A.

Chapter II

Description of the Physical Environment

II. DESCRIPTION OF THE PHYSICAL ENVIRONMENT

A. PHYSICAL SETTING

1. Climate

The Pukalani area is generally cool and equable the entire year. Average annual rainfall ranges between 40 and 50 inches per year, with most rainfall occurring between October and April. The temperature ranges between the high 50's and the high 80's.

Like most areas of the Islands, the prevailing wind throughout the year is the northeasterly tradewind. These are generally more persistent in summer than in winter. Between about October and April, there may be increased frequency of the southerly winds of Kona storms. In the absence of the trades and nearby storms, winds may become light and variable. Then the diurnal heating and cooling of the land gives rise to onshore sea breezes during the day and offshore land breezes at night (Department of Geography, 1983).

2. Topography and Soil Characteristics

The moderately sloping project site ranges in elevation from 1,750 to 1,860 feet above sea level.

Underlying the site and surrounding lands are soils belonging to the Waiakoa-Keahua-Molokai association. See Figure 4. This soil association consists of moderately steep, well-drained soils that have a moderately fine textured subsoil located on low uplands. The soils specific to the subject site are Keahua silty clay loam, 3 to 7 percent slopes (KnB), Keahua cobbly silty clay loam, 15 to 25 percent slopes (KnaD), Keahua cobbly silty clay, 7 to 15 percent slopes (KnhC), and Rock land (rRK). See Figure 5.

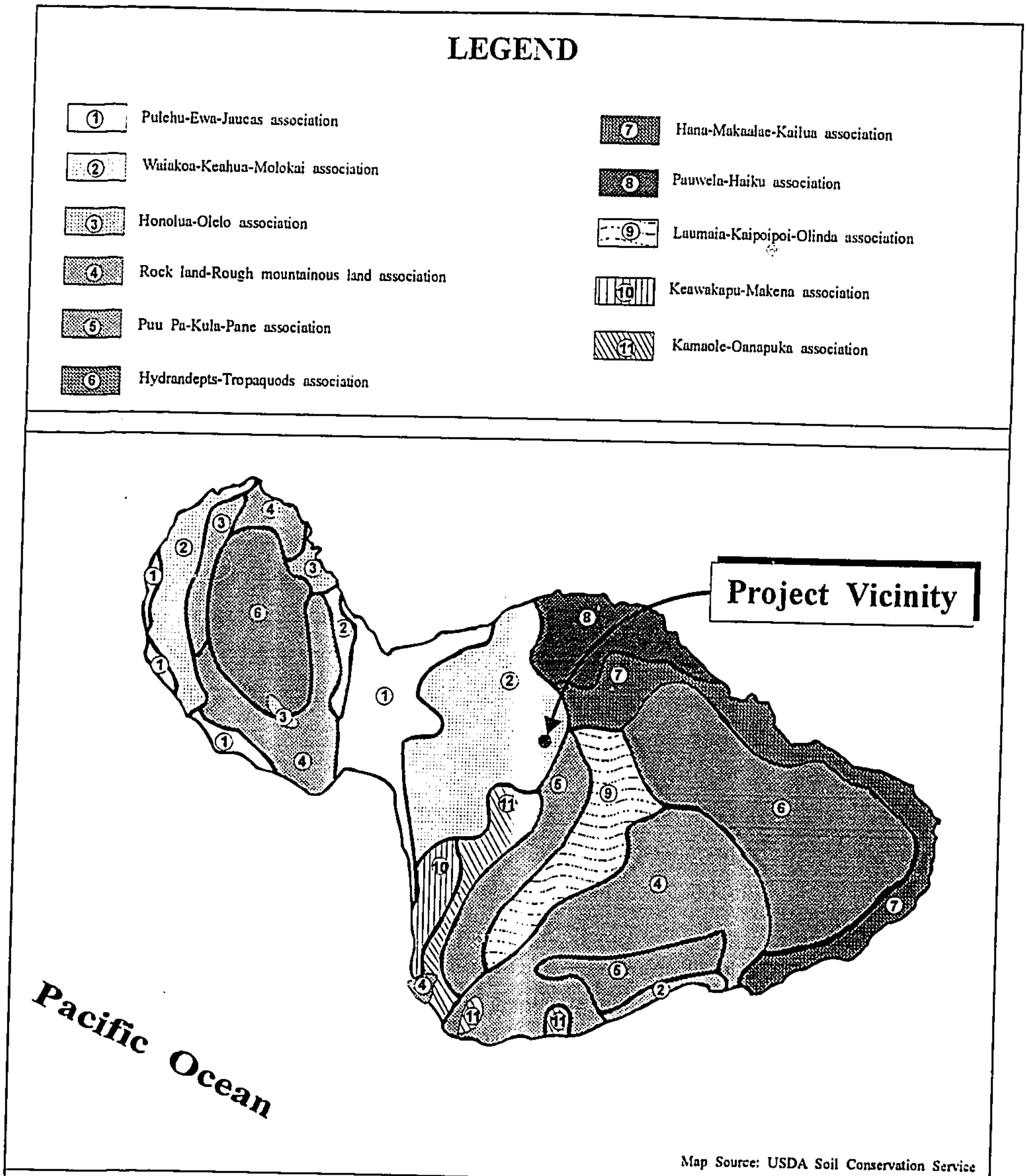


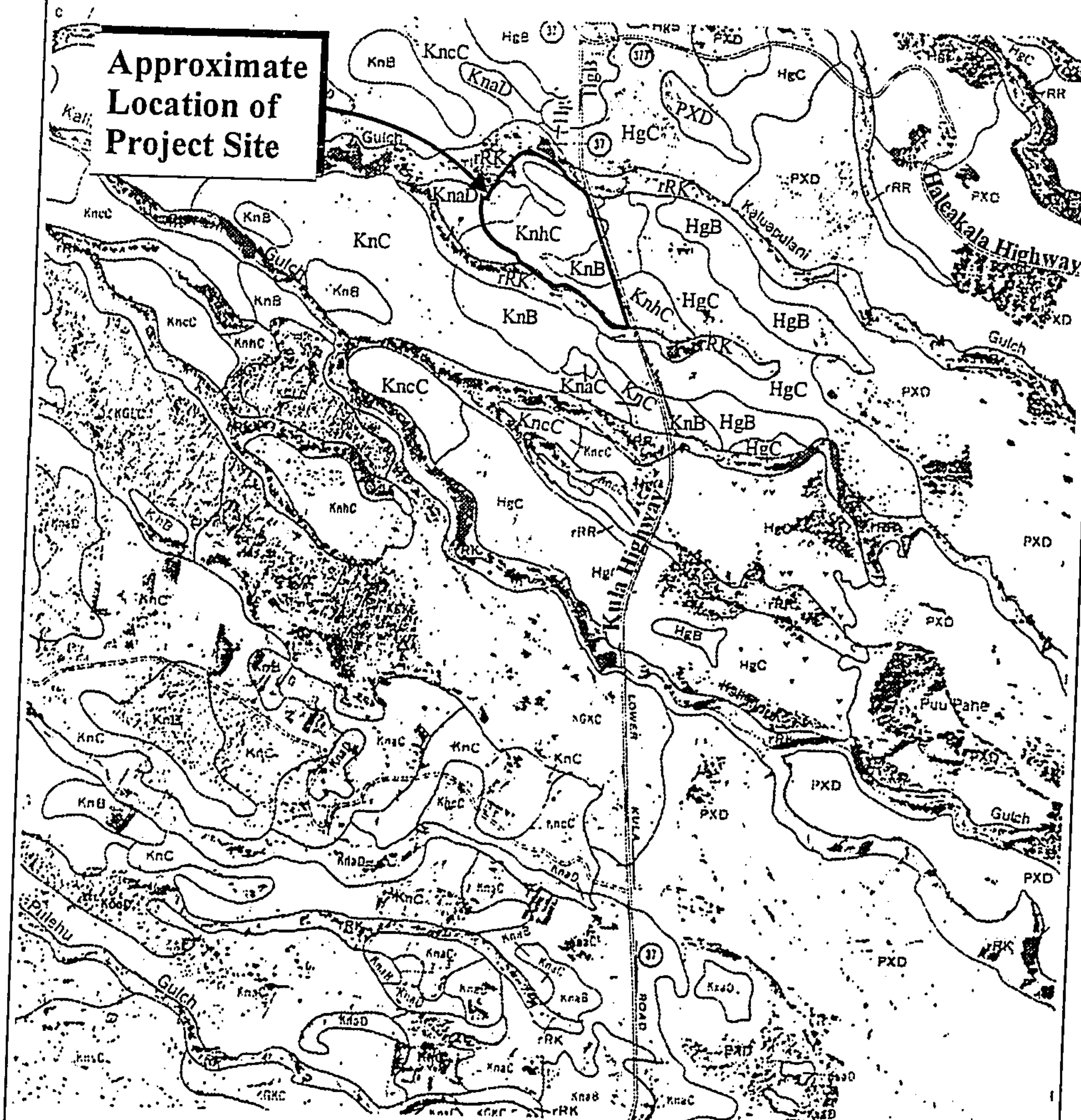
Figure 4

Kulamalu Project
Soil Association Map

MUNEKIYO & ARAKAWA INC.

Prepared for: Kulamalu Limited Partnership

NOT TO SCALE



Source: Soil Conservation Service

Figure 5

Kulamalu Project
Soil Classifications Map

MUNEKIYO & ARAKAWA, INC.

0 1000 2000 4000 Feet

Prepared for: Kulamalu Limited Partnership

A representative profile of Keahua silty clay loam, 3 to 7 percent slopes (KnB) soils consist of a surface layer of dark-reddish brown silty clay loam about 10 inches thick. The subsoil, about 50 inches thick, is dark reddish-brown silty clay loam and very dark gray loam that has a subangular blocky structure. The substratum is mostly soft, weathered basic igneous rock. The soil is slightly acid in the surface layer and slightly acid to neutral in the subsoil. Permeability is moderate. Runoff is slow, and the erosion hazard is slight. Keahua cobbly silty clay loam, 15 to 25 percent slopes (KnaD) soils are characterized by medium runoff and moderate erosion hazard. Keahua cobbly silty clay, 7 to 15 percent slopes (KnhC) soils are characterized by slow to medium runoff and slight to moderate erosion hazard. Rock land (rRK) is made up of areas where exposed rock covers 25 to 90 percent of the surface. The rock outcrops and very shallow soils are the main characteristics. The rock outcrops are mainly basalt and andesite.

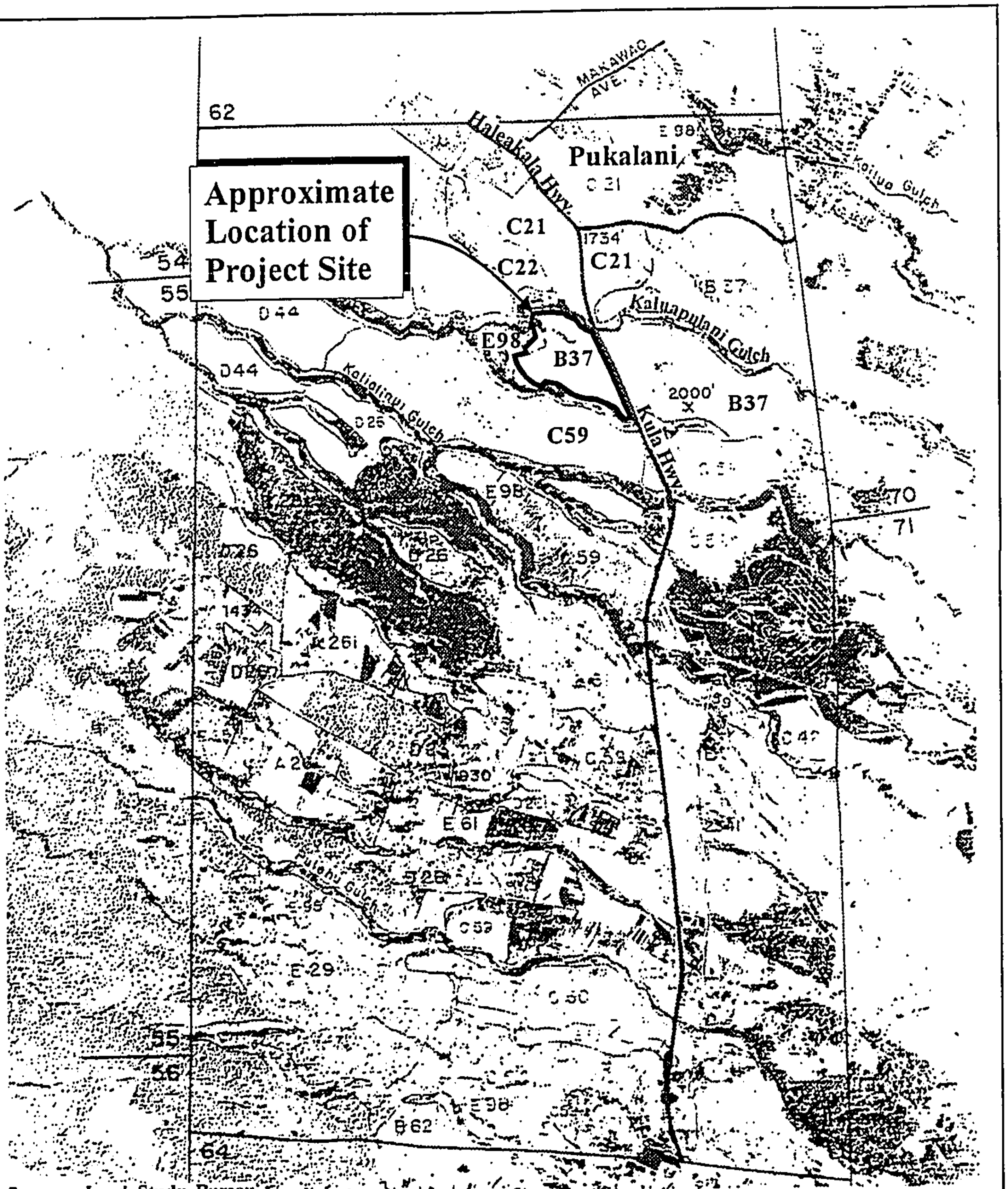
Lands underlying the project site are designated "B" and "E" by the University of Hawaii Land Study Bureau. See Figure 6. This classification system rates lands on a scale of "A" to "E", reflecting land productivity characteristics. Lands designated "A" are considered to be of highest productivity, with "E" lands ranked lowest.

3. *Flood Hazard*

The proposed project is designated by the Flood Insurance Rate Map as Zone C, an area of minimal flooding. See Figure 7.

4. *Flora and Fauna*

The project site is presently being utilized as pasture lands covered



Source: Land Study Bureau

Figure 6

Kulamalu Project
Soil Productivity Ranking

MUNEKIYO & ARAKAWA, INC.

Prepared for: Kulamalu Limited Partnership

NOT TO SCALE

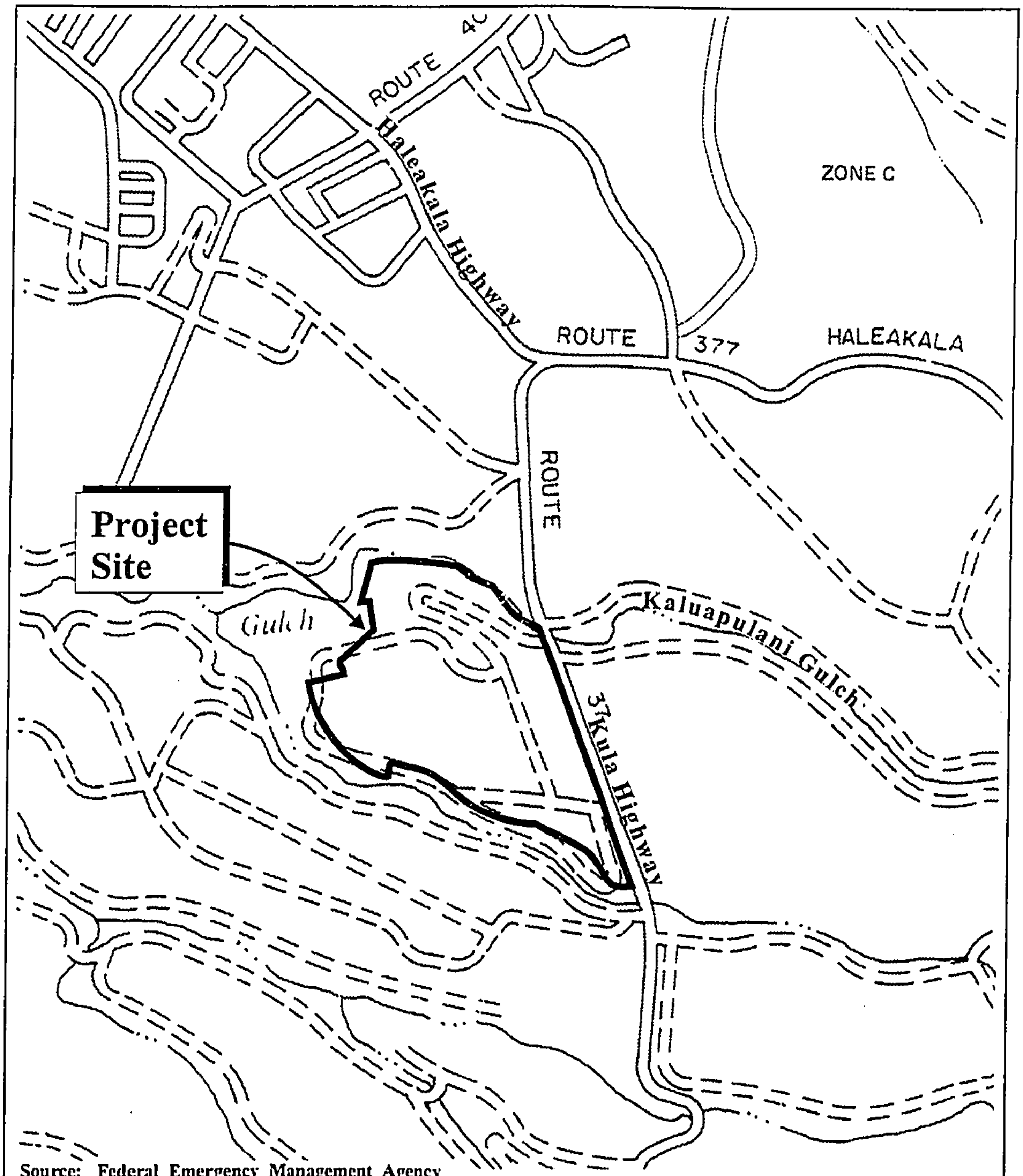


Figure 7

Kulamalu Project
Flood Insurance Rate Map

MUNEKIYO & ARAKAWA, INC.

0 500 1000 2000 Feet

Prepared for: Kulamalu Limited Partnership

with various grasses and low-lying shrubs. Vegetation includes guinea grass (Panicum maximum), lantana (Lantana camara L.), sensitive plant (Mimosa pudica), prickly pear (Opuntia ficus-indica), agave (Agave sisalana), koa-haole (Leucaena leucocephala). The fringes of the former pineapple fields exhibit a few tree specimens, including koa-haole, silver oak (Grevillea robusta), eucalyptus, and Christmas berry (Schinus terebinthifolius).

The rural nature of the region finds a number of fauna such as mongoose, chickens, rats, dogs, and cats. Avifauna in the region typically include mynas, doves, sparrows, and cardinals.

5. ***Archaeological Resources***

An archaeological inventory survey for mauka or eastern portion of the subject property was conducted by Paul H. Rosendahl, Ph.D., Inc. See Appendix B-1.

A single previously unrecorded site, SIHP No. 50-50-10-4181 (PHRI temporary Site 1700-1) containing four component features, was identified. Features A and B of this site are alignments forming terraces in a small swale between former pineapple fields. Features C and D are land-clearing piles of rock, associated with pineapple cultivation.

Site No. 4181 measures approximately 100 meters in length and from 20 meters to 35 meters in width.

Test units at the site have indicated clearly modern artifacts. No evidence of prehistoric activity was found. The swale at Features A and B may have been the result of agricultural irrigation while

Features C and D appear to have been the result of clearing of the adjacent fields.

An archaeological reconnaissance survey was conducted for a 250 acre area which included the makai or western portion of the project site. See Appendix B-2. Two (2) sites containing two (2) component features were identified. Site No. 1707-1 is a petroglyph of what appears to be a canoe with a "crab claw" sail. It measures approximately .32 meter by .28 meter with the bow facing south. This appears to be a prehistoric petroglyph. It appears to be unaltered with no portable remains observed. The site is located to the south of the quarry.

Site No. 1707-2 is a boundary wall on the north side of Kalialinui Gulch. The wall measures 184 meters long by .5 meter wide. The wall height ranges from .8 to 1.4 meters high. The wall appears to be historic in age.

6. ***Air Quality and Noise***

There are no point sources of airborne emissions in the immediate vicinity of the project site. The air quality of the Pukalani and Kula regions are considered good, with existing airborne pollutants attributed primarily to automobile exhaust from the region's roadways.

Surrounding noise levels in the region are characteristic of its rural atmosphere and are considered relatively low. Background noise levels are attributed to natural (e.g., wind) conditions and traffic from the Kula Highway.

7. ***Visual Resources***

Situated on the lower slopes of Haleakala, Maui's central isthmus and the West Maui Mountains are visible from the project site. Mount Haleakala is also visible to the east.

B. *COMMUNITY SETTING*

1. ***Land Use History***

Most of the project area was originally part of a 160-acre parcel deeded to Aui as Grant 1167. A small triangular wedge on the northwest side of the project site was a portion of Grant 1829, Apana 1 to Keawe. The property is currently in use as cattle pasture.

There are no known outstanding citations regarding violations of statutes, ordinances, or rules pertaining to the subject property.

2. ***Land Use and Community Character***

The Makawao-Pukalani-Kula region is a sprawling agricultural, rural and suburban region on the western slope of Haleakala. Pineapple cultivation, smaller independent farming and cattle ranching are the predominant agricultural activities within the region. The towns of Makawao and Pukalani reflect its agricultural roots with the latter being the more recently developed of the two. Kula's residential settlements reflect a lower density over a larger area with smaller commercial clusters in Pulehu, Waiakoa, and Keokea. The region also serves a residential suburban function for people working within other regions of the island.

The project is located on Kula Highway approximately 2,000 feet to the south of the "Five Trees" intersection (Kula Highway -

Haleakala Highway intersection).

To the north of the subject property, there is an electric substation, church and several residential dwellings. The new King Kekaulike High School is located to the northeast of the project site across Kula Highway. Portions of Pukalani Town are located approximately 2,000 feet to the northwest. Lands to the west are currently utilized for cattle pasture. Lands to the south and east of the property are in low density residential and agricultural use.

3. *Population*

The population of Maui has exhibited relatively strong growth over the past decade with the 1990 population estimated at 100,504, a 41.8% increase over the 1980 population of 70,847. Growth in the County is expected to continue, with resident population projections to the years 2000 and 2010, estimated to be 124,562 and 145,872, respectively (Community Resources, Inc., 1994).

The estimated 1990 population of the Makawao-Pukalani-Kula Community Plan region is 18,923. A projection of the region's population shows an increase to 21,760 by the year 2000. By the year 2010, population is anticipated to increase to 23,830 (Community Resources, Inc., 1994).

4. *Economy*

Agriculture and tourism are vital components of Maui's economy. The cultivation of pineapple and sugar cane and the tourist industry provides for much of the Island's economic stability.

The Makawao-Pukalani-Kula region provides the backdrop for ranching of cattle and other farm animals by various individuals. There are a number of farms in the Kula region growing products such as cabbages, onions, tomatoes, corn, carnation and protea. Pineapple is also cultivated on fields surrounding the area. Sugar cane cultivation takes place on lower elevation lands extending to the central isthmus.

C. PUBLIC SERVICES

1. Police and Fire Protection

The County of Maui's Police Department is headquartered at its Wailuku Station. The Department consists of several patrol, investigative, and administrative divisions. The Department's Upcountry Patrol covers the Makawao-Pukalani-Kula region. The nearest police substation is located at the Eddie Tam Gymnasium in Makawao, approximately 2.5 miles away.

Presently, fire prevention, suppression and protection for the region is offered by the County's Department of Fire Control Makawao and Kula Stations. The Makawao Station, is located on Makawao Avenue, approximately one (1) mile from the project site. The Kula Station is located adjacent to Kula Elementary School, approximately 4.2 miles away.

2. Medical Facilities

Maui Memorial Hospital, the only major medical facility on the Island, services the Makawao region. Acute, general and emergency care services are provided by the 185-bed facility which is located in Wailuku. Medical/dental offices are located in Pukalani and Makawao to serve the Upcountry region's residents.

3. ***Solid Waste***

With the closure of the Makawao Landfill, all solid wastes generated in the Upcountry region are transported to the Central Maui Landfill in Puunene. Outside of Hana, the Central Maui Landfill is the only disposal site on the Island of Maui. For the year 1994, solid waste arrived at the Central Maui Landfill at an estimated rate of approximately 400 tons per day. The Makawao-Pukalani-Kula and Paia-Haiku regions accounted for approximately 16% of the volume entering the landfill (R.W. Beck, December 1994).

4. ***Schools***

The State of Hawaii, Department of Education, operates five (5) public schools in Upcountry Maui. They are (with September 1996 student enrollment in parenthesis): Makawao Elementary School (685), Kalama Intermediate School (1,344), Pukalani Elementary School (567), Kula Elementary School (574), and King Kekaulike High School (733). It is noted that King Kekaulike High School opened in September 1995 with only a freshman class. Older public high school students from the Upcountry region presently attend Maui High School in Kahului (telephone conversation with Department of Education employee, Trudy Yip-Onaga, March 1997).

Kamehameha Schools recently opened its temporary facilities within the Pukalani Terrace area serving approximately 80 students in grades K-3. In September 1997, the facility is expected to serve approximately 100 students in grades K-4. In September 1998, approximately 120 students in grades K-5 are expected to be enrolled.

The region is also served by privately operated Haleakala School (grades K-8) and Seabury Hall (grades 6-12).

5. *Recreational Facilities*

Upcountry Maui is served by numerous recreational facilities offering diverse opportunities for the region's residents. These facilities include the County's Eddie Tam Park/Gym, Pukalani Recreation Center, Keokea Park, Rice Park, Kula Gym, and the Kula Ball Park.

D. *INFRASTRUCTURE*

1. *Roadways*

The existing circulation system serving the area, including number of travel lanes, street classifications, and traffic control devices, are described below:

- ***Hana Highway:*** Hana Highway is a major State highway which links Kahului and Hana. Hana Highway is a four-lane, divided highway with channelization at major intersections between Kahului and the Haleakala Highway intersection. North of the Haleakala Highway intersection, Hana Highway serves as a two-lane highway to Hana.

- ***Haleakala Highway:*** Haleakala Highway is a major arterial between Hana Highway and the Haleakala National Park and passes through the town of Pukalani. The section of Haleakala Highway between Hana Highway and the Pukalani Bypass Road is striped for two (2) lanes in the east-bound (mauka) direction and one (1) lane in the west-bound (makai) direction. During the morning peak period of traffic, Haleakala Highway is coned to provide a contra-flow lane from Pukalani Bypass Road to Hana Highway with two (2) lanes in the west-bound direction and one (1) lane in the east-bound direction. East of the Pukalani Bypass Road, Haleakala Highway continues as a two-lane road through Pukalani Town to the Haleakala National Park.

- ***Pukalani Bypass Road:*** In the vicinity of Pukalani town, the Pukalani Bypass Road, a limited access roadway, serves as an alternative route to Haleakala Highway with its western terminus at the intersection with Haleakala Highway and the eastern terminus at the intersection of Kula Highway and Haleakala Highway (Five Trees). The Pukalani Bypass Road is a three-lane Highway, between the Haleakala Highway intersection (west terminus) and Makawao Avenue, providing two (2) lanes in the east-bound direction and one (1) lane in the west-bound direction. South of Makawao Avenue, the Pukalani Bypass Road reduces to a two-lane highway with one (1) travel lane in each direction.

- ***Makawao Avenue:*** Within the study area, Makawao Avenue is a two-lane County collector road serving Pukalani town and Makawao town. Makawao Avenue originates within Pukalani, at its intersection with Haleakala Highway, and extends northeasterly through Makawao town. At the intersection with Baldwin Avenue, Makawao Avenue continues as Kaupakulua Road and eventually connects with Hana Highway in the vicinity of Ulumalu. Baldwin Avenue extends in a northwesterly direction and connects with Hana Highway in Paia town.

- ***Kula Highway:*** Kula Highway is a two-lane arterial highway serving the Upcountry area from its intersection with Haleakala Highway and the Pukalani Bypass Road (Five Trees) to the Kula area. Kula Highway is a north-south arterial serving mainly residential/agricultural uses.

- ***Pukalani Street:*** Pukalani Street is a local two-lane collector roadway serving residential and commercial areas in Pukalani town and connects to Haleakala Highway in a T-intersection.

- ***Iolani Street:*** Iolani Street serves as a two-lane collector roadway within the residential area of Pukalani town.

- ***Ohana Street:*** Ohana Street, a two-lane roadway, provides access to a local residential area and connects to Kula Highway. An existing gated private driveway to the Kulamalu site is situated directly across the Ohana Street intersection on Kula Highway.

2. *Water*

The Makawao-Haiku system is supplied by surface water runoff collected on the windward slopes of Haleakala. This water is collected and conveyed by the Wailoa irrigation ditch and tunnel system, owned and maintained by the East Maui Irrigation Company (EMI), with a capacity of 190 million gallons per day (mgd). The County of Maui, Department of Water Supply (DWS) has an agreement with EMI to draw up to 12 mgd at Kamole Weir forebay.

This water is then treated by the Kamole Weir Water Treatment Plant (WTP), owned and operated by DWS. Kamole Weir WTP is located northeast of Haliimaile near the intersection of Baldwin Avenue and Haliimaile Road. It has a 300,000 gallon concrete treated water storage tank at a floor elevation of 1,114 feet above mean sea level (msl), and can treat up to 8 mgd in compliance with EPA Safe Drinking Water standards.

Water from the Kamole Weir WTP is transmitted by pumping to Makawao through a 24-inch diameter force main along Baldwin Avenue and Olinda Road. Storage is provided by the 0.3 and 2.0 million gallon Pookela tanks at floor elevations of 1,808 and 1,830 feet msl, respectively.

Water is then pumped via an 18-inch force main to the 0.5 mg Maluhia Tank at 2,051 feet msl.

There is a 12-inch main running along Olinda Road, Hanamu Road and Haleakala Highway from the Maluhia Tank to the new King Kekaulike High School.

There are no water mains within the Kula Highway right-of-way fronting the project site. See Appendix E.

3. ***Wastewater***

There are no County wastewater treatment facilities serving the Kula-Pukalani area. The project will connect with a private wastewater treatment plant which serves existing Pukalani Terrace residents. The plant currently provides treated wastewater to the Pukalani Terrace Country Club golf course for irrigation purposes.

4. ***Drainage***

Onsite runoff sheetflows across the project site in an east to northwesterly direction and eventually enters the abutting Kaluapulani Gulch. There are no improved drainage systems within the project site.

5. ***Electrical, Telephone, and CATV***

The distribution system for electrical, telephone, and CATV facilities are on Kula Highway which abut the project site.

Chapter III

Potential Impacts and Mitigation Measures

III. POTENTIAL IMPACTS AND MITIGATION MEASURES

A. IMPACTS TO THE PHYSICAL ENVIRONMENT

1. Flora and Fauna

The property is currently utilized as cattle pasture. There are no known rare, endangered or threatened species of flora and fauna within the project site. The removal of existing vegetation is not considered an adverse impact to this component of the environment.

Similarly, there are no known rare, endangered or threatened species of avifauna and wildlife in the project site. Construction of improvements within the property is not anticipated to adversely impact the area's fauna and avifauna population.

2. Archaeological Resources

During the archaeological inventory survey conducted for the mauka portion of the subject property, one previously undiscovered archaeological site (50-50-10-4181) was found. The site consists of two terrace alignments (Features A and B) and two land-clearing piles (Features C and D).

Site No. 50-50-10-4181 was assessed under Criterion D of the National Register Criteria for Evaluation. Based on the recordation, testing, and reporting, the site has been assessed as no longer significant, based on the recent age of the features and the lack of information content important to history. Refer to Appendix B-1.

The archaeological reconnaissance survey found two (2) new sites. Refer to Appendix B-2. These consist of a prehistoric petroglyph (Site No. 1707-1) and a historic wall (Site No. 1707-2). Both sites are tentatively assessed under Criteria D. However, Site No. 1707-1 is also assessed as being culturally significant. Both sites are recommended for inventory survey.

It should be noted that both sites found in the reconnaissance survey are located outside of the project site.

Should any human remains or significant cultural materials be found during construction, the State Historic Preservation Division will be notified and appropriate mitigation measures taken.

An addendum to the archaeological inventory survey was also done. With the original inventory survey, the entire project site has been analyzed at the inventory level. See Appendix B-3.

3. *Air Quality and Noise*

Air quality impacts attributed to the project will include dust generated by short-term construction-related activities. Site work such as clearing, grubbing and grading, and utilities and roadway construction for example, will generate air-borne particulates. Dust control measures, such as regular watering and sprinkling, will be implemented to minimize wind-blown emissions.

Ambient noise conditions will also be temporarily impacted by construction activities. Heavy construction equipment, such as bulldozers, front-end loaders, and materials-carrying trucks and trailers, would be the dominant source of noise during the construction period. All construction activities are anticipated to be limited to daylight working hours and will comply with the provisions of Hawaii Administrative Rules, Chapter 11-46, "Community Noise Control".

The proposed project is anticipated to contain public/quasi-public and commercial uses, multi-family housing, a halau, and park. The proposed uses are not anticipated to generate significant emissions. Project-related traffic will generate automotive emissions but is not expected to adversely impact local and regional air quality conditions.

For the long-term, the project is not anticipated to significantly impact ambient noise conditions in the vicinity.

4. ***Scenic and Open Space Resources***

The project will be fully landscaped to create a site visually integrated with its surroundings. The proposed project is anticipated to be low-rise in keeping with the existing built environment. It is not anticipated to adversely affect scenic corridors.

5. ***Use of Chemicals and Fertilizers***

Use of herbicides on the project site will generally be limited to the initial plant establishment period. Pesticides are anticipated to be used only as a treatment and not as a preventive measure. As a treatment, application usage will be minimal. In addition, plant selection for the project will be based on hardiness, drought tolerance, pest resistance as well as aesthetic concerns.

Nitrogen/Phosphorus/Potash mixed fertilizers are anticipated to be applied to lawn areas, groundcover, and flowering shrubs. With proper irrigation management practices, leaching of fertilizers should be negligible.

No adverse effects on surface, underground and marine water resources are anticipated.

B. *IMPACTS TO COMMUNITY SETTING*

1. *Surrounding Uses*

The proposed project is not anticipated to have an adverse impact upon surrounding uses. The project will involve commercial, public/quasi-public, multi-family and single-family housing and park uses within an approximately 53.67 acre area. Adjacent to the project site are a high school which is expected to reach full enrollment in September 1998, a church, and low density residential use. To the west of the project site are a private school site and a planned expansion of the Pukalani Terrace residential community. The project will service the Upcountry region and is considered compatible with existing and planned uses.

2. *Population and Local Economy*

On a short-term basis, the project will support construction and construction-related employment. Over the long-term, the project will provide added commercial services within the Makawao, Pukalani and Kula regions.

According to the market study done for the proposed project, there are several competitive advantages for commercial retail development on the subject site. See Appendix C. These include:

1. A relatively large land area;
2. Extensive frontage along Kula Highway;
3. Generally level topography;
4. Close proximity to residential growth area of Pukalani; and
5. No new competing large retail and ancillary office facilities planned in the area. See Appendix C.

Upcountry Maui is under-serviced in terms of neighborhood shopping facilities. Because of the limited retail facilities in the Upcountry region, goods and services for day-to-day living needs that could be purchased in the area, are largely purchased in Kahului.

The Kulamalu commercial project site represents 77 percent of the undeveloped commercial land in Upcountry Maui. Alternative commercial sites suitable for large scale retail development are not available in the area. As a result, retail development at Kulamalu could have a significant competitive advantage to capture a significant share of the projected retail demand. The demand for retail facilities in Upcountry Maui would continue to exceed the available supply, even after the completion of the Kulamalu project.

Based on the characteristics of the target markets and retail trends in the area, the shopping facility could be anchored by a full-service supermarket and drug/variety store. Other tenants could include:

1. Entertainment, such as video, records or electronic/computer games;
2. Theaters;
3. Restaurants, including fast food;
4. Medical and dental offices; and
5. Other personal services, such as hair styling or dry cleaning.

In addition, the center could probably support a gas station to service both residents and visitors.

3. ***Agriculture***

The project site is currently utilized for cattle grazing. There are approximately 71,807 acres of property designated as Agricultural within the Makawao-Pukalani-Kula Community Plan region. The use of approximately 53.67 acres already designated Urban will not have a significant effect on agricultural endeavors on the island and could even support agricultural endeavors through possible inclusion of a farmer's market.

4. ***Police, Fire and Medical Services***

The proposed project is not anticipated to affect service capabilities of police, fire, and emergency medical operations. The project will not extend existing service area limits for emergency services. Environmental design features which may assist in crime prevention will be considered in the final design of the project.

5. ***Recreational and Educational Services***

The 14.74 acre neighborhood park will enhance active recreation pursuits in the Upcountry area. An added amenity is the 5.03 acre Hawaiian cultural learning center for the pursuit of hula, oli, mele, history and genealogy. The proposed day care facility should also complement existing educational facilities within the region. The project should provide additional recreational and educational benefits within the Upcountry area.

It is noted that the proposed reduction in land area for the park from 15.01 acres to 14.74 acres is due to additional right-of-way set aside for the proposed through roadway which links with Kula Highway. Land use allocations for Park, Public/Quasi-Public, Business/Commercial, and Multi-Family Residential were all reduced slightly in order to accommodate the increase in right-of-way.

Within the project site, there are no known traditional beach and mountain access trails.

6. ***Solid Waste***

A solid waste management plan will be developed in coordination with the Solid Waste Division of the County Department of Public Works and Waste Management for the disposal of clearing and grubbing material from the site during construction.

Once completed, it is anticipated that the public/quasi-public, commercial, multi-family, learning center and day care facility portions of the project will be served by a private collection company. The park and single-family residential area will be served by the County of Maui. Solid waste generated by the project will be disposed at the County's Central Maui Landfill.

C. *IMPACTS TO INFRASTRUCTURE*

1. ***Roadways***

A traffic study was conducted for the 53.67 acre Kulamalu Project as part of the Kulamalu Conceptual Planning Area, in Pukalani, Maui. See Appendix D. The subject property includes the development of commercial uses, elderly dwelling units, a park, amphitheater, and public/quasi-public uses. The Kulamalu Project is adjacent to a larger 251.04 acre area; the total 304.71 acres is herein designated as the Kulamalu Conceptual Planning Area. Additional uses in the 251.04 acre area include single-family residential units and a private school which are currently permissible under the existing zoning of this property. Although the extent and timing of the 251.04 acre area is uncertain and predicated by market conditions, this report addresses the traffic impacts of the 53.67 acres for the Kulamalu Project as a part of the Kulamalu Conceptual Planning Area.

In order to assess the traffic impacts of the Kulamalu Conceptual Planning Area in context with other growth expected to occur in the region, two (2) future year traffic assignments were developed for Year 2010 when the conceptual planning area is expected to be completed. First, future *base conditions* were established by estimating future traffic volumes without the Kulamalu-generated traffic. For the second future traffic assignment, the forecasted traffic volumes generated by the Kulamalu Conceptual Planning Area were added to future base traffic volumes. Traffic impacts are identified through the comparison of the analyzed results of these two (2) future Year 2010 traffic assignments.

The base roadway improvements, described below, are required to accommodate the projected de facto growth of traffic (without the Kulamalu-generated traffic) at an acceptable level of operation (LOS D or better). These improvements are consistent with the recommendations of the Maui Long-Range Land Transportation Plan (Draft Final Report, February 1996).

a. ***Haleakala Highway:*** Widen to four (4) travel lanes, two (2) in each direction, between Hana Highway and the makai (west) terminus of the Pukalani Bypass Road. This project is currently funded for preparation of the plans, specifications and construction cost estimate and is being processed to meet the environmental regulatory requirements.

b. ***Pukalani Bypass Road:*** Widen this roadway to four (4) travel lanes to provide two (2) mauka-bound lanes and two (2) makai-bound lanes.

c. ***Intersection of Pukalani Bypass Road (West Terminus) and Haleakala Highway:*** Widen, reconfigure and signalize the intersection to provide two (2) makai-bound lanes on the Pukalani Bypass Road approach, double left-turn lanes on the Haleakala Highway north-bound approach and two (2) through lanes with a separate right-turn lane on the Haleakala Highway mauka-bound approach.

d. ***Intersection of Pukalani Bypass Road/Makani Road:*** Widen, reconfigure and signalize this intersection to provide two (2) mauka-bound lanes, two (2) makai-bound lanes on the Pukalani Bypass Road approaches, and separate turn lanes on the Makani Road approaches.

e. ***Intersection of Pukalani Bypass Road and Makawao Avenue:*** Widen and reconfigure to allow the widening of Pukalani Bypass Road to two (2) mauka-bound and two (2) makai-bound lanes.

f. ***Optimization of Traffic Signal Operations:*** Adjust traffic signal timing as traffic volumes increase to better accommodate the increased traffic flows and to reduce delays at signalized intersections. Also, the existing traffic signals at the intersections of Haleakala Highway/Pukalani Bypass Road/Kula Highway (Five Trees) and Pukalani Bypass Road/Makawao Avenue should be interconnected with the traffic signals at the Pukalani Bypass Road/Makani Road intersection to maintain traffic progression through Pukalani town.

g. ***Alternate Upcountry Access Roads:*** Provide alternate access routes to the Upcountry area to alleviate the traffic congestion at the intersection of Hana Highway and Haleakala Highway. The introduction of new routes could be accomplished through the construction of new roadways, such as the proposed Upcountry-Kihei Road, or through the upgrade/realignment of existing rural, winding roadways, such as Omaopio Road and Pulehu Road. While grade-separated ramps may be constructed at the intersection of Hana Highway and Haleakala Highway, the provision of new/upgraded Upcountry routes would reduce travel times to other areas and redistribute regional traffic volumes from Haleakala Highway and Hana Highway.

Project-related roadway improvements which are recommended for implementation by the developer are at the proposed intersection of Kula Highway and the Kulamalu development primary access road:

Intersection of Kula Highway and Project Road: Provide a separate left-turn storage lane on northbound Kula Highway and a deceleration right-turn lane on southbound Kula Highway. Provide separate left-turn lane and right-turn lane on the project road approach to Kula Highway. Install a traffic signal system when traffic volumes meet the Traffic Signal Warrants of the "Manual on Uniform Traffic Control Devices".

2. ***Water***

The Kulamalu project, by agreement with DWS, will install a well at Huluhulunui Gulch near Kaupakulua. The well improvements will include the drilling of the well, installation of the well pump, reservoir and associated water lines to connect to the existing system. See Appendix E.

With regard to storage, an offsite storage reservoir of approximately 1.0 million gallons is proposed on Maui Land & Pineapple Company land at elevation 1,975 feet mean sea level (msl) above King Kekaulike High School. This storage is sized for use by Maui Land & Pineapple Company, The Malama Group, King Kekaulike High School, and the service area between the 1,860 foot to 1,600 foot elevations of the Kulamalu project, which includes the project area. The reservoir size is based on the requirements set forth by the "Water System Standards, Volume I, 1985, Department of Water Supply". The Department of Water Supply has the option of increasing the reservoir size and to participate in the funding for the upsize costs.

Improvements not within the 53.67 acre project area include a storage reservoir of approximately 350,000 gallons, proposed at elevation 1,690 feet msl on the project site to service area 1,690 feet to 1,320 feet. This reservoir is also sized by maximum daily demand plus fire flow. The existing 850,000 gallon reservoir at elevation 1,416 feet msl will service the area below 1,320 feet msl.

The offsite storage reservoir at elevation 1,975 feet msl will be fed via a 12-inch inflow main connecting to the existing 12-inch Kekaulike High School main at Haleakala Highway. The outflow main will be a 12-inch main installed along Haleakala Highway to Five Trees, then up along Kula Highway to the project site.

The onsite mains along the backbone road within the project between reservoirs will be sized at 12 inches.

3. *Wastewater*

Wastewater generated from the project site is anticipated to flow through onsite gravity lines and enter the existing gravity system within the Pukalani Terrace, Unit II Subdivision, located to the west of the project site. The wastewater will then be conveyed to the privately owned and operated wastewater treatment plant. The plant will be able to accommodate the project's flows. Refer to Appendix E.

4. ***Drainage***

Runoff generated onsite is anticipated to be collected by underground drainage systems and will be conveyed to the abutting Kaluapulani Gulch. The onsite drainage system will be sized by using a 50-year recurrence interval based on a one-hour storm. Detention facilities will also be incorporated within the proposed drainage system to release stormwater into Kaluapulani Gulch at predevelopment rates. Also, offsite runoff will be allowed to flow through Kaluapulani Gulch unimpeded. Refer to Appendix E.

The development of the Kulamalu project is not anticipated to cause adverse effects to adjacent or downstream properties.

5. ***Electrical and Telephone***

Electrical and telephone trunk lines will be extended underground through the proposed 160-foot road right-of-way from Kula Highway. The distribution system for these facilities will also be placed underground in accordance with the provisions of the Maui County Code.

Chapter IV

Relationship to Land Use Plans. Policies and Controls

IV. RELATIONSHIP TO LAND USE PLANS, POLICIES AND CONTROLS

A. STATE LAND USE DISTRICTS

Chapter 205, Hawaii Revised Statutes, relating to the Land Use Commission, establishes the four (4) major land use districts in which all lands in the State are placed. These districts are designated "Urban", "Rural", "Agricultural", and "Conservation". The project site is within the Urban District. See Figure 8.

Public/quasi-public and commercial uses, cultural learning center, day care facility, multi-family elderly housing, single-family residential housing and park uses are allowable within the State Urban District.

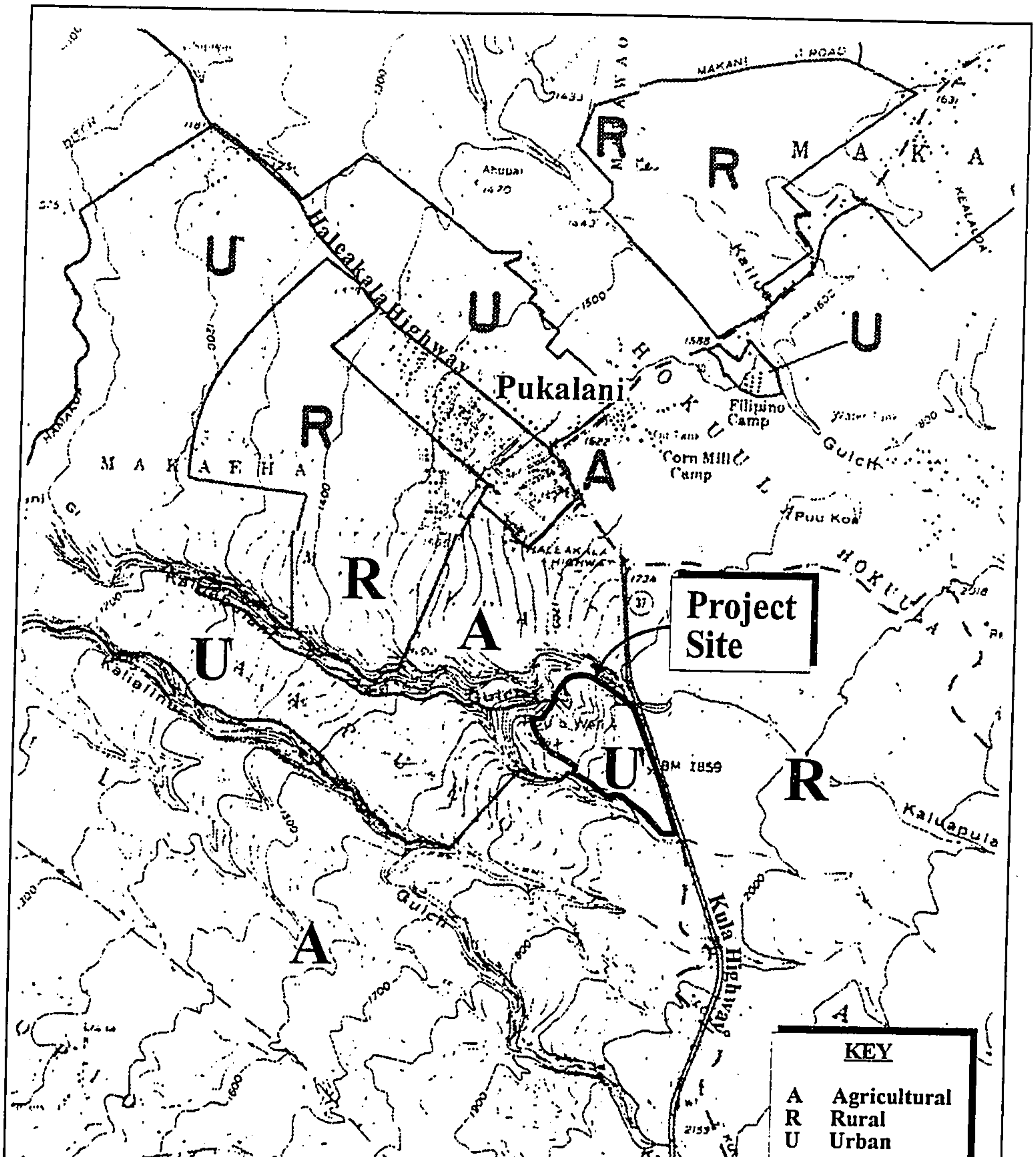
B. MAUI COUNTY GENERAL PLAN

The Maui County General Plan (1990 Update) sets forth broad objectives and policies to help the long-range development of the County. As stated in the Maui County Charter, "The purpose of the General Plan is to recognize and state the major problems and opportunities concerning the needs and development of the County and the social, economic, and environmental effects of such development and set forth the desired sequence, patterns and characteristics of future development."

The proposed action is in keeping with the following General Plan objectives and policies:

Objective:

To preserve for present and future generations existing geographic, cultural and traditional community lifestyles by limiting and managing growth through environmentally sensitive and effective use of land in accordance with the individual character of the various communities and



Source: Land Use Commission District Boundary Maps

Figure 8

Kulamalu Project
State Land Use District Classifications

Prepared for: Kulamalu Limited Partnership

0 1000 2000 4000 Feet

MUNEKIYO & ARAKAWA, INC.

regions of the County.

Policy:

Provide and maintain a range of land use districts sufficient to meet the social, physical, environmental and economic needs of the community.

Objective:

To provide high-quality recreational facilities to meet the present and future needs of our residents of all ages and physical ability.

Policy:

Develop facilities that will meet the different recreational needs of the various communities.

C. *MAKAWAO-PUKALANI-KULA COMMUNITY PLAN*

The subject parcel is located in the Makawao-Pukalani-Kula Community Plan region which is one of nine Community Plan regions established in the County of Maui. Planning for each region is guided by the respective Community Plans, which are designed to implement the Maui County General Plan. Each Community Plan contains recommendations and standards which guide the sequencing, patterns and characteristics of future development in the region.

The Ten Year Update of the Makawao-Pukalani-Kula Community Plan has recently been completed. This process establishes a comprehensive review of community plan provisions by the Makawao-Pukalani-Kula Citizen Advisory Committee, the County Planning Director, the Maui Planning Commission and the Maui County Council. The revisions took effect on July 23, 1996.

Land use guidelines are set forth by the Makawao-Pukalani-Kula

Community Plan Land Use Map. The project site is designated Open Space, Park, Public/Quasi-Public, Business/Commercial, Multi-Family Residential, and Single-Family Residential. See Figure 9.

An implementing action of the Makawao-Pukalani-Kula Community Plan notes the following:

> Require that the development and dedication (pursuant to parks and playgrounds assessment requirements) of the 15.01 acre park and the development of the 5.11 acre public/quasi-public area and 5-acre multi-family/elderly housing in the vicinity of the proposed Kulamalu development along Kula Highway be developed concurrently with the development of the 20-acre commercial site. The commercial site shall be Country-Town Business at the time of zoning.

Since the adoption of the Makawao-Pukalani-Kula Community Plan, there have been relatively minor revisions and fine tuning of the Kulamalu land use plan. Although community plan amendments are being proposed, it is noted that the acreages are generally the same but locations of the land uses have been slightly revised. The existing and proposed land use allocations are shown in Table 1.

Table 1

COMPARISON OF EXISTING AND PROPOSED COMMUNITY PLAN LAND USE ALLOCATIONS		
Land Use Allocation	***Existing Acreage***	***Proposed Acreage***
Park	15.01	14.74
Public/Quasi-Public	5.11	5.10
Multi-Family Residential	5	4.88
Business/Commercial	20	19.41
Park (Amphitheater)	5	0
Public/Quasi-Public (Halau)	0	5.03
Single-Family Residential	4.51	4.51
TOTAL	**54.63**	**53.67**

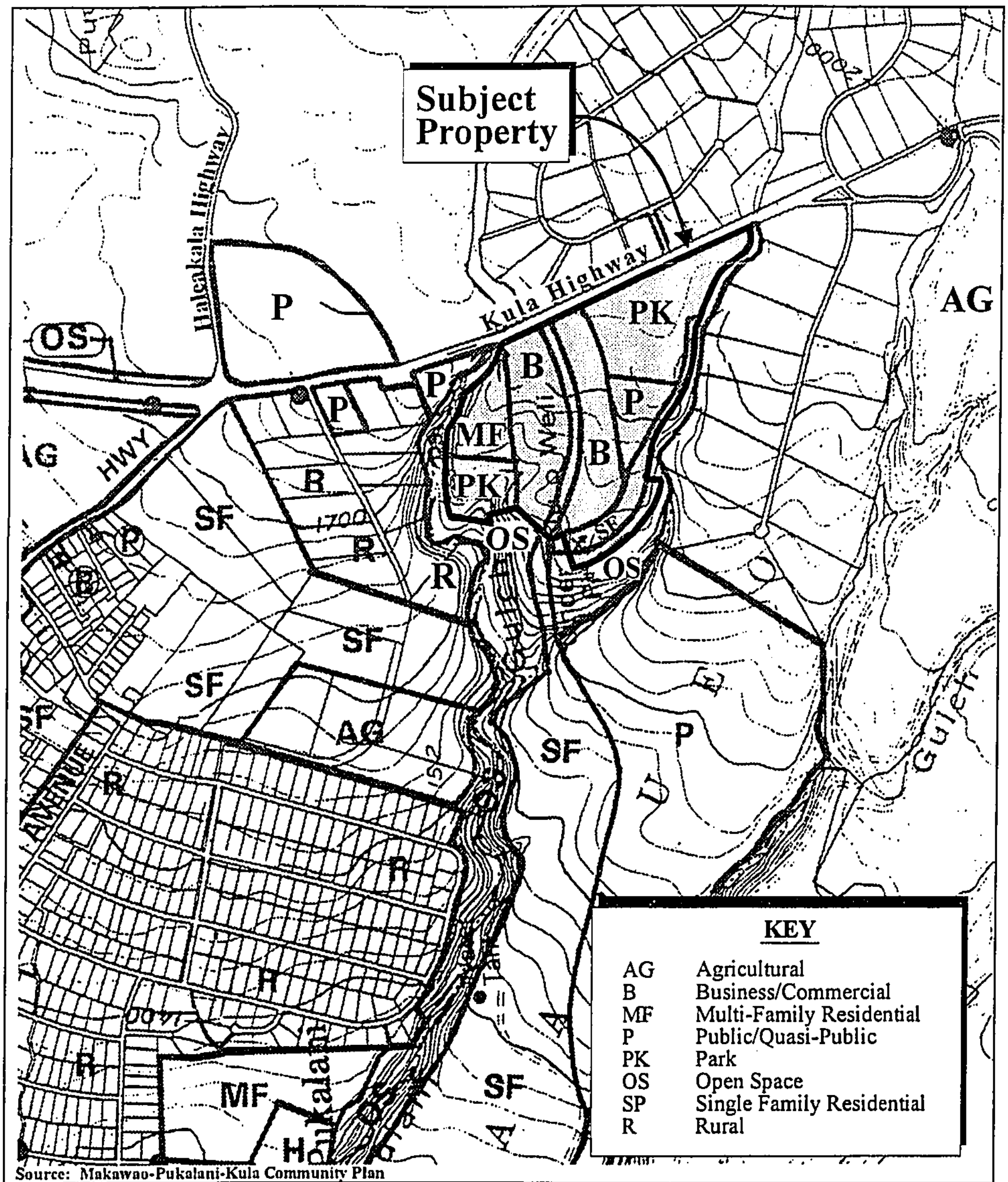


Figure 9 Kulamalu Project

Community Plan Land Use Map

MUNEKIYO & ARAKAWA, INC.

0 500 1000 2000 Feet

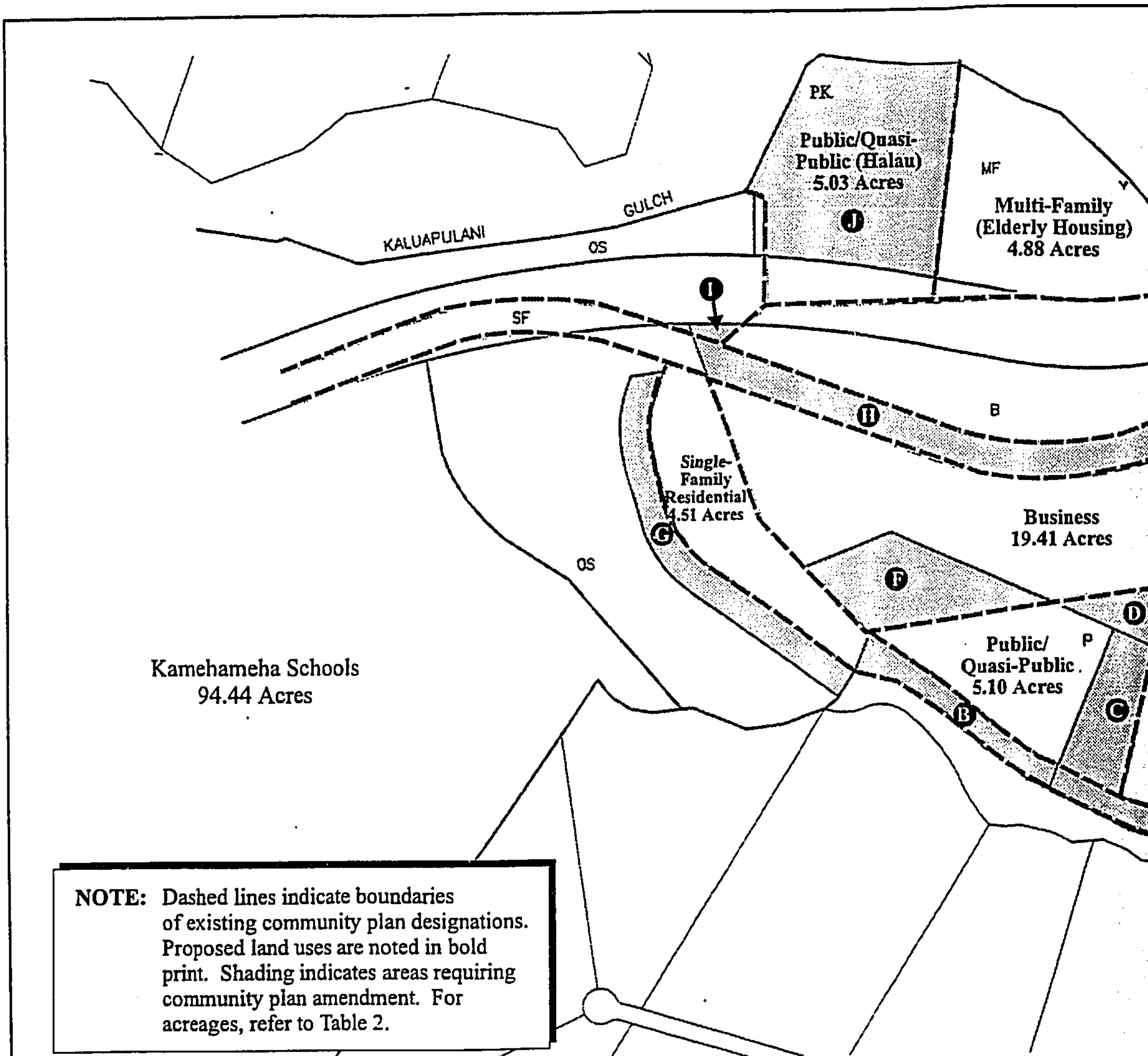
Prepared for: Kulamalu Limited Partnership

The most significant revision concerns the amphitheater site. During the deliberation on the community plan, it was felt that the Park designation may be the most appropriate for an amphitheater to be used primarily by hula halau. However, this site is proposed to be a halau which involves not only the teaching of hula, but also Hawaiian chants, songs, history, genealogy, and customs. Thus, the use of the site is more appropriately classified as an educational facility or school which falls within the Public-Quasi-Public designation. It is noted that minor reductions in acreages between the existing and proposed allocations are due to additional right-of-way set aside for the proposed through roadway which links with Kula Highway.

In order to implement the revised land use plan, areas requiring community plan amendment are delineated in Figure 10 and listed in Table 2.

Table 2

PROPOSED COMMUNITY PLAN AMENDMENTS		
Area	***Proposed Revision***	***Acreage***
A	Single Family Residential to Park	0.79
B	Single Family Residential to Public/Quasi-Public	0.75
C	Public/Quasi-Public to Park	1.14
D	Public/Quasi-Public to Business/Commercial	0.42
E	Park to Business/Commercial	1.35
F	Business/Commercial to Public/Quasi-Public	1.77
G	Open Space to Single Family Residential	1.54
H	Single Family Residential to Business/Commercial	2.85
I	Open Space to Business/Commercial	0.10
J	Park to Public/Quasi-Public	5.03
	Total	**15.74**



NOTE: Dashed lines indicate boundaries of existing community plan designations. Proposed land uses are noted in bold print. Shading indicates areas requiring community plan amendment. For acreages, refer to Table 2.

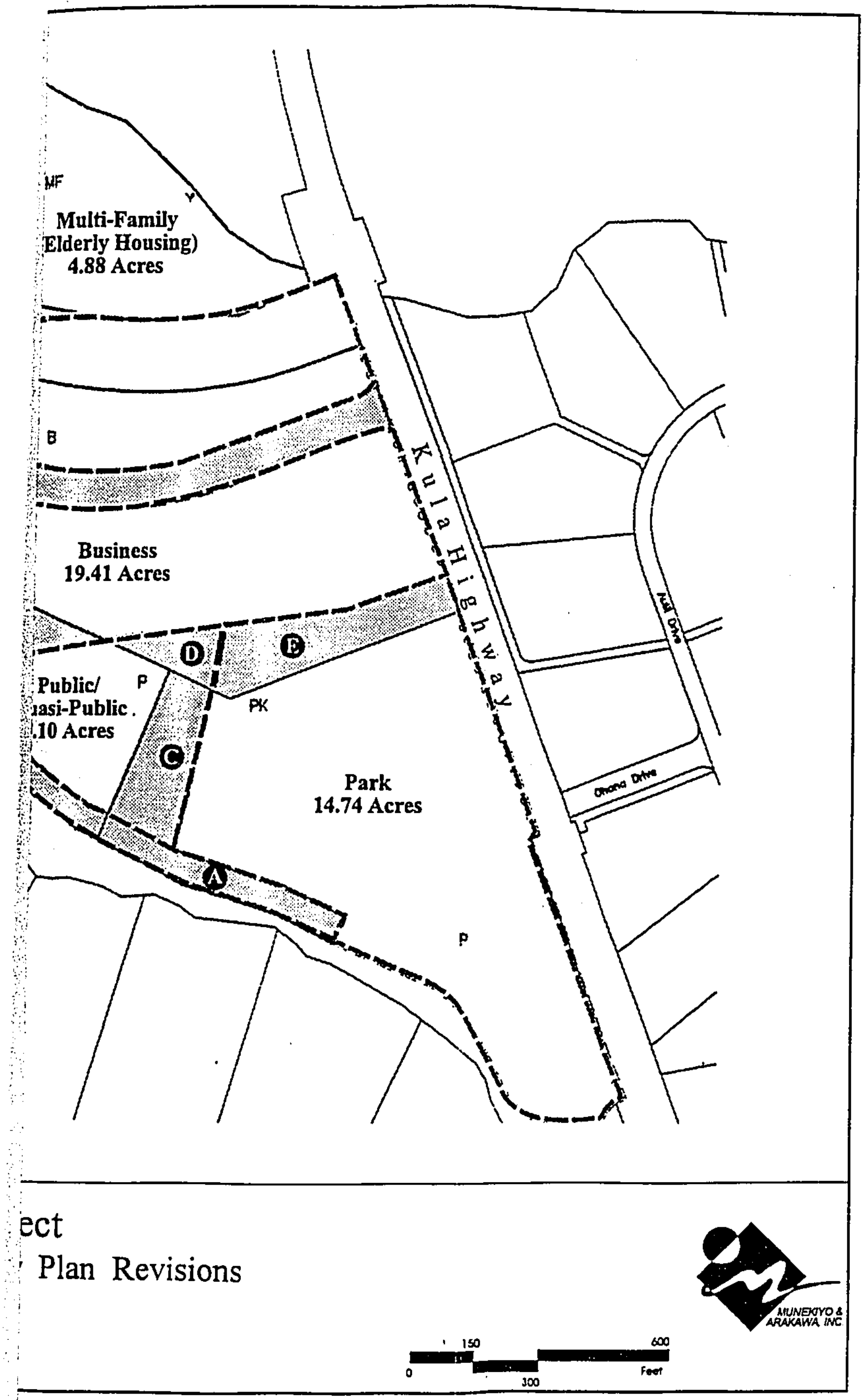
Source: Austin, Tsutsumi & Associates, Inc.

Figure 10

Kulamalu Project

Areas of Proposed Community Plan Revisio

Prepared for: Kulamalu Limited Partnership



ect

' Plan Revisions

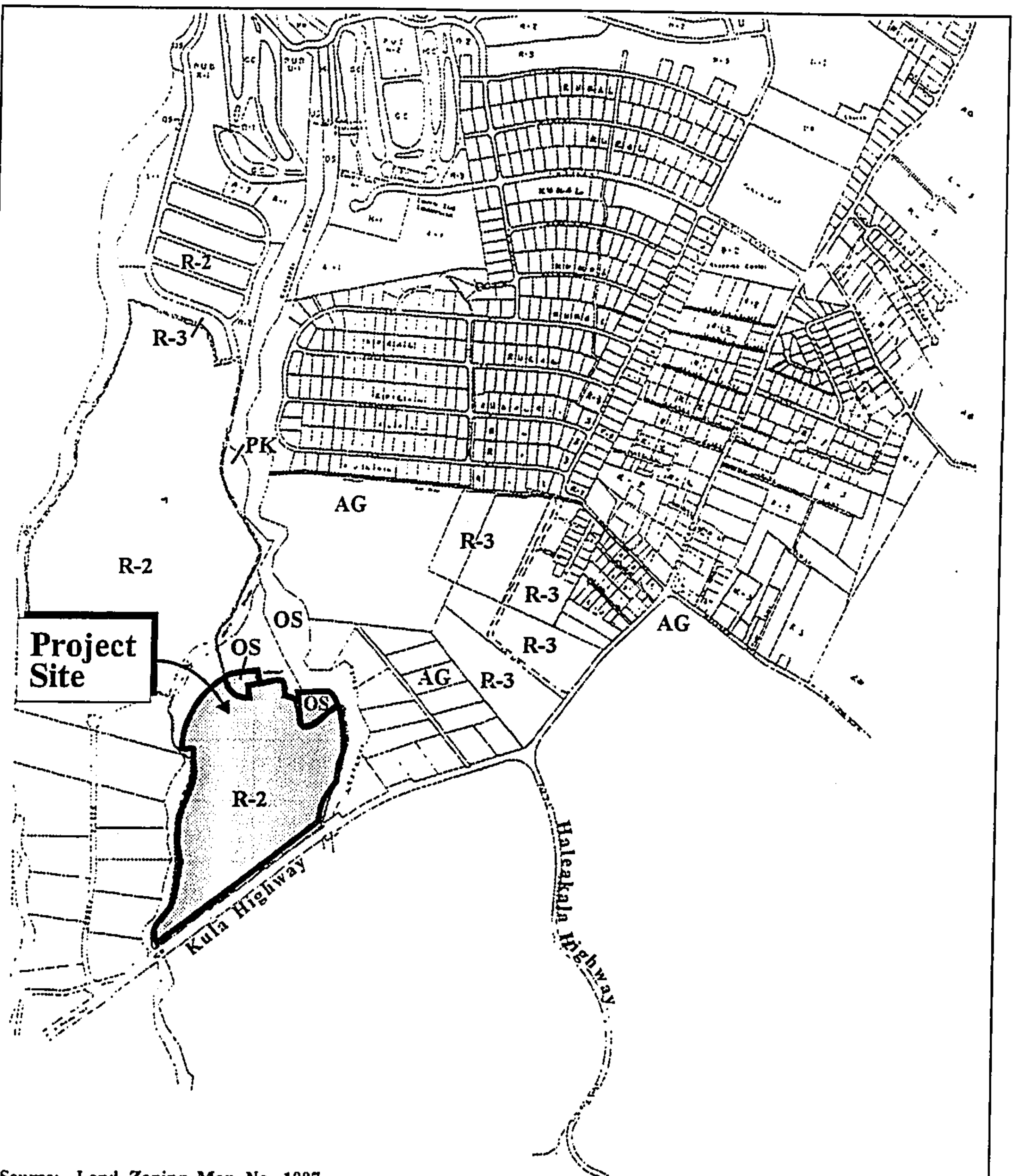
D. ZONING

With the exception of a 1.23 acre area and a 0.36 acre area of the project site near Kaluapulani Gulch both of which are zoned Open Space, the remainder of the site is zoned R-2 Residential District. See Figure 11.

Areas requiring change in zoning are delineated in Figure 12 and listed in Table 3.

Table 3

PROPOSED CHANGES IN ZONING		
Area	***Proposed Revision***	***Acreage***
"A" Park	R-2 Residential District to PK-1 Neighborhood Park District	14.74
"B" Public/Quasi-Public	R-2 Residential District to P-1 Public/Quasi-Public	5.10
"C" Business/Commercial	R-2 Residential District to B-CT Country Town Business District	19.41
"D" Multi-Family Residential	R-2 Residential District to A-1 Apartment District	4.88
"E" Public/Quasi-Public (Halau)	R-2 Residential District to P-1 Public/Quasi-Public	3.80
"F" Public/Quasi-Public (Halau)	OS Open Space to P-1 Public/Quasi-Public	1.23
"G" Single-Family Residential	OS Open Space to R-2 Residential District	0.36
	Total Acreage	**49.52**



Source: Land Zoning Map No. 1007

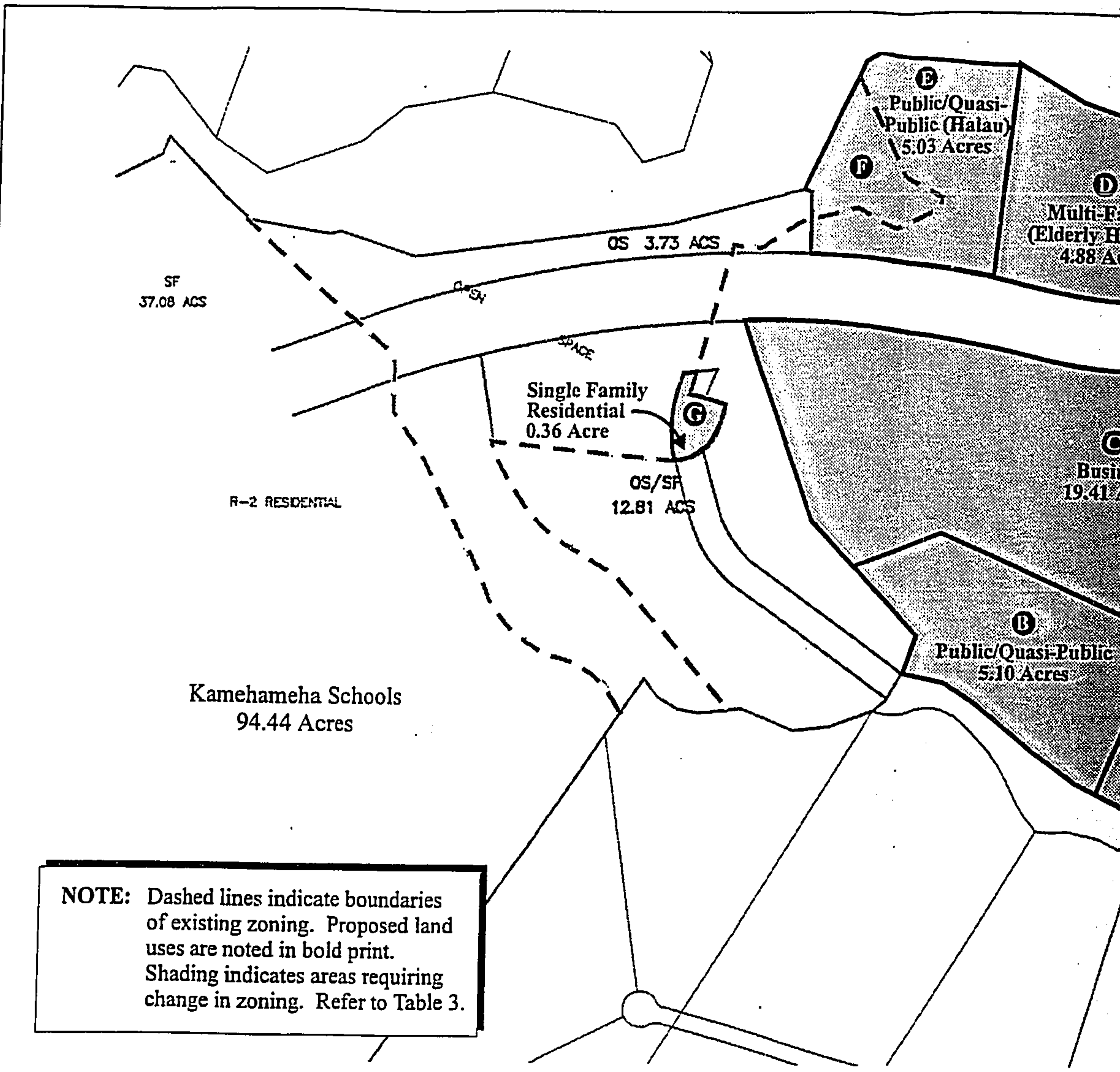
Figure 11

Kulamalu Project
Zoning Map

MUNEKIYO & ARAKAWA, INC.

Prepared for: Kulamalu Limited Partnership

NOT TO SCALE



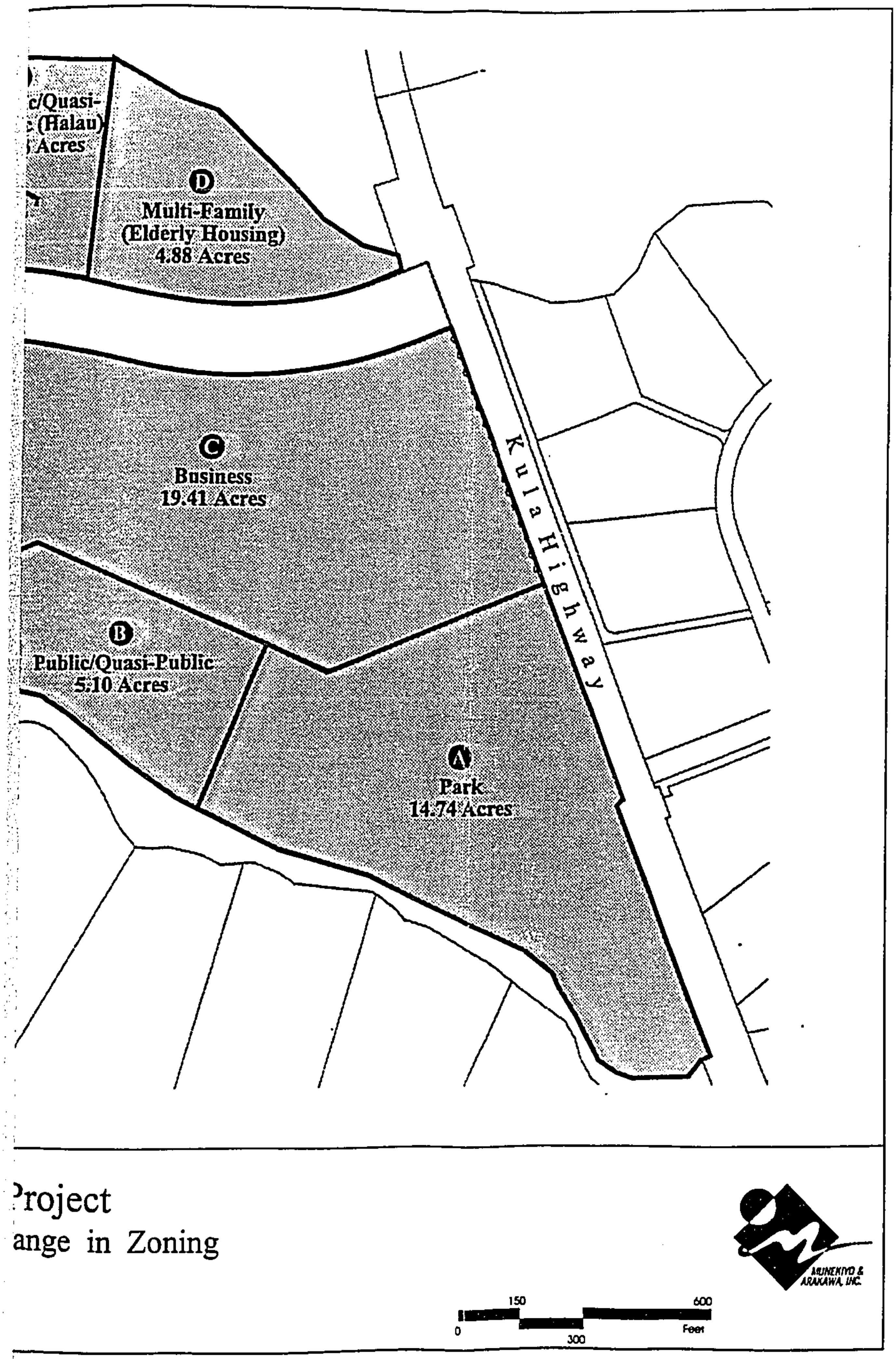
NOTE: Dashed lines indicate boundaries of existing zoning. Proposed land uses are noted in bold print. Shading indicates areas requiring change in zoning. Refer to Table 3.

Source: Austin, Tsutsumi & Associates, Inc.

Figure 12

Kulamalu Project
Area of Proposed Change in Zoning

Prepared for: Kulamalu Limited Partnership



'roject
ange in Zoning

Chapter V

Summary of Adverse Environmental Effects Which Cannot Be Avoided

V. SUMMARY OF ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

The proposed development will result in unavoidable construction-related impacts as described in Chapter III, Potential Impacts and Mitigation Measures.

Potential effects include noise generated impacts occurring from site preparation and construction activities. In addition, there may be temporary air quality impacts associated with dust generated from construction activities, and exhaust emissions discharged by construction equipment.

The proposed project is not anticipated to create any significant, long-term adverse environmental effects.

Chapter VI

Alternatives Analysis

VI. ALTERNATIVES ANALYSIS

Alternatives were considered for the subject property.

A. ALTERNATIVE A

Alternative A represents the proposed action. This alternative creates a mix of commercial, multi-family residential, park, public, and single-family residential uses. The commercial center creates business opportunities for a region in which demand for commercial services exceeds supply. Elderly multi-family residential uses are also created. The development also includes a variety of spaces for a neighborhood park, public uses, such as a church and day care center, and a halau for the teaching of Hawaiian culture and dance.

B. ALTERNATIVE B

Alternative B represents construction of a project in accordance with the existing zoning. Approximately 52.08 acres of the project site are presently zoned R-2 Residential District. The zoning would allow a single family residential development with a minimum lot size of 7,500 square feet. Assuming a density of 5 units per acre, approximately 260 single family residences could be built within the subject property.

On lots of 7,500 square feet or more, the Maui County Code also allows accessory dwellings. Thus, as much as 520 primary and accessory dwellings could be built on a portion of the subject property under existing zoning.

The remainder of the property (approximately 1.59 acres) is zoned Open Space. Although there is an Open Space zoning category noted on the County's zoning maps, there are no corresponding Open Space zoning provisions in the Maui County Code. Thus, only passive uses of property, such as landscaping or natural drainage, are permitted. No uses or structures are allowed in the Open Space zone.

Chapter VII

Irreversible and Irretrievable Commitments of Resources

VII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The proposed development would involve a commitment of fuel, labor, funding and material resources. No other significant irreversible and irretrievable commitments of resources have been identified in connection with the proposed action.

Chapter VIII

Findings and Conclusions

VIII. FINDINGS AND CONCLUSIONS

The "Significance Criteria", Section 12 of Hawaii Administrative Rules Title 11, Chapter 200, "Environmental Impact Statement Rules", were reviewed and analyzed to determine whether the proposed project will have significant impacts to the environment. The following analysis is provided:

1. *No Irrevocable Commitment to Loss or Destruction of any Natural or Cultural Resource Would Occur as a Result of the Proposed Project*

The proposed project will not result in any adverse environmental impacts. There are no known, rare, endangered or threatened species of flora, fauna or avifauna located on the subject property.

Additionally, archaeological inventory and reconnaissance surveys for the subject property were conducted and revealed one archaeological site (50-50-10-4181). The site has been assessed and recorded and is no longer considered significant.

Should any cultural remains be identified during the development of the proposed project, however, work will stop in the immediate vicinity and State Historic Preservation Division will be consulted to establish an appropriate mitigation strategy.

2. *The Proposed Action Would Not Curtail the Range of Beneficial Uses of the Environment*

The proposed project will involve the commitment of lands in the Urban District which may preclude other land options within the project area. This commitment of land resources would not have a significant effect on the range of beneficial uses of the environment.

3. ***The Proposed Action Does Not Conflict With the State's Long-Term Environmental Policies or Goals as Expressed in Chapter 344, Hawaii Revised Statutes***

The State Environmental Policy and Guidelines are set forth in Chapter 344, Hawaii Revised Statutes. The proposed action is in consonance with the following guidelines:

Environmental Policy:

Creating opportunities for the residents of Hawaii to improve their quality of life through diverse economic activities which are stable and in balance with the physical and social environment.

Guideline:

Community Life and Housing:

(1) Develop communities which provide a sense of identity and social satisfaction in harmony with the environment and provide internal opportunities for shopping, employment, education, and recreation; and

(2) Recognize community appearance as major economic and aesthetic assets of the counties and State; encourage green belts, plantings, and landscape plans and designs in urban areas; and preserve and promote ocean-to-mountain vistas.

4. ***The Economic or Social Welfare of the Community or State Would Not Be Substantially Affected***

The proposed project will be a direct economic benefit to the Upcountry area and should have no effect upon social welfare parameters.

5. ***The Proposed Action Does Not Affect Public Health***

No impacts to the public's health and welfare are anticipated as a result of the proposed project.

6. ***No Substantial Secondary Impacts, Such as Population Changes or Effects on Public Facilities Are Anticipated***

The construction of the proposed project will not affect the Island's population base or place new demands on the Island's public services.

7. ***No Substantial Degradation of Environmental Quality is Anticipated***

As the proposed project is implemented, appropriate environmental mitigation measures will be used to ensure that adverse environmental effects are minimized. If any, such effects are anticipated to be limited to temporary construction-related activities. Thus, no substantial degradation of environmental quality resulting from the proposed project is anticipated.

8. ***The Proposed Action Does Not Involve a Commitment to Larger Actions, Nor Would Cumulative Impacts Result in Considerable Effects On The Environment***

All land areas proposed for the development of the proposed project involve urban lands. The proposed project is not anticipated to create any significant long-term adverse environmental effects.

9. ***No Rare, Threatened or Endangered Species or Their Habitats Would Be Adversely Affected By the Proposed Action***

There are no known significant habitats or rare, endangered or threatened species of flora and fauna at the project sites. The removal of the existing flora and the displacement of fauna or avifauna from the area due to construction activities are not considered a negative impact upon these environmental features.

10. ***Air Quality, Water Quality or Ambient Noise Levels Would Not Be Detrimentally Affected By The Proposed Project***

Appropriate environmental mitigation measures will be used during construction to ensure that adverse environmental effects on air quality and noise are minimized. The project will be fully landscaped to create a site visually integrated with its surroundings. Low-rise building improvements are also proposed to keep with the existing built environment.

In the long-term, the proposed project is not anticipated to have a significant impact on air quality, water quality or noise parameters.

11. ***The Proposed Project Would Not Affect Environmentally Sensitive Areas, Such as Flood Plains, Tsunami Zones, Erosion-prone Areas, Geologically Hazardous Lands, Estuaries, Fresh Waters or Coastal Waters***

The subject property is not located within and would not affect environmentally sensitive areas. The subject property is not subject to flooding or tsunami inundation and the underlying soils are not erosion-prone. There are no geologically hazardous lands, estuaries, or coastal waters within or adjacent to the subject property.

Based on the foregoing findings, it is concluded that the proposed project will not result in any significant impacts.

Chapter IX

Agencies Contacted in the Preparation of the Environmental Assessment and Responses Received

IX. AGENCIES CONTACTED IN THE PREPARATION OF THE ENVIRONMENTAL ASSESSMENT AND RESPONSES RECEIVED

The following agencies were contacted during the preparation of the Environmental Assessment:

1. Planning Department
   County of Maui
   250 South High Street
   Wailuku, Hawaii 96793

2. Department of Public Works and Waste Management
   County of Maui
   200 South High Street
   Wailuku, Hawaii 96793

3. Department of Water Supply
   County of Maui
   200 South High Street
   Wailuku, Hawaii 96793

4. State Historic Preservation Division
   State of Hawaii
   Department of Land and Natural Resources
   P.O. Box 621
   Honolulu, Hawaii 96809

Chapter X

Comments Received During the Public Comment Period and Applicable Responses

L. Douglas MacCluer
360 Hoopalua Road
Pukalani, Hawaii 96768

'97 APR -9 P12:20

RECEIVED

April 7, 1997

David Blane
County of Maui
Planning Dept.
250 S. High St.
Wailuku, HI 96793

Dear Planners:

I object to the application for rezoning of tax key 2-3-8-por. 5, por. 38, por. 39, to change from agriculture to park, public/quasi-public, business/ commercial, multi-family residential, single-family residential, and open space. This proposal is not in the best interest for the upcountry public.

In January 1977, the state designated this land as "Prime Agriculture Land of Importance to the State of Hawaii". Have we forgotten how valuable open space and agricultural land is to Maui? When this is all depleted, what will the tourist come to see and keep the industry alive? In the last 20 years, we have watched developers take our best of farm land and "plant" houses.

In the proposed subdivision area, traffic is already badly congested due to the new high school. Concurrently, the upcountry highway from Kihei is also projecte to end here. The nearby community residents request that you not allow this rezoning to occur. Thank you for your consideration into this matter.

Sincerely,

Doug MacCluer

DOUG MACCLUER
LDM/jr

Enclosures

2257'

L. Douglas MacCluer
360 Hoopalua Road
Pukalani, Hawaii 96768

'97 APR -9 P12:23

RECEIVED

April 7, 1997

Planning Commission
County of Maui
Planning Dept.
250 S. High St.
Wailuku, HI 96793

Dear Chairman:

I object to the application for rezoning of tax key 2-3-8-por. 5, por. 38, por. 39, to change from agriculture to park, public/quasi-public, business/commercial, multi-family residential, single-family residential, and open space. This proposal is not in the best interest for the upcountry public.

In January 1977, the state designated this land as "Prime Agriculture Land of Importance to the State of Hawaii". Have we forgotten how valuable open space and agricultural land is to Maui? When this is all depleted, what will the tourist come to see and keep the industry alive? In the last 20 years, we have watched developers take our best of farm land and "plant" houses.

In the proposed subdivision area, traffic is already badly congested due to the new high school. Concurrently, the upcountry highway from Kihei is also projected to end here. The nearby community residents request that you not allow this rezoning to occur. Thank you for your consideration into this matter.

Sincerely,

Doug

DOUG MACCLUER
LDM/jr

Enclosures

KULAMALU
LIMITED PARTNERSHIP

July 21, 1997

Mr. L. Douglas MacCluer
360 Hoopalua Road
Pukalani, Hawaii 96768

SUBJECT: Kulamalu Project

Dear Mr. MacCluer:

We have received a copy of your April 7, 1997 letter to the County of Maui Planning Department and the Maui Planning Commission. As the applicant for the land use changes, we would like to take this opportunity to provide a response to your comments.

With regard to the issue of prime agricultural land, we would like to note that this property has been earmarked for urban development since the early 1970's when it was zoned for single family residential use. While open space and agriculture are valuable assets on an island wide basis, we also believe that a neighborhood commercial center in this location serves the retailing needs of the Upcountry region. Our intent is to mitigate impacts resulting from the development of our project, including traffic impacts.

Our intent is to build a project which will complement the rural nature of the region. If you have any questions, please feel free to call me. Thank you for your interest in the project.

Very truly yours,

KULAMALU LIMITED PARTNERSHIP

By ______________________

Don S. Fujimoto
Its Vice President

DF:to
cc: Don Schneider, Planning Department
Milton Arakawa, Munekiyo & Arakawa, Inc.

dowing/kulamalumaccluer.ltr

ms

May 13, 1997

Director of Planning
County of Maui Planning Department
County Building
200 South High Street
Wailuku, Maui, HI 96793

'97 MAY 21 P3:17

RE: APPLICATION FOR PROPOSED CHANGE IN ZONING
TAX MAP KEY: 2-3-8-POR. 5, POR. 38, POR. 39

Dear Sir:

We respectfully wish to oppose the proposed change in zoning for the project referred to on the attached notice (by Kulamalu Limited Partnership) for the reasons listed below, and would appreciate being informed in advance about any and all hearings, meetings, etc. involving the proposed project.

1. The supply of water to the Upcountry area is hardly enough to meet the needs of current residents and businesses. Water restrictions have become commonplace in our area, and the welfare of everyone here would be further compromised by making even greater demands on an already overburdened water supply. Where will the extra water come from? There should be no new development until current supply and demand can be constantly met.

2. Check the real estate listings in the Sunday Maui News and other publications and you will find numerous homes and ohanas for rent and sale in the Pukalani/Kula/Makawao area, as well as new housing developments in the Pukalani area STILL for sale despite a long period of advertising. This clearly indicates that there is already more than sufficient housing in the area as it is. We can also find no established need or desire for multi-family residential. Our area is what can be called a "bedroom community", with the majority of residents living in the area but working elsewhere (read: Downcountry). If the idea is meant as a cost-saving device for families, they would be better served to find housing closer to their place of work, as the cost of gasoline and maintaining a car to make the run down and uphill each work day is not cheap.

3. As to a commercial center, the number of businesses we have seen go under in the Upcountry area in the past few years, despite a "captive audience" of sorts, should be an accurate barometer in forecasting that a commercial center is not needed and most probably will not survive. The idea of building such a center may sound grand to some, perhaps, but who will come regularly enough to keep the businesses alive after the initial glow has worn off the project? If residents aren't patronizing established firms, what proof is there that more of the same is needed? This seems like overkill, especially in the Upcountry area.

4. In respect to items 2 and 3, the impact of added traffic and pollution in the area must be considered, and this applies not only to the cars of possible new residents, but delivery trucks coming and going as well. As you know, Kula Highway is one lane in each direction, and heavily traveled as it is. The high school will bring about more traffic in itself with its continued growth, and one must also consider the safety of students entering and exiting the school from Kula Highway.

5. The Upcountry area, in general opinion, is a community geared to a more rural attitude. Residents choose to live here for that reason. If we want to do business, we can go to Kahului or Wailuku. Maui has areas of the island for every need, and Upcountry was meant to be quiet and pastoral. Land development is a business - not a charity gesture - and the idea is to make money. To corrupt the virgin landscape in the name of profit is not in the best interest of the Upcountry residents you serve. The term "The greatest good for the greatest number" applies here, and the greatest number are Upcountry residents who do not wish to see our bastion of peace and solitude paved over and built up.

6. As a final note, what studies have proven that an additional load on Upcountry services (utilities, police, fire, other infrastructure, etc.) can be tolerated successfully if such a project were to go ahead? It seems that areas such as Kahului, Kihei or especially Wailuku, which could dearly use revitalization, would be better-equipped to handle such a development.

We could go on, but we believe our main reasons for opposition have been noted by now. If you wish to contact us, please feel free to do so at the address listed below or leave a message on our answering machine and we will certainly get back with you. Thank you for your consideration in this very important matter.

Very truly yours,

Alvin Barnhart

Mr. and Mrs. Alvin K. Barnhart
14 Aulii Place
Pukalani, Maui, HI 96768
573-1696

cc:

Mayor Linda C. Lingle
County Council
Maui News
Haleakala Times
Local Homeowner Associations

KULAMALU
LIMITED PARTNERSHIP

July 21, 1997

Mr. and Mrs. Alvin Barnhart
14 Aulii Place
Pukalani, Hawaii 96768

SUBJECT: *Kulamalu Project*

Dear Mr. and Mrs. Barnhart:

We have received a copy of your letter to the County of Maui Planning Department which was received on May 21, 1997. We would like to take this opportunity to provide a response to the issues raised in your letter.

With regard to water, we would like to note that the project will be developing its own source, transmission, and storage improvements, in consultation with the Department of Water Supply. A new well is proposed to be drilled in Kaupakalua to supply water for the project. An off site and on site reservoir are also proposed to provide for adequate storage capacity for the project. Also, appropriate transmission mains and lines are included as part of the project improvements. Thus, construction of the project should have no adverse effect upon the existing water system and in fact will improve the existing system by adding these facilities.

With regard to residential use, it should be noted that this portion of the project is intended for the elderly multi-family residential market. Since there are not very many elderly multi-family projects in the Upcountry area, we believe that there will be sufficient demand for this type of product.

We would like to note that the commercial portion of the project is intended as a neighborhood commercial center. Our studies have shown that Upcountry Maui is under serviced in terms of neighborhood shopping facilities and that demand for retail facilities will exceed the available supply even if the project is included within the analysis.

With regard to traffic, it is noted that there are a number of improvements already recommended by the Maui Long Range Land Transportation Plan (Draft Final Report, February 1996). Project-related improvements include intersection improvements at Kula Highway and the main project roadway leading to the project.

Mr. and Mrs. Barnhart
July 16, 1997
Page Two

Our goal is to construct a neighborhood shopping center which is geared to the needs of the Upcountry community. Our intent is to mitigate any infrastructural or public service-related impacts resulting from the project and complement the rural nature of the region.

Thank you for your interest in the project. If you have any questions, please feel free to call me.

Very truly yours,

KULAMALU LIMITED PARTNERSHIP

By [signature]
Don S. Fujimoto
Its Vice President

DF:to
cc: Don Schneider, Planning Department
Milton Arakawa, Munekiyo & Arakawa, Inc.
dowling/kulamalu/barnhart.ltr

'IP

USDA

United States
Department of
Agriculture

Natural
Resources
Conservation
Service

210 Imi Kala St.
Suite 209
Wailuku, HI
96793-2100

Our People...Our Islands...In Harmony

'97 MAY 28 P12:39

RECEIVED

May 27, 1997

Mr. David Blane, Planning Director
County of Maui
Planning Department
250 S. High Street
Wailuku, Hawaii 96793

Dear Mr. Blane,

Subject: Kulamalu Project; TMK: 2-3-08: por. 38, 39
I.D. CPA97002, CIZ970005, EA970005

It is recommended that the project effects look at drainage very carefully. The adjacent Kaluapulani Gulch joins Kalialinui Gulch below the Pukalani area and meanders through HC&S sugarcane fields outleting at Kanaha Beach Park. The gulch crosses five major irrigation delivery ditches controlled by HC&S which may be affected by higher runoff. Thus, the proposed detention facilities are very critical.

Thank you for the opportunity to comment.

Sincerely,

Neal S. Fujiwara

Neal S. Fujiwara
District Conservationist

BENJAMIN J. CAYETANO
GOVERNOR

GARY GILL
DIRECTOR

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
235 SOUTH BERETANIA STREET
SUITE 702
HONOLULU, HAWAII 96813
TELEPHONE (808) 586-4185
FACSIMILE (808) 586-4186

'97 MAY 30 P1:02

May 28, 1997

David Blane, Director
Maui Planning Department
250 South High Street
Wailuku, HI 96793

Attn: Don Schneider

Dear Mr. Blane:

Subject: Draft Environmental Assessment (EA) for Kulamalu Project, Pukalani

We have the following comments to offer:

1. *Segmentation*:
   Kulamalu Master Plan is referenced in the document. The EIS law prohibits segmentation of projects and requires that full disclosure of impacts be made on projects in their entirety. Please provide a full analysis and discussion of this and all geograhically-related projects, and indicate whether other project segments are anticipated under this Master Plan.

2. *Water resources*:
   a) Given the chronic water shortages that have plagued Maui in recent years, how will Maui DWS meet water demand for this project and the rest of the Kulamalu master-planned developments? What cumulative impacts will be caused by the continued demand for potable water?
   b) In the final EA please include a full discussion of construction and operational impacts to any surface or ground water sources. Please also indicate any related mitigation measures.

3. *Population impacts*:
The project proposes 50 elderly housing units and 4.5 acres of single family residences, as well as a 19-acre commercial area. What are the anticipated increases in resident and transient populations and their associated impacts for this and for the Master Plan area?

4. *Community notification*:
Notify the nearest neighbors or neighboring landowners and any interested community groups. Include documentation of your contacts in the final EA.

5. *Agency contacts; permits*:
In the final EA include a list of agencies contacted along with copies of any correspondence. Also list all required permits and their status.

6. *Visual outcomes*:
▸ Provide renderings in the final EA of the final appearance of the facilities in this complex;
▸ Provide photos of mauka and makai viewplanes of the site superimposed with a rendering of the final appearance of the complex.

7. *Timing*:
What are the anticipated start and end dates of construction?

If you have any questions, call Nancy Heinrich at 586-4185.

Sincerely,

Gary Gill

GARY GILL
Director

c: Milton Arakawa
Kulamalu Limited Partnership

KULAMALU
LIMITED PARTNERSHIP

July 21, 1997

Mr. Gary Gill, Director
Office of Environmental Quality Control
235 South Beretania Street, Suite 702
Honolulu, Hawaii 96813

**SUBJECT: Draft Environmental Assessment for Kulamalu Project
Pukalani, Hawaii**

Dear Mr. Gill:

We have received a copy of your May 28, 1997 letter to the County of Maui Planning Department relating to the subject project. We would like to provide a response to your comments.

With regard to segmentation issues, we would like to note that the term "master plan" is raised in the EA within the context of the traffic study. The term is misleading and will be revised in the Final EA. The traffic study analyzes the larger 304.71 acre area. The larger area includes the 53.67 acre area which is the subject of the EA. It is noted that the portion of the larger area designated for private school use is owned by a separate development entity. Thus, the extent and timing of development is beyond the control of Kulamalu Limited Partnership. Portions of the larger area are zoned Open Space. These are primarily gulch areas. Other portions have been zoned for single family residential use since 1971. Since there is consistency on State land use, community plan and zoning for single family residential use, development could proceed on this portion without further discretionary approvals. Although traffic impacts of implementing the residential zoning have been assumed as part of the traffic study, the question as to whether this portion of the property is proposed to be developed for single family residential use is uncertain at this juncture. Also, the extent and timing of developing this portion is uncertain. Thus, the lands outside of the 53.67 acre area have been included within the traffic study for contextual purposes although it should be considered outside of the scope of the EA.

With regard to water, it is noted that the 53.67 acre project will be developing its own source as well as transmission and storage improvements. A well construction permit for a new well at Huluhulunui has been granted by the Commission on Water Resource Management (CWRM) on June 2, 1997. Our intent is to move forward with pump tests and subsequent application for pump installation permit from the CWRM. Possible construction and operational impacts of withdrawing water from the Huluhulunui well should be addressed as part of the CWRM application process.

With regard to population impacts, it should be emphasized that approximately 52.08 acres of the project site is presently zoned R-2 Residential District. Compared to what can be built under the existing zoning, the proposed land use changes would lead to a significant reduction in population. Under the existing zoning, approximately 240 single family residences containing 720 people could be built. Under the proposed project, there could be 75 elderly persons living at the multi-family residential portion of the project and 21 single family homes containing 63 people. It is anticipated that people living in the Upcountry area would utilize the commercial area within the project. Thus, the commercial area should not cause an increase in population within the Upcountry region.

With regard to community notification and agency contacts, all landowners of record within 500 feet of the project's tax map parcels were notified that a change in zoning application was being filed. In addition, we had a community informational meeting on July 10, 1997. The public review period of the EA overlaps with the agency review period of the community plan amendment and change in zoning application filed with the County of Maui. (The EA is included in these applications).

We will include a full-size site plan and a site section in the Final EA in order to address issues relating to visual appearance and viewplanes.

Construction on the commercial portion of the project is anticipated to begin in early 1998 with completion by the end of 1998. The park and public/quasi-public areas are intended to be completed at the same time as the commercial portion. The multi-family residential use and the halau should be started and completed in 1999.

If you have any questions, please feel free to call me.

Very truly yours,

KULAMALU LIMITED PARTNERSHIP

By ______________________
Don S. Fujimoto
Its Vice President

DF:to
Attachment
dowling/kulamalu/garygill.ltr

MOX✓

BENJAMIN J. CAYETANO
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF HEALTH
MAUI DISTRICT HEALTH OFFICE
54 HIGH STREET
WAILUKU, MAUI, HAWAII 96793

LAWRENCE MIIKE
DIRECTOR OF HEALTH

LAWRENCE HART, M.D., M.P.H.
DISTRICT HEALTH OFFICER

'97 JUN -2 P1:37

May 29, 1997

Mr. David W. Blane
Director
Planning Department
County of Maui
250 South High Street
Wailuku, Hawaii 96793

Dear Mr. Blane:

Subject: Kulamalu Project
CPA97002, CIZ970005, EA97005
TMK: (2) 2-3-008: por. 5, por. 38, por. 39

Thank you for the opportunity to review and comment on the application. We have the following comments to offer:

> Activities associated with the construction phase of the project must comply with the provisions of Hawaii Administrative Rules, Chapter 11-46, "Community Noise Control".

Should you have any questions, please call me at 984-8230.

Sincerely,

HERBERT S. MATSUBAYASHI
District Environmental Health Program Chief

Maui Electric Company, Ltd. • 210 West Kamehameha Avenue • PO Box 398 • Kahului, Maui, HI 96733-6898 • (808) 871-8

'97 JUN -4 P1:37

June 2, 1997

Mr. David Blane
Planning Director
County of Maui
Maui Planning Department
250 So. High Street
Wailuku, HI 96793

Dear Mr. Blane:

Subject: Kulamalu Project
CPA 97002, CIZ970005, EA970005
(TMK: 2-3-008: 005, Pukalani, Maui)

Thank you for allowing us to comment on the subject project.

In reviewing the information transmitted and our records, Maui Electric Company (MECO) at this time has no objections to the proposed project.

MECO encourages that the project's consultant meet with us as soon as practical so that we may plan for the project's electrical requirements.

If you have any questions or concerns, please call Fred Oshiro at 872-3202.

Sincerely,

Edward Reinhardt

Edward Reinhardt
Manager, Engineering

FO/lh

97\10

BENJAMIN J. CAYETANO
GOVERNOR

HERMAN M. AIZAWA, Ph.D.
SUPERINTENDENT

STATE OF HAWAII
DEPARTMENT OF EDUCATION
P.O. BOX 2360
HONOLULU, HAWAII 96804

OFFICE OF THE SUPERINTENDENT

'97 JUN -6 P2:00

June 3, 1997

Mr. David W. Blane
Planning Director
County of Maui
250 South High Street
Wailuku, Hawaii 96793

Dear Mr. Blane:

Subject: Kulamalu Project, CPA97002, CIZ970005

The Department of Education (DOE) has determined that the proposed 50-unit elderly housing component and the development of approximately 23 single-family units will not have a significant impact upon school facilities in the area.

We request, however, that as a condition of zoning approval the applicant be required to satisfy the DOE's fair-share requirements if the elderly housing complex is instead developed for non-elderly persons.

Thank you for the opportunity to comment. If you have any questions, please call Mr. Sanford Beppu at 733-4862.

Sincerely,

Herman M. Aizawa, Ph.D.
Superintendent

HMA:hy

cc: A. Suga, OBS
R. Murakami, MDO

BENJAMIN J. CAYETANO
GOVERNOR

MAJOR GENERAL EDWARD V. RICHARDSON
DIRECTOR OF CIVIL DEFENSE

ROY C. PRICE, SR.
VICE DIRECTOR OF CIVIL DEFENSE

STATE OF HAWAII
DEPARTMENT OF DEFENSE
OFFICE OF THE DIRECTOR OF CIVIL DEFENSE
3949 DIAMOND HEAD ROAD
HONOLULU, HAWAII 96816-4495

PHONE (808) 733-4300
FAX (808) 733-421

'97 JUN -5 P1:51

June 5, 1997

TO: Planning Department
County of Maui
250 South High Street
Wailuku, Hawaii 96793

FROM: Mr. Roy C. Price, Sr.
Vice Director of Civil Defense

SUBJECT: APPLICATION FOR COMMUNITY PLAN AMENDMENT AND CHANGE IN ZONING, KULAMALU LIMITED PARTNERSHIP

Thank you for the opportunity to comment on the Application for Community Plan Amendment and Change in Zoning by Munekiyo & Arakawa, Inc., for Kulamalu Limited Partnership for park, public/quasi-public, business/commercial, multi-family residential, and single-family residential use, Pukalani, Maui, Hawaii; TMK: 2-3-8:5, 38 and 2-3-8:39.

State Civil Defense (SCD) has no negative comments to this zoning change, although this location does not have any siren coverage. SCD therefore requests that the developer provide a 115 db omni-directional solar powered siren into what appears to be the parking lot for the shopping center. This siren is annotated in red on the "conceptual site plan" with approximate coverage.

If you have any further questions, please call Mr. Norman Ogasawara of my staff at 733-4300.

Enc.

c: Maui Civil Defense Agency

KULAMALU
LIMITED PARTNERSHIP

July 18, 1997

Mr. Roy C. Price, Sr.
Vice Director of Civil Defense
State of Hawaii
Department of Defense
Office of the Director of Civil Defense
3949 Diamond Head Road
Honolulu, Hawaii 96816-4495

Subject: Kulamalu Project

Dear Mr. Price:

We have received a copy of your June 5, 1997 transmittal to the County of Maui Planning Department relating to the subject project.

We understand the public safety benefits of placing a 115 db omni-directional solar powered siren within the commercial portion of the project site and are willing to cooperate in the process of finding an acceptable site.

If you have any questions, please feel free to call me. Thank you for your interest in the project.

Very truly yours,

KULAMALU LIMITED PARTNERSHIP

By ______________________
Don S. Fujimoto
Its Vice President

DF:to
cc: Don Schneider, Planning Department
Milton Arakawa, Munekiyo & Arakawa, Inc.
dowting/kulamalu/defense.tr

n..

LINDA CROCKETT LINGLE
MAYOR

OUR REFERENCE

YOUR REFERENCE

POLICE DEPARTMENT

COUNTY OF MAUI '97 JUN 17 P12:13

55 MAHALANI STREET
WAILUKU, HAWAII 96793
AREA CODE (808) 244-6400
FAX NO. (808) 244-6411

HOWARD H. TAGOMORI
CHIEF OF POLICE

THOMAS PHILLIPS
DEPUTY CHIEF OF POLICE

June 13, 1997

MEMORANDUM

TO : DIRECTOR, PLANNING DEPARTMENT

FROM : HOWARD H. TAGOMORI, CHIEF OF POLICE

SUBJECT : I.D. No.:
TMK:
Project Name:
Applicant:

____ No recommendation or special condition is necessary or desired.

_X_ Refer to attachment(s).

Assistant Chief Charles Hall
for: HOWARD H. TAGOMORI
Chief of Police

TO	:	HOWARD TAGOMORI, CHIEF OF POLICE A/Lu DD 6/13/97
VIA	:	CHANNELS
FROM	:	GREGORY PARESA, LIEUTENANT, BRAVO WATCH
SUBJECT	:	KULAMALA PROJECT APPLICATION FOR COMMUNITY PLAN AMMENDMENT AND 'CHANGE IN ZONING - COMMENTS AND RECOMMENDATIONS

On 05/22/97, I received this assignment from Captain Gerald MATSUNAGA of the Wailuku Patrol Division.

This zoning request change encompasses 53.67 acres of the upper portion of the overall Kulamala Project Development. This area is roughly the size of the presently developed Kula 200 residential subdivision; that is, those homes having entry/exit onto Kula Hwy from Ohana Street. And, according to Appendix C of the Preliminary Wastewater Calculations, it is anticipated that this area comprising of: businesses, elderly housing, single family housing, a public park and other quasi-public areas should support a population of approximately 6,000 people.

It appears from the information provided in the Kulamalu Limited Partnership's booklet that every aspect of a Development of this size has been researched and taken into account, including, police service.

It is therefore suggested in an effort to further enhance police service and a sense of safety by those who will be populating this Development, that the Developer impliment techniques of **Crime Prevention Through Enviornmental Design** as taught at the University of Louisville's National Crime Prevention Institute.

Examples such as:

- utilizing concrete pilings or low hedge throughout the business area parking lot to affort a more controlled and safe flow of traffic.
- strategicly placing large planters infront of display windows or glass doorways to discourage the "smash and grab" using a vehicle.
- using the bougainvillaea or natal plum as an ornamental hedge, etc.
- placing lights at strategic locations through the Development, as well as using the right kind of light source.
- the placing of "speed humps" to deter speeding or imped escape thereby discouraging potential crime.

These are but a few examples that thru **Enviornmental Design**, the Developer can assist in crime prevention and foster a sense of safety among the people in the area.

It is further suggested that upon the completion of the structions, be it home or office, that the Crime Prevention specialist from Maui Police Department be contacted to do an onsite Crime Prevention Survey for the Developer.

Respectfully submitted.

forward.
concur
Capt [illegible] 7797
6/9/97

Gregory Paresa 3719
Lieutenant Bravo Watch
06/08/97

BENJAMIN J. CAYETANO
GOVERNOR
STATE OF HAWAII

KALI WATSON
CHAIRMAN
HAWAIIAN HOMES COMMISSION

JOBIE M. K. M. YAMAGUCHI
DEPUTY TO THE CHAIRMAN

STATE OF HAWAII
DEPARTMENT OF HAWAIIAN HOME LANDS
P.O. BOX 1879
HONOLULU, HAWAII 96805

'97 JUN 23

June 18, 1997

Mr. David W. Blane
County of Maui, Planning Department
250 South High Street
Wailuku, Hawaii 96793

Dear Mr. Blane:

Subject: Kulamalu Project

The Department of Hawaiian Home Lands has reviewed the environmental assessment for the Kulamalu Project.

As part of our review we have noted that Kulamalu's projected water use is 122,620 gpd and that an agreement has been made to install a 1 to 1.5 mgd well and 1,000,000 gallon reservoir. The proposed infrastructure is intended to improve the quantity and reliability of the Lower Kula System.

Hawaiian Home Lands at Keokea and Waiohuli rely upon the Lower Kula System for water. We support improvements to the system and as long as the project does not adversely impact water sources that serve Hawaiian Home Lands, we have no objection.

If you have any questions regarding our comments, please contact Daniel Ornellas of our Planning Office at 583-3836.

Aloha,

Jobie M. K. M. Yamaguchi

for KALI WATSON, Chairman
Hawaiian Homes Commission

4140

BOARD OF WATER SUPPLY
COUNTY OF MAUI
P.O. BOX 1109
WAILUKU, MAUI, HAWAII 96793-7109

'97 JUN 20 P2:29

June 19, 1997

Mr. David Blane, Director
County of Maui
Planning Department
250 South High Street
Wailuku, Maui, Hawaii 96793

Re: I.D.: CPA 970002; CIZ 970005; EA 970005
TMK: 2-3-08: por 5, por 38, por 39
Project Name: Kulamalu Project

Dear Mr. Blane,

Thank you for the opportunity to review this application. The Board of Water Supply has the following comments.

Consumption

The project area totals 53.67 acres comprised of single-family, multi-family, open space, public, and commercial uses. Using per-acre State standards, the project may use about 240,000 gallons per day. The applicant should be advised that, per their March 21, 1996 agreement with BWS, they will need to submit a letter (schedule "G" of the agreement) notifying BWS of their intent to exercise a portion of the storage, transmission, and source credits allocated under the agreement.

Source and System

The applicant should be advised that the proposed subdivision is in the Upcountry area affected by the "Shortage of Water Source Capacity Affecting Upcountry Areas" by the Director of Water Supply, dated March 16, 1993. However, the applicant has entered into an agreement with the Board of Water Supply to provide sufficient water for the project such that service to existing users will not be adversely effected by the development.

Domestic, fire, and irrigation calculations will be reviewed in detail during the development process. Actual fire demand for structures is determined by fire flow calculations performed by a certified engineer.

Water Quality

This project overlies the Makawao Aquifer System. In order to protect the aquifer, BWS recommends that the applicant utilize Best Management Practices (BMPs) designed to minimize infiltration from all construction operations. We have attached sample BMPs for principle operations for reference. Additional information is available from the State Department of Health.

Conservation

To further conserve water resources, the applicant should refer to the attached documents and consider these measures:

Eliminate Single-Pass Cooling: Single-pass, water-cooled systems should be eliminated per Maui County Code Subsection 14.21.20. These units pass water once-through for cooling, and then dispose of the water into the drain. Although prohibited by code, single-pass water cooling is still manufactured into some models of air conditioners, freezers, and commercial refrigerators.

Utilize Low-Flow Fixtures and Devices: Maui County Code Subsection 16.20.675 requires the use of low flow water fixtures and devices in faucets, showerheads, urinals, water closets and hose bibs. Water conserving washing machines, ice-makers and other units are also available, and can help cut back on water bills.

Maintain Fixtures to Prevent Leaks: A simple, regular program of repair and maintenance can prevent the loss of hundreds or even thousands of gallons a day. Refer to the attached handout, "The Costly Drip". The applicant should establish a regular maintenance program.

Use Climate-adapted Plants: The project site is located in "Maui County Planting Plan" - Plant Zone 3. Please refer to the "Maui County Planting Plan", and to the attached documents, "XERISCAPE: Water Conservation Through Creative Landscaping" and "Some of Maui's Native and Polynesian Plants." We encourage the applicants to review the attached documents, refer to the Planting Plan, and consider using climate-adapted and salt-tolerant native plants. Native plants adapted to the area, conserve water and further protect the watershed from degradation due to invasive alien species.

Prevent Over-Watering By Automated Systems: Provide rain-sensors on all automated irrigation controllers. Check and reset controllers at least once a month to reflect the monthly changes in evapotranspiration rates at the site. As an alternative, provide the more automated, soil-moisture sensors on controllers.

Look for Opportunities to Conserve Water Around the Home: A few examples: When clearing driveways, etc. of debris, use a broom instead of a hose. When washing cars, use a hand-operated spray nozzle instead of an open hose. Periodically check for leaks in faucets and toilet tanks.

If you need more information, please contact our Water Resources and Planning Division anytime at (808) 243-7199.

Sincerely,

for David Craddick
Director

wcf

C:\MYDOCU~1\WILL'S\PLANNING\RESPON~1\KULAMALU.WPD

attachments:

"The Costly Drip"
"Some of Maui's Native and Polynesian Plants"
Ordinance 2108 - An ordinance amending Chapter 16.20 of the Maui County Code, pertaining to the plumbing code"
"XERISCAPE - Water Conservation through Creative Landscaping"

"A Checklist for Water Conservation Ideas for Cooling"
"A Checklist for Water Conservation Ideas for Commercial Buildings"
"A Checklist for Water Conservation Ideas for Schools and Public Buildings"
"A Checklist for Water Conservation Ideas for Restaurants"
Selected BMPs from "Guidance Specifying Management Measures For Sources of Nonpoint Pollution In Coastal Waters." U.S. EPA.
"Fire Flow" - Hawaii Insurance Bureau, 1991
"Guide for Determination of Required Fire Flow" - Insurance Service Office, 1974

DEPARTMENT OF
PARKS AND RECREATION
COUNTY OF MAUI

1580-C KAAHUMANU AVENUE WAILUKU, HAWAII 96793

Mayor

HENRY OLIVA
Director

ALLEN SHISHIDO
Deputy Director

(808) 243-7230
FAX (808) 243-7934

'97 JUN 25 P3:12

RECEIVE

MEMO TO: David W. Blane, Planning Director

F R O M: Henry Oliva, Director

D A T E: June 19, 1997

SUBJECT: **Kulamalu Project**
CPA97002, CIZ 970005, EA970005
TMK: 2-3-008:por.5, por.38, por.39

We have reviewed the subject application and note that the applicant has revised the parks and playground assessment requirement outlined in the Makawao-Pukalani-Kula Community Plan. The Community Plan requires a 15.01 acre park, but the applicant proposes a 14.74 acre park instead. A justification for the change in land area is not provided.

The applicant shall arrange a meeting with my office and the Director of Public Works and Waste Management to make an official presentation of the park parcel including information on topography, metes and bounds, easements, and existing onsite/offsite infrastructure. Thank you for the opportunity to comment. Should you have any questions, please contact me at 243-7626 or Patrick T. Matsui, Chief-Planning and Development, at 243-7931.

HO:PTM:GU

c: Charles Jencks, Director-Public Works & Waste Management
Patrick T. Matsui, Chief- Parks Planning & Development
Gerald Unabia, Parks Project Manager
Files

dblane.m10

KULAMALU
LIMITED PARTNERSHIP

July 18, 1997

Mr. Henry Oliva
Director
Department of Parks and Recreation
1580-C Kaahumanu Avenue
Wailuku, Hawaii 96793

SUBJECT: Kulamalu Project

Dear Mr. Oliva:

We have received a copy of your June 19, 1997 memorandum to David Blane regarding the subject project. We would like to provide a response to the comments.

The proposed reduction in land area for the park from 15.01 acres to 14.74 acres is due to additional right-of-way set aside for the proposed through roadway which links with Kula Highway. Land use allocations for Park, Public/Quasi-Public, Business/Commercial, and Multi-Family Residential were all reduced slightly in order to accommodate the increase in right-of-way.

With regard to topography, metes and bounds, easements, and existing onsite and offsite infrastructure for the park parcel, this information will be formulated as part of the subdivision process. We intend to work closely with you in ensuring that your concerns are addressed.

If you have any questions, please feel free to call me.

Very truly yours,

KULAMALU LIMITED PARTNERSHIP

By ______________________
Don S. Fujimoto
Its Vice President

DF:to
cc: Don Schneider, Planning Department
Milton Arakawa, Munekiyo & Arakawa, Inc.

dowling/kulamalu/dprltr.001

BENJAMIN J. CAYETANO
GOVERNOR
SEIJI F. NAYA
DIRECTOR
BRADLEY J. MOSSMAN
DEPUTY DIRECTOR
RICK EGGED
DIRECTOR, OFFICE OF PLANNING

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

OFFICE OF PLANNING
235 South Beretania Street, 6th Flr., Honolulu, Hawaii 96813
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804
Tel.: (808) 587-28
Fax: (808) 587-2824

'97 JUN 30 P12:36

Ref. No. P-6756

June 20, 1997

Mr. David W. Blane
Planning Director
Planning Department
County of Maui
250 South High Street
Wailuku, Hawaii 96793

Attention: Mr. Don A. Schneider

Subject: Kulamalu Project, CPA970002, CIZ970005, EA970005
TMK: 2-3-08: por. 5, por. 38, and por. 39
Pukalani, Maui

We have reviewed the proposal by Kulamalu Limited Partnership for a mix of business, multi-family residential, single-family residential, park and public/quasi-public uses. The existing zoning designation is Open Space and R-2 Residential. The Community Plan designation is Park, Public/Quasi-Public, Business/Commercial, Multi-Family Residential, Single Family Residential, and Open Space. It is our understanding that a portion of the subject property is owned by Kamehameha Schools/Bishop Estate (TMK: 2-3-08: 39).

Since the 53.67-acre project site is within the Urban Land Use District, we have no comments at this time.

Thank you for allowing us the opportunity to review this proposal. If you have any questions, please contact Lorene Maki at 587-2888.

Sincerely,

Rick Egged
Director
Office of Planning

cc: Ms. Esther Ueda, LUC

-4·

'97 JUN 27 P3:18 STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P.O. BOX 621
HONOLULU, HAWAII 96809

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT
WATER RESOURCE MANAGEMENT

LD-NAV Ref.: CPA97002.RCM

JUN 26 1997

The Honorable David W. Blane
Planning Director
County of Maui
Planning Department
250 S. High Street
Wailuku, Hawaii 96793

Dear Mr. Blane:

SUBJECT: Review : Application for Community Plan Amendment Change in Zoning
I. D. Nos.: CPA97002, CIZ970005 and EA970005
Project : Kalamalu Project
Applicant : Kalamalu Limited Partnership
Location : Pukalani, Island of Maui, Hawaii
TMK : 2nd/ 2-3-08: Portion of 5 and 38

Thank you for the opportunity to review and comment on the subject Application for Community Plan Amendment and Change in Zoning pertaining to the Kalamalu project.

Our Commission on Water Resource Management has the following comments to offer on the proposed project:

1. We recommend coordination with the county government to incorporate this project into the county's Water Use and Development Plan; and

2. A Well Construction Permit (approved June 2, 1997), and a Pump Installation Permit (to be based on pump test results), from CWRM would be required before ground water is developed as a source of supply for the project.

Our Engineering Branch has confirmed that the proposed project site is located in Zone C (unshaded). This is an area of minimal flooding.

The Department of Land and Natural Resources has no other comments to offer on the proposed project at this time. Should you have any questions, please contact Nick Vaccaro of the Land Divisions' Support Services Branch at 1-808-587-0438.

HAWAII: Earth's best!

Aloha,

for MICHAEL D. WILSON

c: Maui Land Board Member
At Large Land Board Member
Maui District Land Office

KULAMALU
LIMITED PARTNERSHIP

July 16, 1997

Mr. Michael D. Wilson, Director
State of Hawaii
Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Subject: Kulamalu Project
Pukalani, Maui, Hawaii

Dear Mr. Wilson:

We have received a copy of your June 26, 1997 letter to the County of Maui Planning Department relating to the subject project. We would like to provide a response to your comments.

In accordance with the comments of the Commission on Water Resources Management (CWRM), we are coordinating with the County of Maui Department of Water Supply to incorporate the project into their Water Use and Development Plan.

The CWRM has also approved a Well Construction Permit for our proposed well at Huluhulunui. We intend to initiate well drilling and construction shortly. Thereafter, a pump installation permit application is expected to be filed with the CWRM.

If you have any question, please feel free to call me.

Very truly yours,

KULAMALU LIMITED PARTNERSHIP

By ______________________
Don S. Fujimoto
Its Vice President

DF:to
cc: Don Schneider, Planning Department

LINDA CROCKETT LINGLE
Mayor

CHARLES JENCKS
Director

DAVID C. GOODE
Deputy Director

AARON SHINMOTO, P.E.
Chief Staff Engineer

'97 JUL -1 A9:45

RALPH NAGAMINE, L.S., P.E.
Land Use and Codes Administration

EASSIE MILLER, P.E.
Wastewater Reclamation Division

LLOYD P.C.W. LEE, P.E.
Engineering Division

BRIAN HASHIRO, P.E.
Highways Division

Solid Waste Division

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
AND WASTE MANAGEMENT
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

June 30,1997

MEMO TO: DAVID W. BLANE, DIRECTOR OF PLANNING

FROM: CHARLES JENCKS, DIRECTOR OF PUBLIC WORKS AND WASTE MANAGEMENT

SUBJECT: COMMUNITY PLAN AMENDMENT, CHANGE IN ZONING AND DRAFT ENVIRONMENTAL ASSESSMENT
KULAMALU PROJECT
TMK (2) 2-3-008:005, 038 & 039
CPA-97/002, CIZ-97/005, EA-97/005

We reviewed the subject application and have the following comments.

1. A road lot shall be provided for the proposed collector road to provide for future 100-foot wide right-of-way if designated as a "Parkway" classification and improved to County standards to include, but not be limited to, pavement widening, construction of curb, gutter, and sidewalk, and relocation of utilities underground. Said lot shall be dedicated to the County upon acceptance of the improvements. The slope of said proposed collector road shall not exceed eight (8) percent as per AASHTO standards.

2. A 50' radius shall be provided at the intersection of the proposed collector road and the adjoining State road. Please confirm with the State Department of Transportation, Highways Division, for additional requirements.

3. A final detailed drainage master and erosion control plan including, but not limited to, hydrologic and hydraulic calculations and scheme for controlling erosion and disposal of runoff water shall be submitted to the Department of Public Works, Engineering Division, for our review and approval. The master plan shall provide verification that the grading and runoff water generated by the project will not have an adverse effect on the adjacent and downstream properties.

4. A site plan and a "sight distance" report to determine required sight distance and available sight distance at existing and proposed street intersections shall be provided for our review and approval.

5. The 100-year flood inundation limits shall be shown on the project site plans.

6. Construction waste should be taken to the Maui Demolition and Construction Landfill on North *Kihei Road near its intersection* with Honoapiilani Highway.

7. A subdivision application for the proposed project has not yet been received as of this date. The subdivision shall be in conformance with the approved community plan and zoning amendments prior to granting of final approval.

If you have any questions, please call David Goode at 243-7845.

DG:co/mt

xc: Engineering Division
Solid Waste Division
Wastewater Reclamation Division

S:\LUCA\CZM\KULAMALU.

KULAMALU
LIMITED PARTNERSHIP

July 18, 1997

Mr. Charles Jencks, Director
Department of Public Works
and Waste Management
200 South High Street
Wailuku, Hawaii 96793

SUBJECT: Kulamalu Project
TMK 2-3-8:por. 5, por. 38, por. 39
Pukalani, Hawaii

Dear Mr. Jencks:

We have received a copy of your memorandum dated June 30, 1997 to the Director of Planning relating to the subject project. We would like an opportunity to provide a response to the issues raised in your letter.

With regard to the slope of the proposed collector road, we note that adjacent land uses within the project site will consist of business uses. On abutting makai lands, there is a planned school and other lands zoned for single family residential uses. Under these conditions, it would be appropriate to characterize the adjacent land use as mountainous urban and to use a lower design speed for the highway. Therefore, the design criteria could be adjusted to utilize a design speed of 40 miles per hour (posted 35 mph) and maximum grade of 10 percent (AASHTO Green Book, page 525). Since the project site is close to the terminus of the collector road, it is desirable to reduce the highway speed limit approaching Kula Highway to provide the transition from the open highway to the Stop condition at Kula Highway.

We will comply with a 50 foot radius at the intersection of the collector road and the adjoining State road. A final detailed drainage master and erosion control plan will be submitted to the Engineering Division for review and approval.

A sight distance report will be submitted to the Department for review and approval. We will show the 100-year flood inundation limits on the project site plans.

We intend to arrange for construction waste to be taken to the Maui Demolition and Construction Landfill.

Mr. Charles Jencks
July 16, 1997
Page Two

We understand that any future subdivision application must be in conformance with applicable community plan and zoning provisions.

Thank you for the opportunity to provide a response. If you have any questions, please feel free to call me.

Very truly yours,

KULAMALU LIMITED PARTNERSHIP

By______________________________
Don S. Fujimoto
Its Vice President

DF:to
cc: Don Schneider, Planning Department
Milton Arakawa, Munekiyo & Arakawa, Inc.
dowling/kulamalu/dpwwmltr.001

P. O. Box 1417 • Wailuku, Hawaii 96793 • 808/244-1500 • 808/242-2777

BENJAMIN J. CAYETANO
GOVERNOR

KAZU HAYASHIDA
DIRECTOR

DEPUTY DIRECTORS
GLENN M. OKIMOTO

'97 JUL -9 P1:28

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:
STP 8.8023

July 3, 1997

Mr. David W. Blane
Director
Planning Department
County of Maui
250 South High Street
Wailuku, Hawaii 96793

Dear Mr. Blane:

Subject: Kulamalu Project
Applications for Community Plan Amendment
and Change in Zoning
I.D.: CPA97002, CIZ970005, EA970005
TMK: 2-3-008: por 5, por 38 & por 39

Thank you for your transmittal requesting our review on the subject applications.

Our comments are as follows:

1. The Maui Long Range Land Transportation Plan (MLRLTP) recommends a new two lane Upcountry-Kihei roadway which will connect Haleakala Highway to Piilani Highway. Currently there are several alternative alignments, including one which runs through the subject development. The developer should coordinate with our Highways Division for any right-of-way (ROW) requirements and dedicate the land when necessary.

2. The MLRLTP also recommends the widening of Kula Highway, fronting the subject project from two to four lanes. Additional ROW or setback may be required and should be coordinated with our Highways Division.

3. The developer should be responsible for those required transportation improvements attributable to his project and for his pro-rata share of required regional roadway improvements.

Mr. David W. Blane
Page 2
July 3, 1997

STP 8.8023

The proposed intersection improvements identified in the Traffic Impact Analysis Report (TIAR) including traffic signals should be closely coordinated with our Highways Division.

4. The design of the park in proximity to the highway right-of-way (ROW) should consider the prevention of balls entering the highway ROW.

5. Plans for construction work within the State highway right-of-way must be coordinated and approved by our Highways Division.

Very truly yours,

KAZU HAYASHIDA
Director of Transportation

KULAMALU
LIMITED PARTNERSHIP

July 18, 1997

Mr. Kazu Hayashida, Director
State of Hawaii
Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813

Subject: Kulamalu Project
TMK 2-3-8:por. 5, por. 38 and por. 39
Pukalani, Maui, Hawaii

Dear Mr. Hayashida:

We have received a copy of your letter dated July 3, 1997 to the County of Maui Planning Department relating to the subject project. We would like to take this opportunity to provide a response to the issues raised in the letter.

With regard to the Upcountry-Kihei roadway, we understand that several alternative alignments are being considered. Our intent is to coordinate with the Highways Division regarding applicable right-of-way requirements.

We understand that the Maui Long Range Transportation Plan recommends the widening of Kula Highway, from two to four lanes, in the vicinity of the project. In conjunction with the Highways Division, Maui Office of the DOT, we have shown a structure setback line of 40 feet from the existing right-of-way line to allow space for future widening in the vicinity of the project.

We will construct, at our cost, those transportation improvements specified in our traffic impact study as project related. We have no objection to entering into discussions with the Highways Division regarding pro rata share of regional roadway improvements. The implementation of traffic signals a the project roadway-Kula Highway intersection will also be coordinated with the Highways Division.

Mr. Kazu Hiyashida
July 16, 1997
Page Two

It is intended that park design be conducted by the County of Maui. Thus, we will forward concerns regarding balls entering the State highway right-of-way tot he Department of Parks and Recreation.

We also intend to coordinate construction work within the State highway right-of-way with the Highways Division.

Thank you for the opportunity to provide a response. If you have any questions, please feel free to call me.

Very truly yours,

KULAMALU LIMITED PARTNERSHIP

By ______________________
Don S. Fujimoto
Its Vice President

DF:to
cc: Don Schneider, Planning Department
Milton Arakawa, Munekiyo & Arakawa, Inc.

dowling/kulamalu/barnhart.ltr

References

References

Community Resources, Inc., Maui County Community Plan Update Program Socio-Economic Forecast Report, March 1992.

Department of Geography, University of Hawaii, Atlas of Hawaii, Second Edition, University of Hawaii Press, 1983.

R.W. Beck, Solid Waste Characterization Study- Maui, Hawaii, December 1994.

State of Hawaii, Department of Business and Economic Development, Data Book, 1990.

State of Hawaii, Department of Education, telephone conversation with employee, Trudy Yip-Onaga, March 1997.

University of Hawaii, Land Study Bureau, Detailed Land Classification - Island of Maui, L.S.B. Bulletin No. 7, May 1967.

U.S. Soil Conservation Service, Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii, U.S. Government Printing Office, 1972.

Appendices

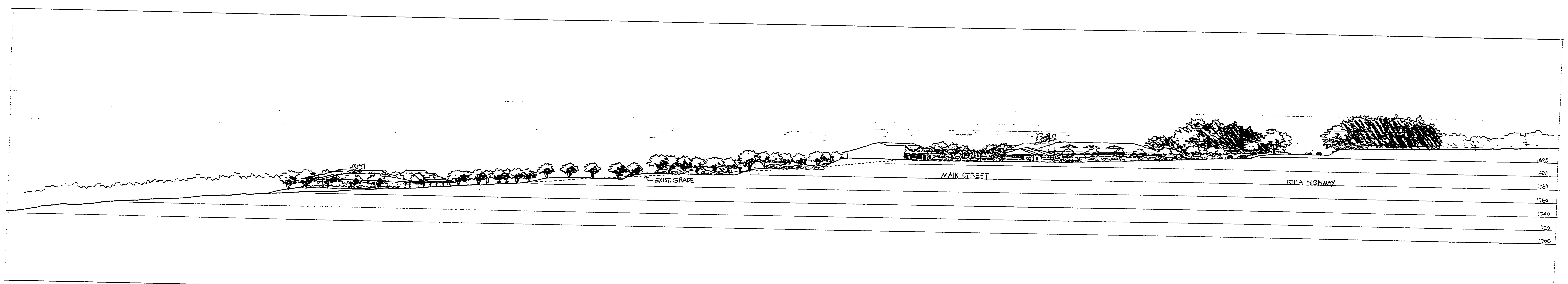
Appendix A

Site Plan and Site Section

OVERSIZED
DRAWING/MAP

PLEASE SEE
35MM ROLL

0021



0 50 100 150 200

KULAMALU TOWN CENTER
PUKALANI, MAUI

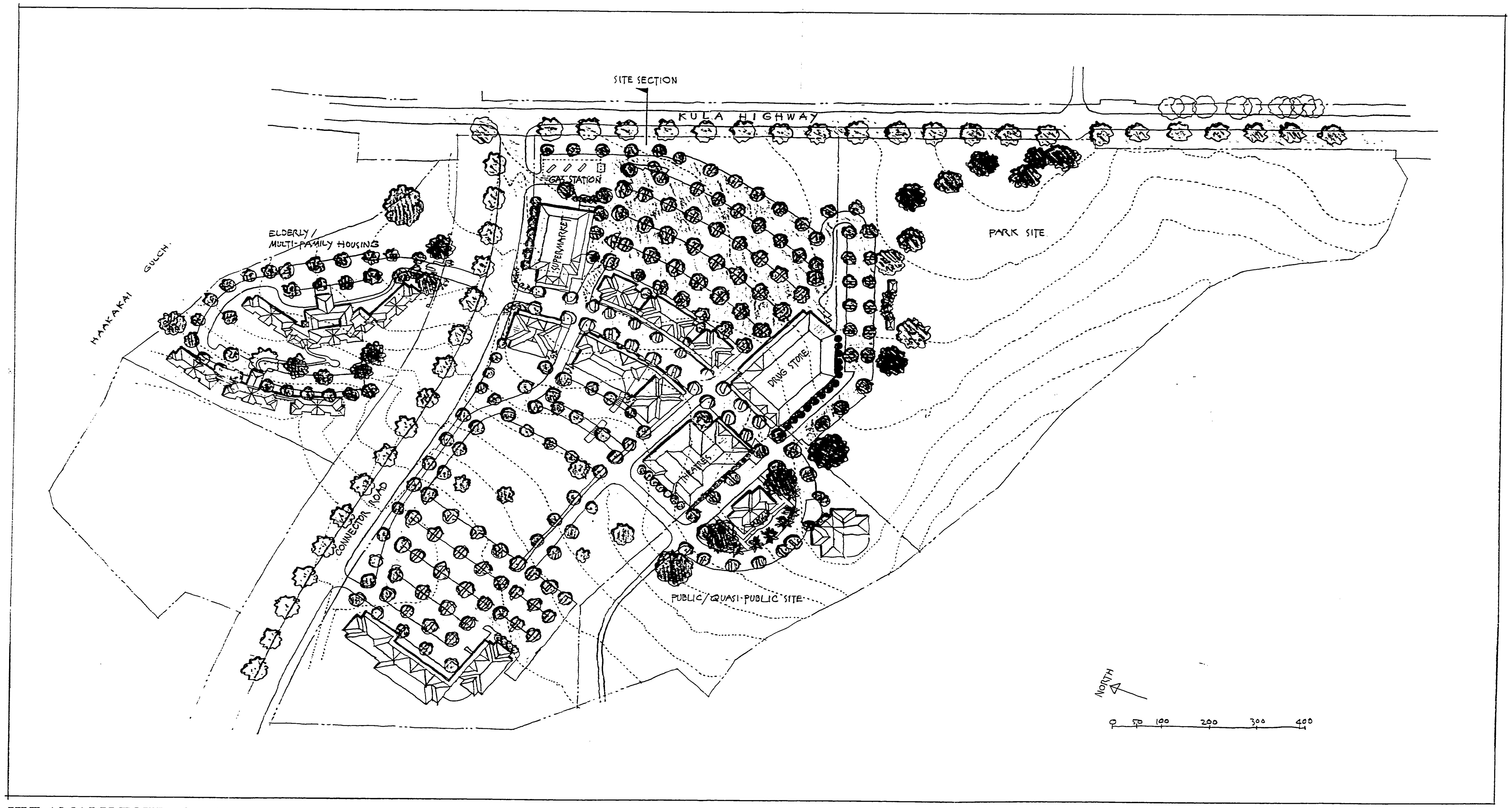
SITE SECTION

Group 70
International

OVERSIZED
DRAWING/MAP

PLEASE SEE
35MM ROLL

0022



KULAMALU TOWN CENTER
PUKALANI, MAUI

CONCEPTUAL SITE PLAN

Group 70
International

Appendix B-1

Archaeological Inventory Survey

Report 1700-030196

Archaeological Inventory Survey 44-Acre Pukalani Terrace Subdivision III

Land of ʻAʻapueo, Makawao District
Island of Maui

PHRI Paul H. Rosendahl, Ph.D., Inc.
Archaeological • Historical • Cultural Resource Management Studies & Services

Report 1700-030196

Archaeological Inventory Survey 44-Acre Pukalani Terrace Subdivision III

Land of ‘A‘apueo, Makawao District Island of Maui (TMK:2-3-08:Por.5)

BY

Warren Walzen, B.A. • Projects Supervisor
and
Paul H. Rosendahl, Ph.D. • Principal Archaeologist
with
Helen Wong Smith, M.A. • Historical Researcher

PREPARED FOR

Dowling Company, Inc.
c/o Munekiyo & Arakawa, Inc.
1823 Wells Street, Suite 3
Wailuku, Hawai‘i 96793

MARCH 1996

PHRI Paul H. Rosendahl, Ph.D., Inc.
Archaeological • Historical • Cultural Resource Management Studies & Services
HAWAII: 204 Waianuenue Ave. • Hilo, Hawaii 96720 • (808) 969-1763 • GUAM: P.O. Box 23305 • G.M.F., Guam 96921 • (671) 472-3117

SUMMARY

At the request of Mr. Don Fujimoto, vice president of Dowling Company, Inc., Paul H. Rosendahl, Ph.D., Inc. (PHRI) conducted an archaeological inventory survey of a 44-acre parcel located in the Land of ʻAʻapueo, Makawao District, Island of Maui (TMK:2-3-08:Por.5). The purpose of the survey was to identify all sites of potential archaeological significance present within the project area and evaluate each site for significance.

The project area contains previously recorded sites. Two are petroglyph sites located in the gulches that border the Pukalani Terrace property (50-50-10-1061* and 50-50-10-1062). A third, Site 50-50-10-4179 (previously reported as PHRI temporary Site 1707-1, McPhatter and Rosendahl 1996) is a petroglyph site in a tributary of Kaluapalani Gulch, south of Puʻu o Weli. The fourth is a wall, Site 50-50-10-4178 (previously reported as PHRI temporary Site 1707-2, ibid.) In addition, two other unrecorded collections of rock, apparently cleared from pineapple fields, were located on the fringe of the present project area during reconnaissance survey in the adjoining property (ibid.).

One site (Site 4181) was identified during the current work (previously reported as PHRI temporary site 1700-1; Wulzen and Rosendahl 1996). The site consists of four features: two agricultural clearing piles, and two rock alignments connecting the clearing piles. The two rock alignments function as terrace walls.

Two test unit excavations were placed against the rock alignments forming the terrace features. Only one excavation yielded artifacts, and neither yielded ecofacts. Site 4181 is assigned a function of historic to modern agriculture, and has been evaluated as no longer significant. No further archaeological work is recommended.

---

* *State Inventory or Historic Places site number (50=State of Hawaiʻi; 50=Maui; 10=USGS 7.5' Quad [1983; "Puʻu o Kali"].*

Contents

Illustrations

Tables

INTRODUCTION

BACKGROUND

At the request of Mr. Don Fujimoto, vice president of Dowling Company, Inc., Paul H. Rosendahl, Ph.D., Inc. (PHRI) conducted an archaeological inventory of a 44-acre parcel that is a portion of the 305-acre Pukalani Terrace Subdivision Unit III. The subject property is located in the Land of 'A'apueo, Makawao District, Island of Maui (TMK:2-3-08:Por.5) (*Figure 1*, in *Appendix A*; USGS 1957).

The overall purpose of the survey was to satisfy the cultural resources requirements of the Department of Land and Natural Resource - State Historic Preservation Division (DLNR-SHPD). The project was conducted February 1 and 2, 1996 by Crew Chief Blair McPhatter, B.A., and Field Archaeologist Harley Lanham, B.A. Additional Survey, site recording, and testing were conducted on February 6-9, 1996 by Projects supervisor, Warren Wulzen, B.A. Principal Archaeologist Paul H. Rosendahl, Ph.D., and Hawaii Projects Director, Alan T. Walker, B.A. provided overall guidance for the project.

SCOPE OF WORK

The basic purpose of an archaeological inventory survey is to identify—to discover and locate on available maps—all sites and features of potential archaeological significance present within a specified project area. An inventory survey is an initial level of archaeological investigation. It is extensive rather than intensive in scope, and is conducted primarily to determine the presence or absence of archaeological resources. A survey of this type indicates both the general nature and variety of archaeological remains present and the general distribution and density of such remains. It permits a general significance assessment of the archaeological resources and assists in the formulation of recommendations and estimates for any subsequent mitigation work that might be necessary or appropriate. Such mitigative work could include further data collection involving detailed recording of sites and features, and selected test excavations; in addition, mitigation could include further data-recovery excavations, construction monitoring, interpretive planning and development, and/or preservation of sites and features with significant scientific research, interpretive, and/or cultural values.

The basic objectives of the survey would be four-fold: (a) to identify all sites and site complexes present within the project area; (b) to evaluate the potential general significance of all identified archaeological remains; (c) to determine the possible impacts of proposed development upon the identified remains; and (d) to define the general scope of any subsequent further data collection and/or other mitigation work that might be necessary or appropriate.

Based on a review of readily available background literature, basic familiarity with the general project area, and extensive familiarity with the current requirements of pertinent review authorities, the following specific tasks were determined to constitute an adequate and appropriate scope of work:

1. Review archaeological and historical literature relevant to the project area, and conduct historical documentary research (emphasis on readily available literature and documentary sources);

2. Conduct 100% coverage high intensity ground survey of the entire project area, to find and record (a) any previously identified sites and features, and (b) any previously unidentified sites and features;

3. Conduct limited subsurface testing by manual excavations of the proposed culvert area and the features identified during a December 13, 1995 field inspection of the property, (a) to determine the presence or absence of potentially significant subsurface cultural features or deposits, and (b) to obtain suitable samples for age determination analyses;

4. Laboratory analyses—the principal areas of analysis include age determination, artifactual analysis, and ecofactual; and

5. Analyze field and historical research data, and prepare appropriate reports.

The inventory survey was carried out in accordance with the current standards for inventory-level survey required by DLNR-SHPD. The significance of all archaeological remains identified within the project area was assessed in terms of (a) the National Register criteria contained in the Code of Federal Regulations (36 CFR Part 60), and (b) the criteria for evaluation of traditional cultural values prepared by the National Park Service (1990). DLNR-SHPD and Maui County Planning Department use these criteria to evaluate eligibility for both the Hawaii State and National Register of Historic Places.

To further facilitate client management decisions regarding the subsequent treatment of resources, the preliminary significance of all archaeological remains identified during the survey was to also be evaluated in terms of three PHRI cultural resource management value modes that are derived from the previously mentioned federal evaluation criteria. Sites were to be evaluated in terms of potential scientific research, interpretive, and/or cultural values. Scientific research value refers to the potential of archaeological resources for producing information useful in the understanding of culture history, past lifeways, and cultural processes at the local, regional, and interregional levels of organization. Interpretive value refers to the potential of archaeological resources for public education and recreation. Cultural value, within the framework for significance evaluation used here, refers to the potential of archaeological resources for the preservation and promotion of cultural and ethnic identity and values.

PROJECT AREA DESCRIPTION

The project area consists of c. 44 acres, a portion of the 305-acre Pukalani Terrace Subdivision Unit III, and is located in the Land of ʻAʻapueo, Makawao District, Island of Maui (TMK:2-3-08:Por.5). The project area is depicted on two topographic maps, "Kilohana, Hawaii" (USGS 1983a), and "Puu O Kali, Hawaii" (USGS 1983b) (*Figure 1*). ʻAʻapueo may have been located in the old Kula District (for more detail, see Appendix B, Historical Documentary Research). The parcel is primarily former pineapple land, bounded on the north and south by branches of Kaluapulani Gulch (Kaakakai Gulch on tax maps). The eastern project boundary is the Kula Highway (Hawaii State Route 37). On the west, the project area is adjacent to a 250-

acre parcel that was subjected to reconnaissance survey by PHRI just prior to the present work (McPhatter and Rosendahl 1996). Pu'u o Weli, which has been used as a cinder quarry, is within the 250-acre parcel, just west of the present project area.

Most of the project area was originally part of a 160-acre parcel deeded to Aui as Grant 1167. A small triangular wedge on the northwest side of the project area was a portion of Grant 1829, Apana 1, to Keawe. The Maui Land and Pineapple Company later acquired these properties, and cultivated pineapple there until c. 1970 (D. Fujimoto, pers. comm.). The gently rolling slopes were modified during pineapple planting by plowing and the construction of roads and irrigation ridges. The parcel is currently in use as cattle pasture.

The elevation in the project area ranges from c. 518 m (1,700 ft) above mean sea level (AMSL) at the northwestern end, to c. 572 m (1,875 ft) AMSL at the eastern end of the parcel. Rainfall reported at the Kula Sanitorium station (916 m, 3,004 ft AMSL) averages less than 12.7 cm (five inches) per month (Armstrong 1983:62), and the temperature ranges between highs of 21-26 degrees C (70-78 degrees F) and lows of 16-11 degrees C (60-52 degrees F) (Armstrong 1983:64).

Terrain within the project area slopes moderately from the east end towards the west. Soils comprise Keahua silty clay loam (3%-5% slopes and 7% -15% slopes), Keahua silty clay (7%-15% slopes), Keahua cobbly silty clay (7%-15% slopes), and Keahua cobbly silty clay loam (15%-25% slopes). (Foote et al. 1972: Maps 106 and 115). The Keahua Series comprises "...well drained soils on uplands on the island of Maui. These soils developed in material weathered from basic igneous rock" (Foote et al. 1972:65). Pu'u o Weli is an abandoned cinder quarry, and Kaluapulani Gulch is classified as rock land.

In prehistoric time, this land may have been in the dryland forest and shrub zone (Sohmer and Gustafson 1994). Presently, the vegetation of the Pukalani Terrace project area is dominated by grasses and low-growing shrubs, including guinea grass (*Panicum maximum*), lantana (*Lantana camara* L.), sensitive plant (*Mimosa pudica*), prickly pear (*Opuntia ficus-indica*), agave (*Agave sisalana*), *koa-haole* (*Leucaena leucocephala*), and other unidentified grasses and weeds. The fringes of the former pineapple fields exhibit a few tree specimens, including a some large *koa-haole*, silver oak (*Grevillea robusta*), eucalyptus, and Christmas-berry (*Schinus terebinthifolius*) (identifications from Neal 1965).

PREVIOUS ARCHAEOLOGICAL WORK

Prior to the reconnaissance of the 250-acre parcel (McPhatter and Rosendahl 1996), no previous archaeological work had been conducted in the Pukalani Terrace Subdivision Unit III project area, and no other archaeological surveys in 'A'apueo are known. However, two survey reports from Omaopio Ahupua'a, to the south of the present project area illustrate the types of sites likely to be found in 'A'apueo. Folk and Hammatt (1993) report three sites, a petroglyph, a rectangular enclosure, and a linear mound. Donham (1992) reports a petroglyph site, three walls, and a rock pile from field clearing.

The DLNR-SHPD has identified two archaeological sites between the Kula Highway and Liholani Street at the far western end of the Pukalani Terrace III property. Both are petroglyph sites; one is in Kaluapulani Gulch (50-50-10-1062), and one is in Kalialinui Gulch to the south (50-50-10-1061) (letter of March 7, 1994 from Don Hibbard, administrator, DLNR-SHPD, to Brian Miskae, director, Maui Planning Department). Sites 1061 and 1062 were formerly known as MA-B22-1 and MA-B22-2 (Cox 1989:92-93). The DLNR site record states of Site 1061 that it stretches for over 500 m along Kalialinui Gulch and contains both rockshelters and numerous (c. 191) petroglyphs (Hommon 1973). Site 1062, in Kaluapulani Gulch, *makai* of the Kula Highway, consists of fewer petroglyphs, and all are on the north side of the gulch, opposite the present project area (Connelly 1973c). These two sites were targeted for relocation.

Two additional sites are reported in the vicinity, but *makai* of the Pukalani Terrace property, in Kaluapalani Gulch. Site 50-50-10-1231 is another petroglyph site, containing 31 elements (Connelly 1973b). Site 50-50-10-1264 is a burial cave (Connelly 1973a).

During the reconnaissance survey of the contiguous 250-acre portion of the Pukalani Terrace Subdivision III, two previously unrecorded sites were identified (McPhatter and Rosendahl 1996). Site 50-50-10-4179 (reported as PHRI temporary Site 1707-1) is located in a branch of Kaluapulani Gulch at the southern foot of Pu'u o Weli and consists of two petroglyph panels containing at least five elements of canoes and crab claw sails. Site 50-50-10-4180 (reported as PHRI temporary Site 1707-2) is an apparent boundary wall located on the bluff above Kalialinui Gulch (*Figure 2, in back pocket*). Two land-clearing piles associated with prior pineapple cultivation were noted just outside of the present project area, but these were not recorded as sites (ibid.). Based on the findings of previous archaeological work in the project area vicinity and on the results of historical documentary research, site types expected were petroglyphs, walls, and sites relating to pineapple cultivation.

FIELD METHODS AND PROCEDURES

The 100% pedestrian survey was conducted on February 1 and 2, 1996, by Crew Chief Blair McPhatter, B.A., and Field Archaeologist Harley Lanham, B.A., immediately after concluding the reconnaissance of the contiguous 250-acre parcel. Additional survey, site recording, and testing were conducted on February 6 through 9, 1996, by Projects Supervisor Warren Wulzen. Principal Archaeologist Paul H. Rosendahl, Ph.D., and Hawai'i Projects Director Alan T. Walker, B.A., provided overall guidance for the project.

Blue-and-white flagging was used by field personnel throughout the project area to mark the start and termination points of each transect. Pink flagging was used at the beginning and ending of every other transect to facilitate sighting from a distance. The single site identified during the pedestrian survey was marked with pink flagging tape and assigned a PHRI temporary number, 1700-1. The site was tagged with an aluminum strip bearing the date, the letters "PHRI" and the site number. All transects and sites were plotted onto a 1"= 300' scale project map (10-ft contours) supplied by Austin, Tsutsumi & Associates, Inc., of Wailuku, Maui. Previously recorded sites were relocated using copies of the SIHP site records.

A PHRI site record form was completed for the single recorded site, along with a site map. The site map was produced using metric tape and compass. A complete 35-mm black-and-white photographic record of field work was kept. One artifact was collected from the site surface for analysis.

Subsurface excavation was undertaken at two features of the newly recorded Site 50-50-10-4181. Feature A was excavated with a 2.0 by 0.5 m trench that was placed through the rock alignment to discern architectural detail and soil differences above and below the terrace. Feature B was excavated with a 1.0 by 1.0 m unit placed *mauka* of the center of the rock alignment forming the terrace. The two test units were excavated according to natural stratigraphic layers. When necessary, excavation by arbitrary 10 cm levels was employed within thick layers. Excavation proceeded by hand using carefully controlled methods. A datum was established for stratigraphic control. Line levels, trowels, brushes, dust pans and various other small instruments were employed. Excavation of the units terminated below the rock alignments that formed the terraces.

Field documentation of the controlled excavation units consisted of recording the horizontal and vertical proveniences of recovered portable materials, samples, and the subsurface features and strata encountered. These data were recorded on standard PHRI archaeological excavation grid and feature forms. Plan views and stratigraphic section drawings were made to scale. Black-and-white photographs were taken to document the field work and to support the written and graphic record. All recovered matrices were passed through 1/4-inch and 1/8-inch nested screens, and sorted in the field for cultural material, including charcoal, ecofacts, and artifacts.

After an excavation was completed, at least one representative sidewall was profiled and the soils in each natural layer were described on standard PHRI stratigraphic forms, according to U.S. Soil Conservation Guidelines (Soil Survey Staff 1962) and Munsell Color Charts (Kollmorgen Instruments Corp. 1990). Both units were backfilled to their original appearance.

FINDINGS

SITE 4181

During the inventory survey, a single previously unrecorded site, SIHP No. 50-50-10-4181 (PHRI temporary Site 1700-1) containing four component features, was identified (*Table 1* and *Figure 3*). Features A and B of this site are alignments forming terraces in a small swale between former pineapple fields (*Figures 4* and *5*). Features C and D are land-clearing piles of rock, associated with pineapple cultivation. These are similar to the previously reported land-clearing piles that were noted but not recorded as sites during the survey of the 250-acre parcel (McPhatter and Rosendahl 1996).

Table 1. Summary of Identified Sites and Features

SIHP Site No.	Fea.	Formal Site or Feature Type	Functional Interpretation	*CRM Value Mode Assessment R	I	C	Completed FieldWorkTasks DR	SC	EX
4181		Complex	Historic Agriculture	L	L	L	+	+	+
	A	Terrace							
	B	Terrace							
	C	Land Clearing Rock Pile							
	D	Land Clearing Rock Pile							

* *Cultural Resource Management ValueModeAssessment*

–Nature: *R = Scientific research*
I = Interpretive
C = Cultural

–Degree: *H = High*
M = Moderate
L = Low

Completed FieldWorkTasks: *DR = Detailed recording (scaled drawings, photographs, and written descriptions)*
SC = Surface collections
EX = Test excavations

Overall, Site 4181 measures c. 100 m in length (SE-NW) and from 20 m to 35 m in width (*Figure 3*). The features are arrayed along a swale, the head of which is c. 25 m southeast of the beginning of Feature C, and continues to an eventual steep drop-off into Kaluapalani Gulch, c. 250 m to the northwest. Features C and D line the upper edges of the swale, while Features A and B run across the swale, perpendicular to the natural flow of water down the drainage.

Features A and B appear to be constructed from rock removed from the land-clearing piles. Each spans a distance of c. 16 m between the Features C and D, and is one to two meters wide. The greatest height of the architecture is c. 0.7 m. The soil deposit on the uphill side of the alignment is level with the architecture. Both features exhibit some careful stacking in some places, but haphazard piling in others. Cattle trails cut through the features and may have degraded the architecture.

The land-clearing piles, Features C and D, extend along the upper interior edge of the swale. Feature C is much larger, extending for the whole site length, c. 100 m, and with widths of two to five meters. Most of the rock appears to have been tossed over the edge of the swale, but there are a few areas which exhibit piling. Features A and B are both directly connected to Feature C. Feature D runs from the northeast end of Feature A for c. 45 m, terminating near Feature B. The rock piles of Feature D are smaller than those of Feature C, and exhibit some stacking.

Two artifacts were noted during the recording of the site, a short piece of iron rail and a base fragment of a clear glass soda bottle. The bottle fragment was collected from Feature C, south of Feature A, and accessioned as ID No. 1700-1. The diameter of the bottle base is 2¼ in. (5.6 cm) and the glass is 5/16 in. (0.7 cm) thick. The bottle fragment measures 2½ in. (6.8 cm) in maximum height. Embossed around the base of the bottle is the legend, "NET CONTENTS 6½ FLUID OUNCES CITRIC ACID ADDED." The addition of citric acid would indicate that the bottle contained a lemonade or orange soda. The base of the bottle contains manufacturer's marks indicating that the Owens-Illinois Pacific Coast Company, Oakland, California, plant produced the bottle in the 1950s (Toulouse 1972:406-9). Large capital letters "S.Y." presumably indicate the brand of soda, but this does not match any known distributor in Hawai'i (Millar 1988).

Two one-square-meter test units (TU) were excavated at Site 4181. Feature A was tested with TU-1, a 2.0 m by 0.5 m excavation, the orientation of which was perpendicular to the axis of the rock alignment (*Figure 4*). TU-2, a 1.0 m by 1.0 m excavation, was placed against the uphill side of the Feature B alignment (*Figure 5*). In both units, an architectural layer of rock and two soil layers were revealed. The architectural layer at both features rests atop the lower soil layer, and retains the upper layer to the depth of the stacked rock on the uphill side of the alignment.

TU-1, Feature A

The datum for TU-1 was established 8.0 cm above the ground surface of the southwest corner of the unit. The rock alignment divided the 2.0 meter-long test unit into two smaller units. The soil surface of the uphill (south) half of the unit sloped from the southeast corner 3.0 cm below datum (cmbd), to 23 cmbd against the rock alignment. Below the alignment, the soil surface ranged from 74 cmbd against the base of the alignment to 91 cmbd in the northwest corner of the unit. In order to retain the integrity of the terrace, architectural rocks were removed only after the soil had been excavated from behind them, and some were not moved at all.

This unit yielded no ecofactual material. A total of 115+ artifacts (the "+" indicating that due to the degradation of the plastic, small pieces continue to break off in storage) were collected from the screens and *in situ*. Pieces of black plastic, commonly used in the pineapple fields as mulch, made up 114+ of the artifactual total. These were found behind the alignment as deep as 97 cmbd, or deeper than the existing architecture. The only other artifact was a small (1.0 cm by 2.3 cm by 2.2 cm) triangular piece of ceramic, 0.5 cm thick, composed of light brown clay and glazed white on both sides. This artifact is not large enough to be diagnostic. No artifacts were found in Layer II.

The excavation of Feature A revealed two soil layers (*Figure 6*). The designation "A" was used for architectural rock that was clearly a part of the design and construction of the alignment forming the terrace. For purposes of differentiation of the collections from south and north of the alignment, Layer I was subdivided into Layer IA, uphill (south) of the stacked rock, and Layer IB, below (north of) the alignment. The soil descriptions for Layer IA and IB were identical. The Layer I soil appears to have been deposited contemporaneously with the construction of the terrace alignment, which consists of only a single line of basalt boulders and cobbles. Layer II was found beneath Layer IB, and appeared to represent natural soil development. A description of the soil stratigraphy follows:

Layer	*Description*
A	17-93 cmbd, ranging from 0-76 cm in thickness; architectural layer; basalt boulders; very abrupt, irregular boundary; cultural layer, constructed by humans;
IA	3-93 cmbd, ranging from 70-88+ cm in thickness; very dusky red (2.5YR 2.5/3 moist); clay loam; dark reddish brown (5YR 3/3 dry); moderate, fine, crumb structure; slightly hard, friable, sticky, plastic consistence; many, fine, tubular roots; many, fine, interstitial pores; unknown boundary; cultural layer containing one ceramic piece and 109+ pieces of black plastic;
IB	88-98 cmbd, ranging from 8-11 cm in thickness; very dusky red (2.5YR 2.5/3 moist); clay loam; dark reddish brown (5YR 3/3 dry); moderate, fine, crumb structure; slightly hard, friable, sticky, plastic consistence; many, fine, tubular roots; many, fine, interstitial pores; abrupt, smooth boundary; cultural layer containing five pieces of black plastic;
II	97-113+ cmbd, ranging from 11-14+ cm in thickness; very dusky red (2.5YR 2.5/2 moist); clay loam; dusky red (2.5YR 3/3 dry); weak, medium, subangular blocky; slightly hard, friable, slightly sticky, slightly plastic consistence; common, medium, tubular roots; common, medium, interstitial pores; non-cultural layer.

TU-2, Feature B

The datum for TU-2 was established 10 cm above the ground surface of the southwest corner of the unit. The basalt boulders of the terrace alignment formed the north wall of the unit and were not excavated. Unlike at Feature A, numerous cobbles and small boulders were piled to the south of the alignment, apparently to protect it from erosion. The surface of the unit sloped from the southwest corner, 10 cmbd, to 18 cmbd in the southeast corner, to 23 cmbd against the rock alignment. Below the piled rock, the soil surface ranged from 56 cmbd to 59 cmbd.

TU-2 yielded neither ecofactual nor artifactual material. The excavation of Feature B revealed two soil layers designated Layer I and II, similar to those found in Feature A. The designation "A" was used for architectural rock that was clearly a part of the design and construction of the alignment forming the terrace. Layer II was found beneath Layer I, and appeared to represent natural soil development. A description of the soil stratigraphy follows:

Layer	Description
A	20-73 cmbd, ranging from 0-53 cm in thickness; stony texture; architectural layer - terrace alignment along north side of unit; very abrupt boundary; cultural layer;
I	10-64 cmbd, ranging from 31-48 cm in thickness; dark reddish brown (5YR 3/2 moist); clay loam; dark reddish brown (5YR 3/3 dry); moderate, medium, crumb structure; slightly hard, friable, sticky, plastic consistence; common, fine, tubular roots; common, fine, interstitial pores; clear, smooth boundary; non-cultural layer;
II	55-73+ cmbd, ranging from 0-12 cm in thickness; dusky red (2.5YR 3/4 moist); clay loam; dusky red (2.5YR 4/4 dry); weak, medium, subangular blocky structure; hard, friable, slightly sticky, slightly plastic consistence; few, fine, tubular roots; few, fine, interstitial pores; non-cultural layer.

Summary, Site 4181

The persistence of clearly modern artifacts into the deepest level of Layer I in TU-1 indicates a recent age for the terrace. No evidence of prehistoric activity was observed in the site. It appears that the swale itself may be the result of agricultural irrigation, and Features C and D are likely to have been the result of clearing of the adjacent fields. The bottle fragment collected from Feature C dates to the 1950s. Features A and B must postdate Features C and D, if the supposition that the alignments are constructed of rock from the land-clearing piles is correct. Based on the homogeneity of the soil deposit, the Layer I fill uphill of the alignments appears to have been placed there as the rocks were stacked, as opposed to being an alluvial deposit. Thus, it may be that the terracing of Features A and B was intended as a soil conservation effort.

SITES 1061 AND 1062

In order to be able to report the location of sites 50-50-10-1061 and -1062 to the client, their reported locations were revisited. The Kalialinui petroglyphs, Site 1061, were relocated (*Figure 2*), and they appear to match the existing site record (Hommon 1973). In Kaluapalani Gulch, a panel of petroglyphs belonging to Site 1062 was located farther west than expected (as shown on *Figure 2*); however, all the petroglyphs were on the north side of the gulch, as reported (Connelly 1973c).

CONCLUSION

DISCUSSION

The 44-acre Pukalani Terrace Subdivision has been thoroughly surveyed for archaeological resources. The existence of irrigation ditches, furrows, and the remnants of roads indicates that this parcel was planted in pineapple in the past, although it has not been cultivated for c. 25 years. The lack of precipitation would have made prehistoric agriculture unlikely on this land, and therefore, prehistoric habitation would have also been unlikely. However the existence of three petroglyph sites in the gulches bounding the Pukalani Terrace property, with no associated evidence of traditional Hawaiian agriculture, suggests that 'A'apueo Ahupua'a was visited for non-subsistence activities.

The fact that six land grants were made in the Pukalani Terrace property might indicate the existence of historic house sites or agricultural improvements, but the only possible trace of that era was the previously reported Site 50-50-10-4180, a possible boundary wall in the contiguous 250-acre parcel (McPhatter and Rosendahl 1996). Modification of the land to accommodate pineapple growing probably eliminated any other archaeological evidence in the current project area.

During the current work, only one site (50-50-10-4181) was identified. This site consists of two land-clearing rock piles (Features C and D) and two terrace alignments (Features A and B). The site was recorded and tested, and is assigned a late historic to recent age, based on the Feature C and D apparent association with pineapple agriculture and artifacts of recent origin from the excavations in Features A and B.

TENTATIVE GENERAL SIGNIFICANCE ASSESSMENT AND RECOMMENDED GENERAL TREATMENT

Site 50-50-10-4181 has been assessed for significance based on the National Register Criteria for Evaluation, as outlined in the Code of Federal Regulations (36 CFR Part 60 n.d.). DLNR-SHPD uses these criteria for evaluating cultural resources (DLNR Draft Rules 1994). To be assessed as significant a site must possess integrity of location, design, setting, materials, workmanship, feeling, and association and must be characterized by one or more of the following four criteria:

(A) It must be associated with events that have made a significant contribution to the broad patterns of our history;

(B) It must be associated with the lives of persons significant in the past;

(C) It must embody distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic value or represent a significant and distinguishable entity whose components may lack individual distinction; or

(D) It must have yielded or may be likely to yield, information important in prehistory or history.

Sites are also assessed for cultural significance using: (a) guidelines prepared by the National Park Service (1990), and (b) guidelines established by the DLNR-SHPD (DLNR Draft Rules 1994). The Hawaii State guidelines utilize this additional fifth criteria (Criterion E) which defines significant cultural resources as ones that "have an important traditional cultural contribution or value to the native Hawaiian people or to other ethnic groups of the state" (Ibid.).

Most archaeological sites are initially evaluated as significant under Criterion D. After the evaluative process of an inventory survey, or the data recovery process of a mitigation program, the research potential of some sites may be exhausted (i.e., after extensive mapping, testing, surface collection, historical research, etc.). In these cases, the sites may maintain their information content value but lose their information content significance. Hence, the sites would be considered as "No Longer Significant" (NLS).

Based on the federal criteria described above, Site 50-50-10-4181, which has been recorded, tested, as reported here, is assessed as no longer significant, based on the recent age of the features and the demonstrated lack of information content important to history. No further work is recommended for this site.

The previously recorded petroglyph sites (50-50-10-4179, 50-50-10-1061, and 50-50-10-1062) have been relocated. To insure they are not impacted by development of the Pukalani Terrace Subdivision Unit III, a monitoring plan for the sites should be prepared and implemented prior to any construction in the area.

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APPENDIX A: ILLUSTRATIONS

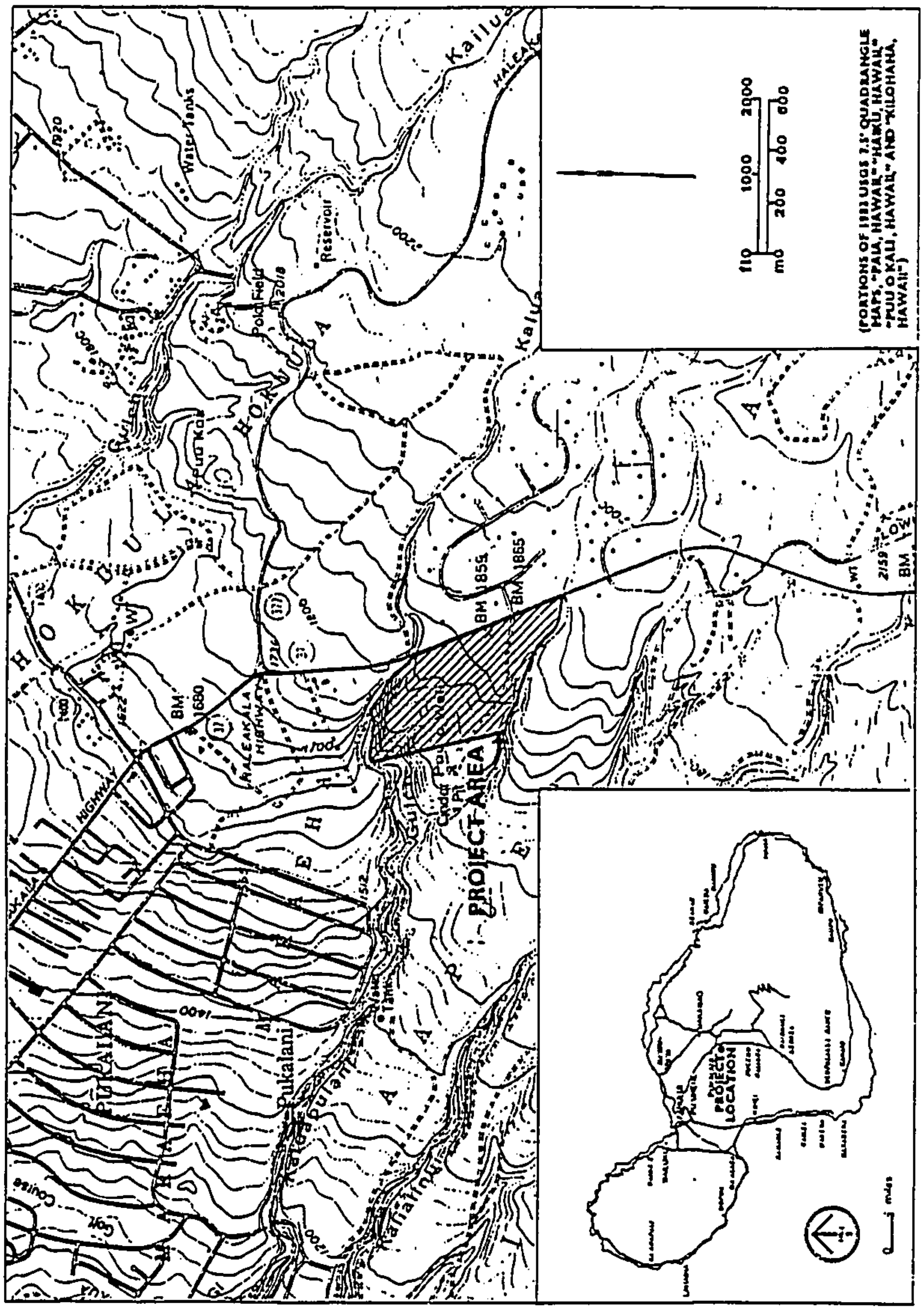

Figure 1. Project Area Location

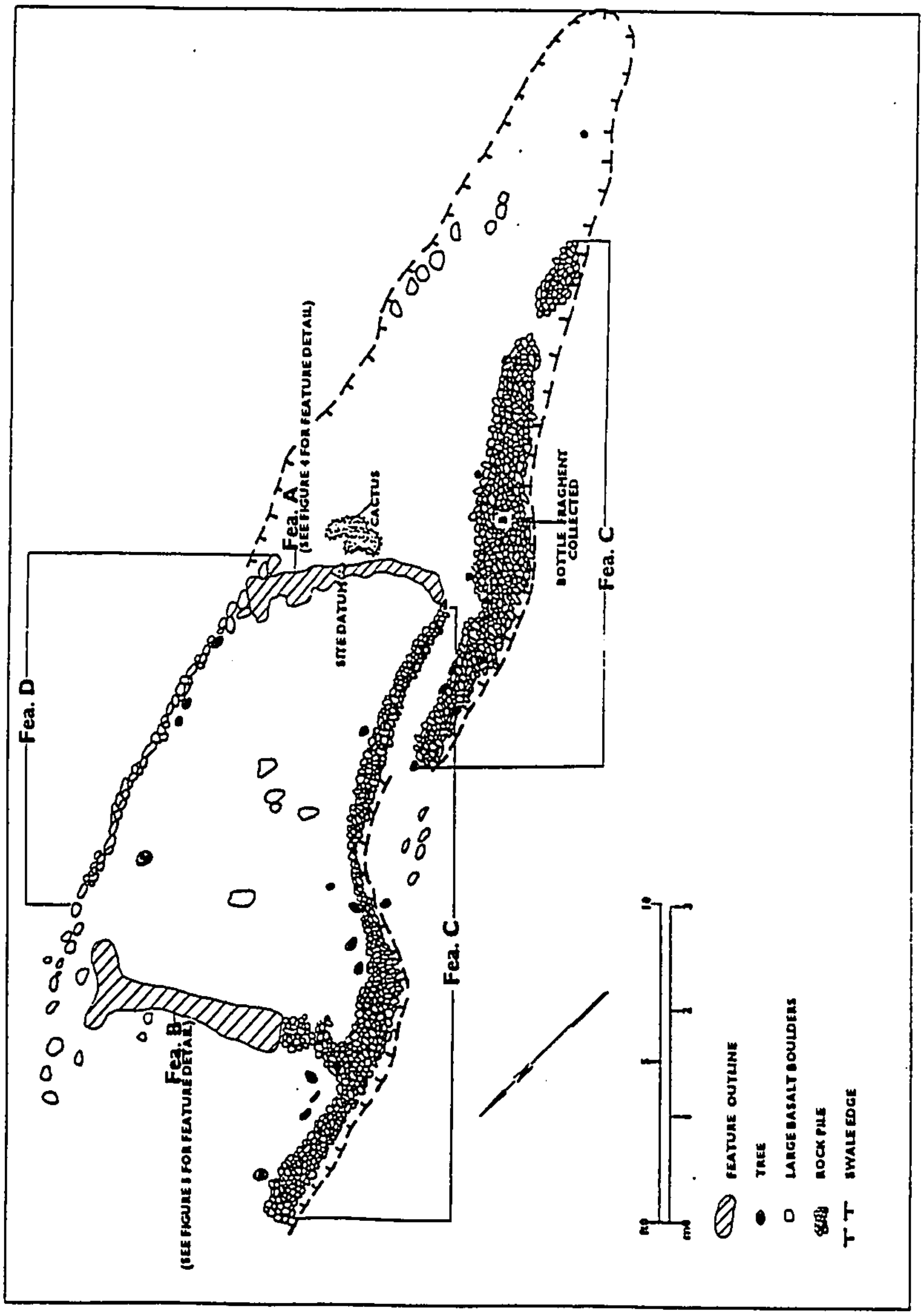

Figure 3. Map of Site 4181

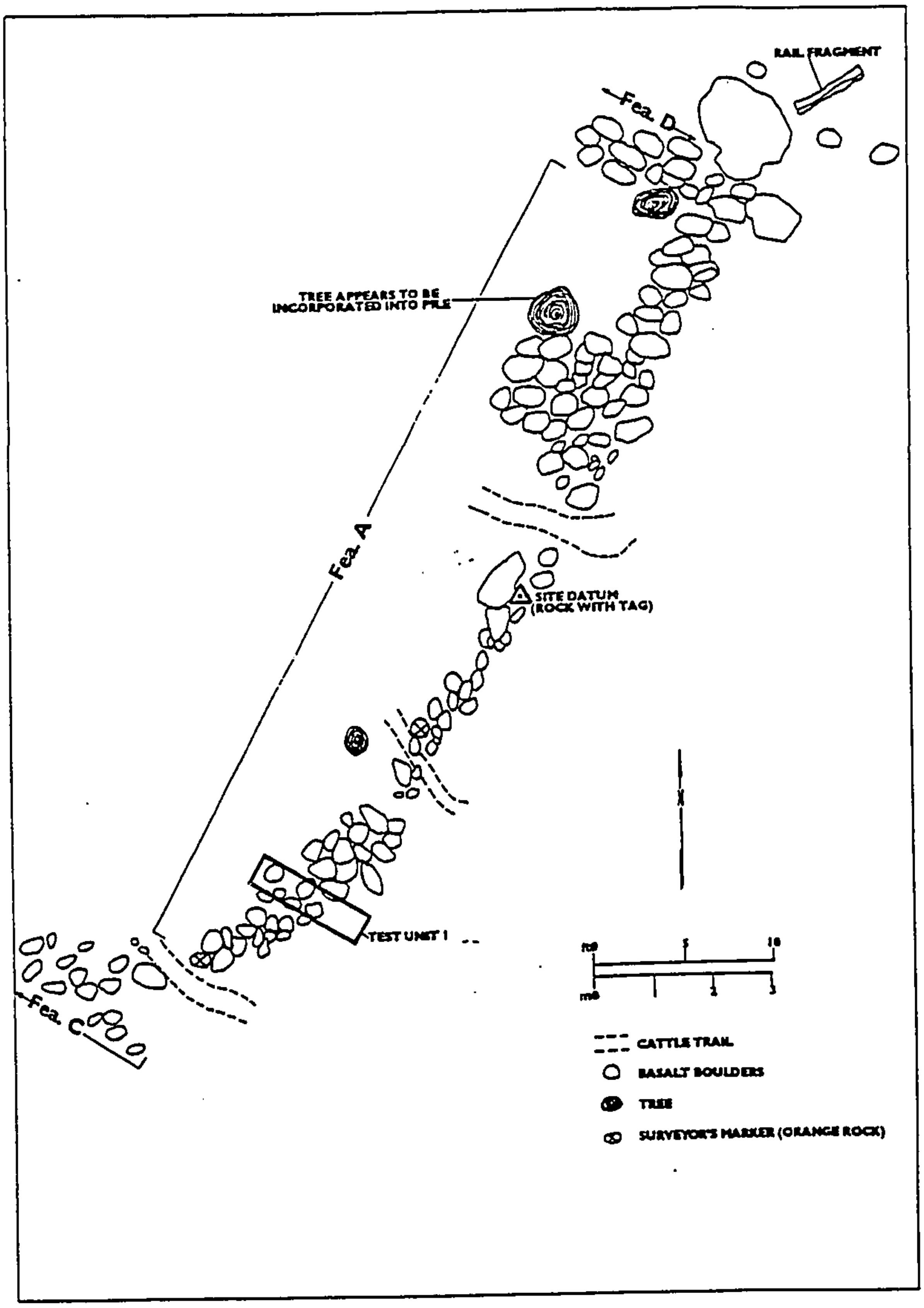

Figure 4. Detail Map of Feature A, Site 4181

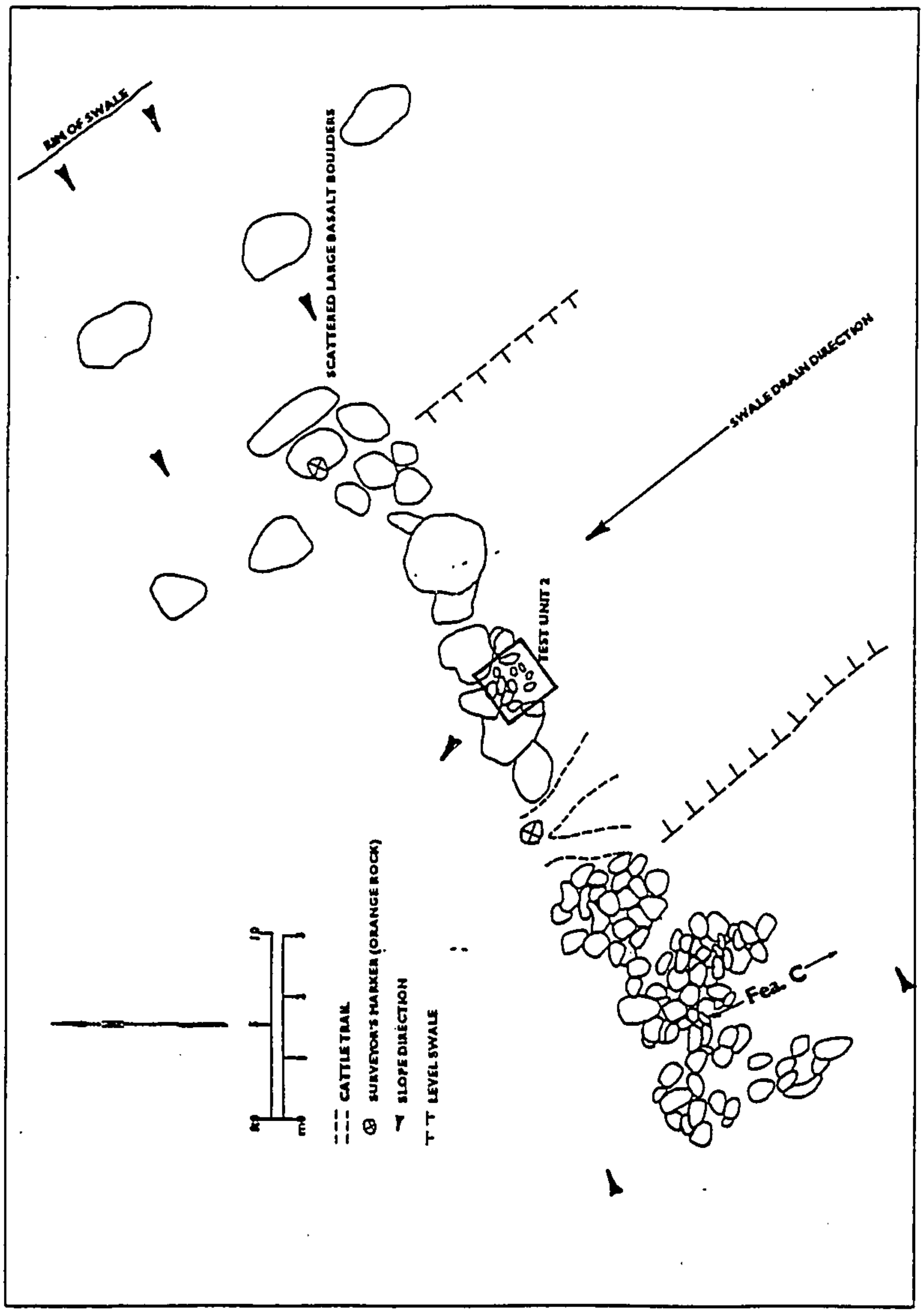

Figure 5. Detail Map of Feature B, Site 4181

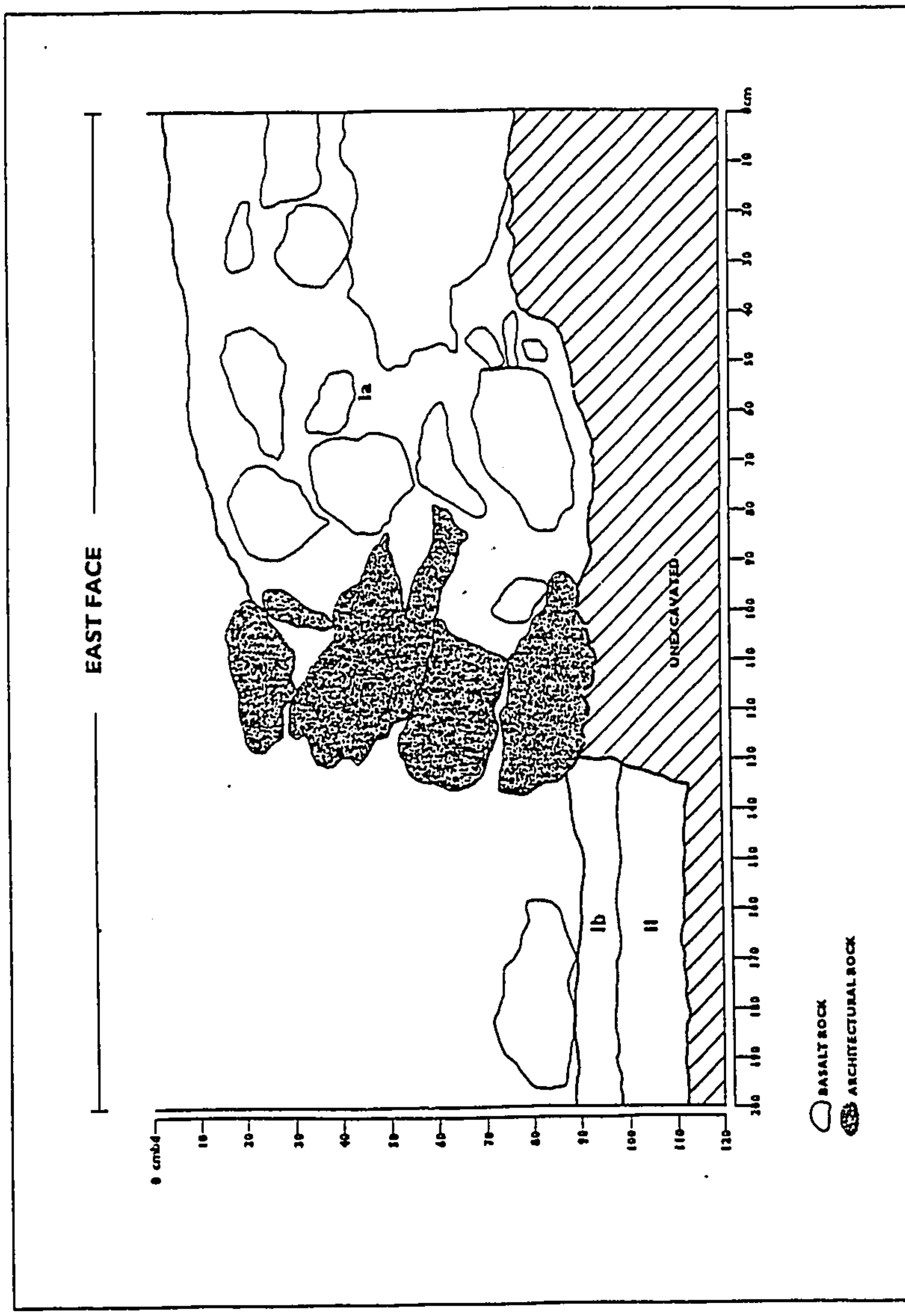

Figure 6. Profile of TU-1, Feature A, Site 4181

APPENDIX B: HISTORICAL DOCUMENTARY RESEARCH

by Helen Wong Smith, Historical Researcher

INTRODUCTION

Background

This research project was conducted at the request of Paul H. Rosendahl, Ph.D., Inc., in conjunction with an archaeological inventory survey for the Pukalani Terrace Unit III, Maui, project area, situated in the Land of ʻAʻapueo, Makawao District, Island of Maui (TMK:2-3-08:por.5).

Scope of Work

The current research included review of Land Commission Award (LCA) testimonies, grant survey notes, correspondence addressed to the Hawaiʻi Kingdom's Minister of the Interior, published historical documents, cartographic material, and reports on previous archaeological work conducted in nearby areas. This report does not include oral history interviews; however, other interviews in previous archaeological reports are discussed.

Project Area Description

With the exception of Land Commission Award testimonies and occasional correspondence during the monarchy, direct references to ʻAʻapueo are meager. For this reason, the following description of the project area is derived from descriptions of the more general areas of Makawao and Kula.

ʻAʻapueo is in the district of Makawao, which encompasses four older Hawaiian political districts: Hamakuapoko, Hamakualoa, Honualua, and Kula *(Figure B-1)*. Hamakualoa is along the windward slopes of Haleakala, while Kula is along the western flank (Kennedy 1991:4, Riford 1987:1). ʻAʻapueo is not listed in the bibliography of archaeological reports by Spriggs and Tanaka (Spriggs and Tanaka 1988). However, Spriggs and Tanaka place the adjacent *ahupuaʻa* of Kalialinui in Hamakualoa. Based on Kalialinui's inclusion in Hamakualoa, the author surmises that ʻAʻapueo also fell into the district of Hamakualoa. Many archaeological reports refer to ʻAʻapueo in the district of Kula (Jadelyn Moniz, pers. comm. 2/96). Modern vernacular places the area as "lower Kula" (pers. comm., Emma Desha Araki 2/7/96).

PREHISTORIC PERIOD

Legendary Setting

Notes of Sterling and Ashdown, located in the Maui Historical Society's archival collection, provide the following two references to Makawao. The first is in reference to *ʻolohe* on the plains of Kamaʻomaʻo:

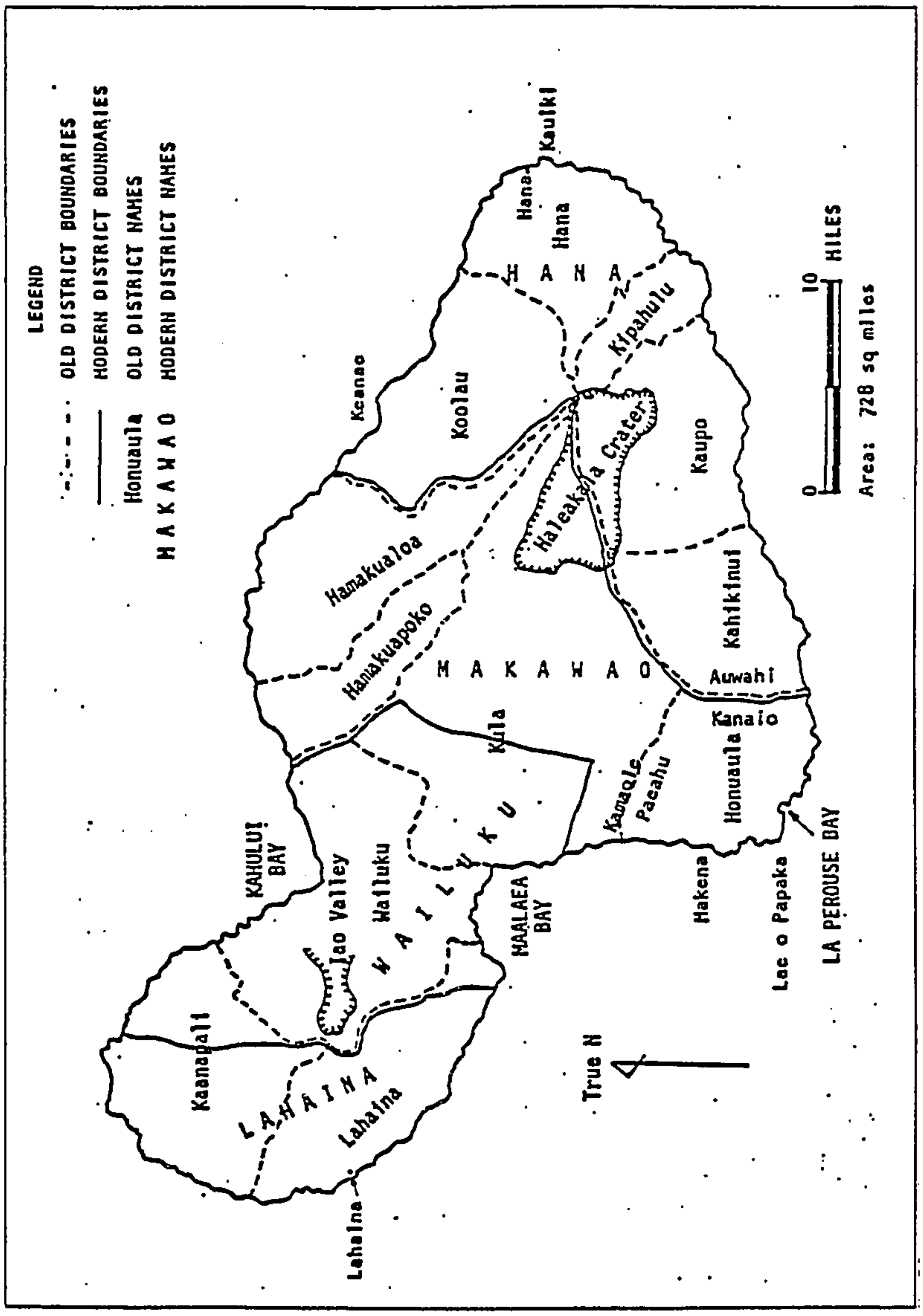

Figure B-1. Ancient and Modern Districts of Maui (from Barrere 1975)

O native sons of those sections, the ones who watch for the dancing (*ha'a*) of the naked ones (*'olohe*) on the plains of Kama'oma'o, where the *'iwa* birds dwell in the *ukiuku* rain of Makawao....S. W. Nailiili, "E noho ana oe e oe ehoolono iki mai ana" KeAu Okoa, Nov. 6, 1865, Hamakuapoko and Hamakualoa (Sterling n.d.).

Ashdown's reference mentions a legend associated with an area in the vicinity:

> In the area of Wahine'oma'o (now called the "Baseball Park" above the modern Poli-Poli camp) and nearby Lua-ma-ma-ne, was a structure said to be for bird catching ceremonies because that region was full of birds. The 'Oma'o bird is known as the Hawaiian Thrush, and they were plentiful and provided green feathers. The Woman of 'Omao' dwelt at Mamane and she was called Mamao because she was of such very high rank. She was so sacred that others must keep their distance. A handsome lesser chief fell in love with her beauty and tried to win her. Of course this was kapu. Her heart was heavy with the knowledge that because he came near to her shadow he had to be punished. A high priest conducted ceremonies of purification at the temple there and revived happiness. Today the Mamane trees are stunted and soon the foreign trees such as California Redwood, Norfolk Pines and others will be replacing the former green verdure (Ashdown 1971:46).

Prehistoric Land Divisions and Control

Traditionally, Maui was divided into twelve political districts (Kolb 1991:61). Nine of those districts, of which Hamakualoa is one, were in East Maui. Kolb classified the *'ahupua'a* of Hamakualoa as in Zone 1, which is characterized by perennial streams. Hamakualoa, like Hamakupoko, is "characterized by gently sloping land dissected by a series of steep gulches which widen at the mouth" (Kolb 1991:62).

In her report on Waile'a, Makawao, Dorothy Barrere provides a history of Maui's prominent *ali'i*. Barrere commences with the 15th century chief, Ka-malo-o-Hua, who ruled "over the greater part of Maui," and a presumed relative, Wakalana, who ruled over the "windward side of the island (Barrere 1975:5). She continues the lineage until Ka-'ula-hea, circa A.D. 1750. Ka-'ula-hea was the great-great-great-grandson of the great chief, Pi'ilani, who was the first to rule the entire island by joining the lineages of East and West Maui in A.D. 1600. Pi'ilani's reign was recognized as a time of peace and expansion. Fornander writes:

> ...through his good and wise government, and through his connection with the reigning chief families of Oahu and Hawaii, [he] brought Maui up to a political consideration in the group which it never had enjoyed before....During Piilani's reign, and perhaps that of his father, the Hana chiefs acknowledged the suzerainty of the Moi of Maui... (Fornander 1880:87 IN Barrere 1975:5).

Pi'ilani's successor, second son Kiha-a-Pi'ilani, is noted to be associated with the construction of the Kihaapiilani Trail, a pavement of smooth rocks in the Hana and Koolau districts (Barrere 1975:6).

Kiha-a-Pi'ilani was not the original heir of Pi'ilani. He sought refuge in Kula when his brother sought him after the death of their father:

> Upon the death of Piilani in c.a. A.D. 1600, the kingdom of Maui fell into the hands of two of Piilani's sons (Lono-a-Piilani and Kiha-a-Piilani). The rule of

> Maui passed on to Lono-a-Piilani, the oldest son of Pi'ilani. Kiha-a-Piilani, was not present at the death of his father because he was on the island of Oahu where he was raised. Bitterness arose between the two brothers, and Lono tried to kill Kiha when he believed that Kiha was trying to undermine his rule. Kiha fled, first to Molokai and then to Lanai. Eventually, he found himself back on Maui. He lived in disguise first at the boundary between Honua'ula and Kula, and then later "close to the boundary of Kula and Makawao) (Kamakau 1992:22-23).

Another account cites an ali'i seeking refuge in the Kula area. This account, which takes place in 18th century, supports *Figure B-1,* which shows Kula extending to the sea:

> When Kekaulike heard that Alapa'i, the ruling chief of Hawaii 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. Some went by canoe and some overland, and the fleet landed at Kapa'ahu at the pit of 'Aihako'ko in Kula *[old name for Makawao]. Here* on the shore the chiefs prepared a litter for Kekaulike and bore him upland to Haleki'i in Kukahua (Kamakau 1961:69).

A contemporary of Kekaulike, Ke-a-ulu-moku, who had ties to both Maui and Hawai'i island, is mentioned in association with the general vicinity of the current project area:

> Ke-a-ulu-moku was another celebrated man of Kalaniopu'u's day. His father was the great chief Kau-ua-kahi-akua-nui, son of Lono-maka'i-honua and Kaha-po'ohiwi, but his mother belonged to Naohaku in Kohala. He was celebrated as a composer of war chants, chants of praise, love chants, prophetic chants, and genealogical chants. When he went back to Hawaii with Kalaniopu'u he was homesick for the two Hamakua districts of Maui where he had lived with Kamehameha-nui and Kahekili. His love for the place found expression in a chant he composed, of which the following is an excerpt:
>
> *Aloha, Aloha*
> Affectionate longing,
> *Aloha wale o'u maku-a la*
> Affection for my (foster) parents,
> *e o'u makua,*
> my parents,
> *Aloha wale o'u makua*
> Affection for my parents
> *Mai na 'aina Hamakua,*
> Who belong to Hamakua,
> *He mau 'aina Hamakua elua,*
> The two districts of Hamakua
> *No'u mua kaikua'ana i noho ai*
> Where my elder brothers live.
> *He ala pali na'u he mau ali'i ia*
> My hillside trails are theirs to rule
> (Kamakau 1961:112).

Fornander (1969) includes an account of an uprising by Kula farmers that takes place some time shortly after 1781:

> During the fleeing of Kekaulike, [while] Kahekili was carrying on the war on Oahu and suppressing the revolt of the Oahu chiefs, (Kamakau dates this 1785) a serious disturbance on Maui had occurred which gave him much uneasiness. It appears that he had given the charge of his herds of hogs that were running in the Kula district and on the slopes of Haleakala to a petty chief named Kukeawe. This gentleman, not satisfied with whatever he could embezzle from his master's herds, made raids upon the farmers and country people of Kula, Honuaula, Kahikinui, and even as far as Kaupo, robbing them of their hogs, under pretext that they belonged to Kahekili. Indignant at this tyranny and oppression, the country people rose in arms and a civil war commenced. Kukeawe called the military forces left by Kahekili at Wailuku to his assistance; a series of battles were fought, and finally Kukeawe was killed at Kamaole-i-kai, near Palauea, and the revolted farmers remained masters of the situation (Fornander 1969:228).

This uprising of the country people was called the "Battle of the pig-eating Ku-keawe" ('Aipua'a-a-Ku-keawe) (Kamakau 1961:142).

Heiau in the Vicinity

Several references to *heiau* in the Makawao and Kula districts were found. In his discussion of archaeological remains in the Kula District, Winslow Walker postulates on the extent of habitation:

> Much of the Kula land was inhabited, judging from the number of heiaus found there, but the mountainous parts of both East and West Maui were sparsely inhabited if at all (Walker 1931:66).

Walker located an unidentified *heiau* (Site 228), in 'A'apueo, which he described as a small L-shaped enclosure, 22 meters long, with a maximum width of 16 meters. Adjacent to the enclosure was a terraced platform 12 meters square (Walker 1931:291).

T.G. Thrum reported on a *heiau* in Makawao named Kailua:

> Kailua...Makawao, one-half mile west of Makawao - Wailuku road; about 80x50 ft. in size; its ruins yet to be seen. Kula, Makawao, on Grant 3085, M. Previer. No particulars obtained further than it is still standing (Hawaiian Annual 1909:39).

In his 1930 survey Winslow Walker places this *heiau* in the Hali'imaile region, as "Heiau Site 58." He situates it near Kailua Gulch, half a mile west of the Paia Road. He did not actually find the *heiau*, and he postulates that it was "[P]robably destroyed in cane (Walker 1931:152).

A *heiau* located even further from 'A'apueo is located in Makawao town:

> Across from the Makawao Post Office (the old one) stood a large heiau on land once owned by Louis von Tempski, and another just above where Bullock's is now on the Puka-lani road. That entire area was upland farming for natives

> and particularly for Kiha-a-Pi'lani who lived near Pi'iholo and planted his sweet potatoes on the red hill called Pu'u o Kali where many petroglyphs and human footprints in the lava still are to be found. Kiha had the reputation of being so powerful that he could do the work of eighty strong men. He and his wife, Ku-maka, being of aristocratic lineage and gods, did not know how to make tapa or farm until they were driven from Hana by his brother, Lono-a-Pi'ilani (Ashdown 1970:58).

In Kula, the residents of Kula and Honua'ula practiced a religious ritual. Traveling to the west or south rims of Haleakala Crater at night, they would, "toss into the crater the bones of their dead" (Handy and Handy 1972:336). Kamakau notes that:

> ...the people were paying homage to Pele, the goddess who dwelled in the crater of Kilauea on Hawai'i island. The inhabitants of that island who wished for their dead to become a volcanic manifestation would take the "bones, hair, fingernails or some part of the dead body" to the crater and offer them to Pele (Kamakau 1991:64).

Pele controlled most of the south or leeward areas of the islands that were dry, and whose people depended on sweet potato. Thus, the people in the Kula area came under the domain of Pele. They were part of the "Clan of Pele" (Handy and Handy 1972:337). Under Pele's domain the people "developed rain-making ritual" and were closely tied to Lono-makua (Lono-the-parent) who was Pele's uncle, the keeper of fires and the rain maker (Kamakau 1991).

Ka-Miki References

There is no mention of 'A'apueo in *The Tale of Ka-Miki;* however, there is a reference to Kaluanui in the Makawao District (Maly in prep; issue date 6/3/1915):

> Ka-lua-nui (the great pit) (from the account of Kumauna and Ha'ao, Ka'u) Kumauna prepared food and 'awa from Puna for Ka-Miki. The 'awa was very powerful, and like the strong wind at Makawao which strip the bark from the trees, Kumauna was overtaken. But for Ka-Miki: *He ua li'ili'i noenoe ala, ke hele a hihi i ka lau o ke pili lauholu o Kaluanui.* The 'awa [was like] a fine mist rain which blows tangling the swaying pili grass of Kaluanui (Maly, in prep).

Regional Place Names

The only reference that includes a translation of the name 'A'apueo is found in Winslow Walker's survey of archaeological sites on Maui, where he notes, "Aapueo: owl call - land section in Kula" (Walker 1931:48). Hawaiian language instructor and authoress, Kahi Wight, was contacted for an interpretation of the name. She stated that *'a'a* is the term for a girdle or belt, which was made of feathers, which was reserved for royalty (pers. comm 2/14/96). Based on her proposed translation, the *ahupua'a,* in this text, will be spelled with the glottal marks.

It is common for place names to reflect natural phenomena of the area. In Makawao, the rain appears to have influenced the name. In 1854, Edward G. Beckwith toured Maui, and noted in his journal:

We noticed a peculiar meteorological phenomenon through the whole ride. The trade wind which blows from the ocean across the Northwestern slope of Haleakala, is highly charged with vapor, which is condensed by the cool mountain air, and falls in abundant rains over the region of Makawao. Along the west side of the mountains about half way to the summit, lay a long line of cumulo stratus clouds, and between this and the nimbus there was but little space. The former lay along side of the mountain, apparently immovable, while the latter would advance and recede, now coming very near and coquettishly scattering its shining rain-drops beneath the very head of immovable cumulus, and now retreating as though afraid of its more dignified companion. While mentioning this latter peculiarity to a gentleman this evening, he remarked that it was this feature of the clouds which gave the place its name - Makawao, Mako = to be afraid, wao = a cloud (*Journal of a Tour on Maui*, Hawaiian Mission Childrens' Society June 5, 1854).

Sterling, however, notes that this is incorrect, stating that "afraid translates *maka'u* and *ao* is cloud" (Sterling n.d.).

The rain of Makawao is described by Mrs. Minerva Kalama to Sterling (n.d.) as: "'ukiu rain = a soft drizzle (the ua Kama'aina of Makawao) when the kiu rain cloud from Makawao meets the Naulu rain cloud from Kula then the rain comes, the typical Makawao rain" (Sterling n.d.). Mary Kawena Pukui mentions this rain as well in her anthology of poetical sayings *'Olelo No'eau* (Pukui 1983:#1602). Early European accounts concerning the Makawao District generally comment on the weather.

Pukui provides additional proverbs regarding Makawao:

> *Keiki holoholo kuaua o Makawao*
> The lad of Makawao who goes about in the rain.

Said of a native of that place who is not afraid of being wet (ibid:#1705).

> *E hu'e mai 'oe i ke koai'e o Makawao!*
> I defy you to tackle a lad of Makawao!

A boast from a native of Makawao, Maui. (1983:#298)

> *O 'Alelele ke awa kaulana o Makawao.*
> 'Alelele, the famous diving pool of Makawao.

Refers to Makawao, Maui. (1983:#2355)

> *Ulu kukui o Liliko'i.*
> Kukui grove of Liliko'i. (1983:#2869)

This kukui grove, in Makawao, Maui, was much visited by travelers, for it was a favorite spot of the chiefs. The nuts gathered from the trees produced a fragrant, tasty relish.

PROTO-HISTORIC AND EARLY HISTORIC PERIODS (1778-1820)

Land Tenure

Ethnohistoric accounts of Kula are sparse. Jadelyn Moniz notes, "In an island wide perspective, the Kula area of Maui was not a chiefly center" (pers. comm., 2/96). According to Moniz, it may have to do with late settlement of areas in the district and the size of the population living in the district.

Michael Kolb identified land use by partitioning the island into four zones based primarily on an ecological and geographical criteria. The districts of Kahikinui, Honua'ula, and Kula fall within Zone 4, which is land that was "very arid" and where dryland agricultural fields were planted late in Hawaiian history (Kolb 1991).

Kula land is described by Handy and Handy (1972:510) as "open country, or plain, as distinct from valley...and has often been used as a term to distinguish between dry, or 'kula land' and 'wet-taro land'". Specific to Maui, E.G. Handy reports:

> KULA was always an arid region; throughout its long, low seashore vast stony kula lands, and broad uplands. Both on the coast, where fishing was good, and on the lower westward slopes of Haleakala a considerable population existed. So far as I can learn Kula supported no Hawaiian taro, and the fisherman in this section must have depended for vegetable food mainly on poi brought from Waikapu and Wailuku across the plain to supplement their sweet potato staple diet (Handy 1940:161).

To postulate the extent of prehistoric and proto-historic communities and the associated land tenure, archaeological findings should be recognized:

> Modern settlements like...Makawao, Kula...are probably built on the sites of older villages....But there is now no accurate way to determine just how large their former populations may have been. The villages on Maui were, in general, placed at the mouths of the larger gulches or at least within sight of the sea. No villages were seen in the higher forested parts of the island although a few scattered house sites were observed (Walker 1931:67).

Despite Handy's contention that dryland taro was not a crop of the vicinity, Walker reports that it was:

> Dryland taro required no special terrace for its cultivation, so there is nothing to indicate where it was grown formerly, but the natives say it was cultivated on the Kula side of Haleakala (Walker 1931:72).

In their discussion of Hawaiian sweet potato planting techniques, Handy and Handy (1972) mention the Kula area of Maui and describe it as "[w]here potatoes are planted in crumbling lava with humus, as on eastern Maui and in Kona, [in] Hawaii the soil is so ftened and heaped carelessly in little pockets and patches using favorable spots on slopes...[r]ocky lands in the olden days were walled up all around with the big and small stones of the patch until there was wall (*kuaiwi*) about 2' high" (Handy and Handy 1972:131).

Land Commission awardee claims confirm that within the Kula district crops included dryland taro, banana, sugar cane, and sweet potato (Handy and Handy 1972:27; Kuykendall 1938:6). In the uplands, dryland (non-irrigated) taro patches grew up to an altitude of 3,000 ft. (Handy and Handy 1972:337).

Although sweet potato crops grew well in these areas when the conditions were right, there were frequent setbacks in the form of grubs, caterpillars, blight, frost or too much sun (Malo 1951:204). As a result, the people of Kula and Makawao were burdened with famine when sweet potato crops failed. At these times they were forced to subsist on "laulele, pualele, popolo (glossy nightshade, Solanum americanum) and other weeds" (Kamakau 1992:23).

Kamakau notes that Kiha-a-Piilani found Kula and Makawao to be a waterless region (Kamakau 1992:23). As a result, the people of Kula and Makawao were at time forced to subsist on weed species found in the area (ibid.).

Notations on the hardship brought on by drought continued throughout the centuries. This one by John B. Whitman who kept a journal of his experiences in Hawai'i from 1813-1815:

> In 1806 these Islands were visited by a severe calamity. I am informed by a respectable American who lived at that time on the Island of Mowee that no rain fell on that Island from October to April of the succeeding year, consequently almost every thing that could support life was destroyed. The earth was parched and barren not a green thing was to be seen on any of the low lands, even the taro patches which were usually covered with water to the depth of from four to eight inches were dry and cracked in fissures opening in numerous places from four to sic inches wide and to the depth of three feet or the length of his walking cane. Goats, hogs and poultry were destroyed by it in great numbers and their carcasses lay about to rot on the ground, not a cloud was seen during this time, a burning sun poured down its destroying influence, and every thing seemed doomed to perish (Whitman 1979:65).

Transitions in Hawaiian Subsistence Practices and Land Tenure

Traditional agriculture was labor intensive and relatively restricted in the less than ideal environment of Kula. However, with the increased demand for provisions for the whaling industry and then the gold miners in California, Kula experienced an escalation in cultivation.

Historian Ralph Kuykendall (1968 [1]:313) discusses the period when Kula yields turned from subsistence crops to commodities:

> ...Before that time the whalers had created a limited market for fresh vegetables, fresh meat, and fruit; the great increase in the number of whaleships after 1840 caused a corresponding increase in the demand for such products of the soil. In bulk and value, potatoes (sweet and Irish) ranked first in this traffic. In the early days only sweet potatoes had been obtainable at the islands, but after 1830, if not sooner, cultivation of the Irish potato was taken up and during the 1840s and 1850s became of great importance. It was shortly before 1840 that Irish potatoes were first raised in the Kula district, which proved to be so well

adapted to them that it soon came to be called the "potato district." Jarves describes the region as it appeared to him in July 1846:

> It ranges along the mountain (Haleakala) between 2000 and 5000 feet elevation, for the distance of 12 miles. The forest is but partially cleared, and the seed put into the rich virgin soil. The crop now in the ground is immense. The fields being all in blossom have a fine appearance, spreading as they do, over the broad surface of the mountain.

From this upland region the potatoes were carried down to the shore and taken to Lahaina or were sold directly to ships which called at Kalepolepo. In the spring of 1847 it was estimated that the crop would amount to 20,000 barrels. In 1854, G.D. Gilman estimated that the local Hawaiian market, including whaleships, could be depended on to consume about 20,000 barrels of Irish potatoes annually.

The influx of gold seekers together with the comparative neglect of agriculture in California created a demand for potatoes and other vegetables, as well as for sugar, molasses, and coffee. This demand began to be felt strongly in 1847, but the potato "boom" commenced in the fall of 1849. At the beginning of November a correspondent wrote from Maui to the *Polynesian*:

> The call for [potatoes] is loud and pressing, as some vessels bound for California have taken as many as 1,000 barrels each. The price is high, and the probability is that the market can not be supplied this autumn. Kula, however, is full of people. Strangers from Wailuku, Hamakua, and Lahaina are there preparing the ground and planting, so that if the demand from California shall be as urgent next spring as it is now the people will reap a rich harvest...They often repeat the saying of a foreigner, who after visiting the mines of California, came back to Maui quite satisfied, and said to his neighbors at Waikapu, "California is yonder in Kula. There is the gold without the fatigue and sickness of the mining country."

The foreigner's remark caught the fancy of the Hawaiians and they were soon referring to Kula as "Kalifonia" or "Nu Kalifonia" and working with great diligence to extract the wealth from the rich pay dirt on the slopes of Haleakala. To encourage the spirit of enterprise which had been thus awakened among the native people, the privy council voted to have the government lands in Kula surveyed and divided into small lots of from 1 to 10 acres and offered for sale to the natives at a price of $3/acre (1968:321).

C. Speakman (1978), in his book entitled *MOWEE* also remarks on the fervor of cash-cropping:

> During the gold rush, hundreds of Hawaiians were going into business for themselves on Maui-growing potatoes and hauling them to the port where they were snapped up and shipped to San Francisco. The Maui fields were called Nu Caliponi, or New California; potatoes were gold, and a fortune could be dug out of the ground by one man. The potato boom was short lived, and, when the prices dropped, the Hawaiians lost interest. Perhaps the problem was that Hawaiians did not share the white man's concept of time (Speakman 1978:116).

Kuykendall states, *kula* plots were cultivated for personal use, but many tenants were involved in ranching and cash crops (1968).

HISTORIC PERIOD

Mahele of 1848, Land Commission Awards (LCA)

A discussion of LCA awards in the Makawao District (traditionally Kula) must begin prior to the 1848 Mahele because Makawao was involved in a pre-Mahele experimental program of land awards. Kuykendall recounts the reasons for this trial fee ownership program:

> It will be remembered that the year 1845, during which the new land law was written and in part enacted, was disturbed by an anti-foreign agitation, accompanied by a rather pointed suggestion that lands be given or sold to the common people and that the legislative committee, in its reply to the petitions *of the people, approved the idea of selling land to Hawaiian subjects. This was* directly in line with suggestions contained in Dr. Judd's report as minister of the interior, and there were frequent allusions to the subject in the proceedings of the legislature. The agitation among the people probably hastened the decision of the government to make an experimental beginning without waiting for the new law to go into operation. The places selected for the experiment were the Makawao district of Maui and Manoa valley on Oahu.
>
> During the King's tour of Maui in December, 1845, and January 1846, the party visited Makawao and it was announced that the entire district, with the exception of McLane's plantation, was to be offered for sale to the people in fee simple. Rev. J.S. Green, pastor of the Hawaiian church at Makawao, undertook to manage the business of selling the land. In afterwards relating his experience in connection with the project, Green said he called the people together, showed them his instructions from the government, and explained the plan to them.
>
> A few of them purchased at once, others had less confidence that lands thus purchased would be secure, but soon abandoned their scruples, while others still could not for a long time, be persuaded that there was not some catch about it—some design to enrich the chiefs at their expense. But nearly all of these were finally talked out of their suspicions & took up each a small piece of land (letter in *Polynesian*, July 14, 1849).
>
> Another missionary, Rev. Richard Armstrong, assisted the enterprise by making surveys. The land was sold at $1 per acre, and nearly a 100 parcels were taken up, most of them ranging from 5 to 10 acres. Altogether about 900 acres were purchased by the people of the district. (Kuykendall 1968 [1]:283).

The "Great" Mahele took place during the reign of Kamehameha III. The Mahele separated and defined the undivided land interests of the King and the high-ranking chiefs and *konohiki* [*konohiki* originally referred to the person in charge of a tract of land on behalf of the king or chief. It is in the later statues that the chiefs or landlords were referred to as "konohikis" (Chinen 1958:vii and Chinen 1961:13)]. More than 240 of the highest ranking chiefs and *konohiki* in the kingdom joined Kamehameha III in this division. The first *mahele* was signed on Jan. 27, 1848 by Kamehameha III and Princess Victoria Kamamalu by her guardians Mataio Kekuanaoa and Ione Ii. The last *mahele* was signed by the King and E. Enoka on March 7, 1848 (Chinen 1958:16). The *mahele* did not convey any title to any land. The chiefs and *konohiki* were required to present their claims to the Land Commission and to receive awards for the lands quitclaimed to them by Kamehameha III. Until an award for these lands was issued, title remained with the government. Because of the lack of surveyors at the time of the Mahele, the lands were divided by name only, with the understanding that the ancient boundaries would prevail until a survey of such lands could be made in the future. Thus the Land Commission awarded lands to chiefs and *konohiki* by their names only. These awarded lands became known as Konohiki Lands (Chinen 1961:13).

During this process all land was placed in one of three categories: King's Land (In 1865, during the reign of Kamehameha V, these were renamed "Crown" land in order to prevent dowager Queen Emma from retaining lands held by her husband Kamehameha IV, thus making them the property of the occupant of the throne), Government Lands, and Konohiki Lands. These were all "subject to the rights of native tenants" (Laws of Hawaii, 1848:22). Native tenants were the commoners who lived and worked the land for their subsistence.

Whenever *ali'i* procured an entire *ahupua'a*, they were bound to respect the rights of the existing tenants. These tenants, if they filed a claim to The Board of Commissioners to Quiet Land Titles (Board of Commissioners 1929), could continue to cultivate and reside on their parcels.

The Kuleana Act of 1850 permitted the Land Commissioners to issue awards to the farmers for houselots and gardens cultivated by them for their own subsistence only, providing the claimants had fulfilled all other legal requirements, such as making a written application before February 14, 1848, having two witnesses give sworn testimony regarding applicant's past occupation and use of the land for an extended period, and having no counter claims made by others (Kelly 1971:6). The parcels for house and garden purposes became known as *kuleana* (responsibility). Until its dissolution on March 31, 1855, the Land Commission issued thousands of awards to native tenants for their *kuleana*; even so, less than 30,000 acres of land were awarded to the native tenants as Kuleana Lands.

The *ali'i* and commoners had to file a claim to Quiet Land Titles with the Board of Commissioners, usually referred to as the Land Commission. When such a claim was filed, a Land Commission Award (LCA) was assigned and, upon payment of a fee, a Royal Patent was awarded (Erickson 1980:9).

Lilikala Kame'eleihiwa's treatise, Native Land and Foreign Desires, tallies the apportionment of lands in Kula and the transactions that follow. Of the 26 *ahupua'a* in Kula, three went to the King, and 23 went to the Government (Kame'eleihiwa 1992:234). Kamehameha III (Keauikeaouli) then gave the government seventy-five percent of his land on Maui, including all of Makawao (ibid.:238).

The principal awardee for 'A'apueo was Analea Keohokalole, who held the fifth largest number of *'aina* after the Mahele. Keohokalole was mother of King Kalakaua, Queen Liliuokalani, Miriam Likelike Cleghorn, and William Pitt Leleiohoku (Indices 1929). As a result of the Mahele, this young woman of 34 years now held 96 *'aina*. The majority of her holdings were on Maui and Hawai'i Island. Her holdings on Maui were mostly in Kula. She relinquished 48 percent of her *'aina* to the government, leaving her with 50 parcels, 25 of which were on Maui (Kame'eleihiwa 1992:245).

At the time of the Mahele, ʻAʻapueo appears to have been divided into four sub-*ahupuaʻa*. ʻAʻapueo (assumedly one) and ʻAʻapueo 3 are listed as Government Land. The parcel of ʻAʻapueo 2, granted to A. Keohokalole, was surrendered for commutation (Indices 1929).

LCA 8452 to A. Keohokalole

Native Testimony vol. 10:326
"Below is a list of the lands I wish to convey to the government. Aapueo ahupuaa Kula, Maui. (dated Jan. 3, 1850)

Resolved, that the Minister of the Interior be and is hereby authorized to transfer to the list of lands belonging to Keohokalole,...and Aapueo 2, Kula, Maui, and transfer to the Government and list one of the Alae's in Kula, Maui, on lieu of Aapueo 2, sold by Kapaakea through mistake. By order of Privy Council Dec. 22, 1850

Following are the LCA testimonies for parcels awarded to the native tenants of ʻAʻapueo:

LCA 8630 to Koolau

Native Register vol. 6:473
Here are the names of my land claims at Aapueo in Kula, Maui. The claims on the east are Kahaukakahe, Koloakapeelua, without a konohiki. On the west, Kahanumaule, Kauhiku, Kailikoa. That ends our claims at Aapueo....Here is an explanation to you, the Land Commissioners, concerning our house lot at Aapueo — our names are set here: Koolua, Kauahi. (Signed) Koolau Kula, 31 Jan. 1848

Foreign Testimony vol. 8:182
Section 1 - Pasture in Koloakapeelua ili of Aapueo ahupuaa
Section 2 - Pasture in Kauhiuhi ili of Aapueo ahupuaa
Section 3 - Pasture in Papawahanui ili of Aapueo
Section 4 - Pasture in Makoleiki ili of Kalialinui.
Land from Koolau's parents long ago at the time of Kamehameha I, no dispute from the beginning.

LCA 9022 [Aapueonui, Kula, Maui] to Kekahuna

Native Register vol. 6:496
I hereby state my claim for land in the ahupuaa of Aapuueo. My land of Pakaka is at Kiloa. On the east is a collection of houses, on the west is Kauhiuhi, on the north is a ridge, on the south is broken ground. I cultivate in jumps in some of these places. At Makehu of Welehine, I have a claim for fishing rights. On the north is a road, on the east is a road, on the south is a stream, on the west is a road. Kula, 20, Jan. 1848

Native Testimony vol. 7:106
Malai sworn he has seen this land - 2 sections
Section 1 - Pasture ili of Kamakaula, Aapueo...
Inherited land from parents at time of Kame I., no objections, 2 poalimas in section 1. [bound by] Mauka - Malai, Makawao - Aapueo Stream, Makai - Kanuku, Honuaula - Aapueo stream.

LCA 9025 [Aapueo I] to Kama

Native Register vol. 6:498
...I hereby state my claim for land. At Aapueo I are four claims. At Kaluli I, Kauluha II, there are eight mo'o, and 3 makmaki trees. I received them from Kaapohuehue. At Aapueo two places were from him. One piilani /obscure/.

Native Testimony vol. 7:49
Koolau sworn he has seen Kama's land of 2 sections
Sec 1 - Ili pasture Waieli, Aapueo
Sec 2 - Ili pasture Popolo, Aapueo
Land from Kaaipohuehue in 1845, no disputes, 1 poalima in section 1. [bound] Sec 1 - mauka - Kaai, Makawao - Koolau, Makai - Makahuloli, Honuaula - Kamole stream. Sec 2 mauka - Aupuni, Makawao - Koolau, Makai - Kikiana, Honuaula - Waieli stream

LCA 9026 to Kaaipohuehue

Native Register vol. 6:498
...at Aapueo 1, two claims for sweet potatoes, five claims for Irish potatoes. The names are Paikukui, and Paili. At Aapueo 2 I have two places, Paipala and Papawahanui, two claims for sweet potatoes. I received them from Keohokalole. There are three "jump" claims at Aapueo which I received from Nahuina. A claim for sweet potatoes at Waiohuli was received from Ihu. There is a claim for a planting of Irish potatoes. This ends my claims
24 Jan. 1848

Native Testimony vol. 7:53
Kalama sworn = 2 pasture land sections.
Sec 1 - Pasture ili Ohiamukumuku, Aapueo
Sec 2 - Pasture ili Kailikoa, Aapueo
Ancient land from parents at the time of Kamehameha I, no objections, to Kaaipohuehue. [bound] Sec 1 - mauka - Koolau, Makawao - Nahuina, Makai, Aupuni/Koolau, Honuaula - Road for descending Sec 2 - mauka Kikiana, Makawao - Koolau, Makai - Kalama, Honuaula - Aapueo stream.

This last award is for the adjoining *ahupua'a* of Kalialinui, but it does mention crops in 'A'apueo:

LCA 9024 [Kalialinui, Kula, Maui] to Kikiaua

Native Register vol. 6:497
...at Kalialianui, four claims, first, a kula, second, a boggy place, third, a claim for a planting of Irish potatoes, fourth, a house claim. The name of the claim for winter kula is Paa of Pahoa, bounded on the east by Ahua, on the west by stream, on the north by mountain top, on the south by a gulch. ...There are jump claims at Omaopio and a claim for Irish potatoes at Aapueo. Dated: 26 Jan 1848

Native Testimony vol. 7:50
Kuaihulu sworn - 5 land sections:

Sec 5 - Ili pasture Waieli of Aapueo ahupuaa. Boundaries similar to Sec 1 (A konohiki is on all sides).

Correspondence and other records housed at the Hawai'i State Archives provide us with information on land transactions and tenure in the *ahupua'a*. The documents provide us with knowledge of the most common uses of the land from the time immediately following the Mahele through the 20th century.

Privy Council Vol. 6:427
Resolution authorizing the Minister of the Interior to grant a fee simple title to E.W. Clark for 490 acres of the above land, providing that he relinquish his right to the land at Wahiawa.

Privy Council Vol. 8:193
Resolution confirming the sale of 190 acres of land in Koheilo & the above lands to Nathan F. Sayre.

Aapueonui

Privy Council Vol. 7:149
Resolution confirming the sale of 86 1/2 acres of the ahupuaa to Keawe.

Privy Council Vol. 7:209
Resolution confirming the sale...to several persons as per list.

Aapueo 1 & 2

Public Instruction 1851 March 25
Letter from E. Bailey to R. Armstrong
In reference to his desire to secure the above lands for $500 or $600 if Kapaakea wants the money immediately borrow it. Have applied the land of Koheilo, in his own name &c.

Public Instruction 1852 Jan 28
Letter from E. Bailey to Minister of Public Instruction
Acknowledging receipt of his notes of 22nd and 23rd. As to above land, the greater part of said land is first rate land for cane.

Aapueo 1
Interior Department 1860 Dec. 10
In letter from P. Nahaolelua to Minister of the Interior, forwarding list of ahupuaa, which had been sold to Needham & Cook, the above and being one.

Interior Department 1861 Oct 19
Report showing that P. Nahaolelua, had received amounts from the following persons for the rent of the above land, Kula Maui. Nahau, Kekahuna & Kailianu.

Interior Department 1863 April 21
In statement by P.N. showing amounts collected for the Government lands leased to Kailianu in the above land.

Interior Department 1865 March 31
In report by the Governor of Maui (Nahaolelua) showing that $20 had been received as rent for the above land.

Interior Department 1866 Aug 31
In letter from P.N. to the Minister of Interior stating that the above ahupuaa is situated in the district of Kahikinui by does not know whether the same has been sold to Needham & Cooke.

Interior Department 1876 May 4
In letter from K. Kauhi to the Minister of Interior applying to lease the above land.

Interior Department Book 13:355 1876 May 5
In letter from Min of Interior to K. Kauhi, have received his application to lease the above land in Kula Maui at $75.00 a year for the term of 10 years.

Interior Department 1877 March 21
In letter from W.D. Alexander to the Minister of Interior informing that 400 acres of land in the upper end of the above places was leased to Kauhi.

Interior Department 1877 June 30
In report from W.L. Moehonua to the Minister of Interior showing that $75 had been received from Kauhi for the rental of a piece of Government land in the above place.

Interior Department 1891 March 19
In letter from L.A. Thurston to Minister of Interior, applying on behalf of the Haleakala Ranch Co., for a remnant:
"...of the Government land in Aapueo, Kula, Maui, lying above the Government road, containing 376 acres." The land is entirely surrounded by the land of the Haleakala Ranch Co. lying a bout a half mile from and above the Government road, the Company's land lying between it and the road, and all around it. The piece is a long narrow one, very much cut up with three gulches running through its length. It is pasture land and of much less value per acre than the piece somewhat similarly situated, which was purchased a short time since by the Company. The land is not, an has not to my knowledge, brought or is it bringing any income to the Government. I hereby offer the sum of $500 as purchase price of the same on behalf of the said Company as an upset price.

Report of Government Survey Office regarding this parcel. March 19, 1891. Application Number 438.
Nature of land: Upland grazing land broken by gulches. Notes: From the best information I have, I judge that this land is not specially desirable for Homestead or cultivation purposes. And I believe that no other application has ever been made for it and would accordingly recommend its sale at upset price named. Signed, J.F. Brown per Walter E. Wall.

Properties in Aapueo

Interior Department 1898 Nov. 25
S.E.K. Apapau to Minister of Interior applying for a copy of the properties belonging to the Estate of Malai (k),

Aapueoiki, Land at

Liliuokalani's Collection 1908 May 28
A.F. Tavares to Joseph K. Aea
Advising him to sell the 17 acres of land at the above place Kula, Maui, assessed to W.K. Kaleihua at $170.00 at $15.00 an acre & if he can obtain $20.00 an acre for same, to sell same at said figure, &c.

Aapueo Nui

Interior Department 1875 Feb. 24
In letter from Chas. Koelling to the Minister of Interior applying to lease the above land for a term of 25 or 30 years.

Historic Maps

Three maps of the vicinity were studied at the Hawai'i State Archives (Kahikinui, Nakula, and Papaanui Government tracts, Feb. 1915; Portion of Kula, 1909; and Makawao and Kalialinui, 1904). None of the maps, however, provided information on the attributes of 'A'apueo. Two maps were sought at the Hawai'i State Survey Office. The older of the two was too fragile to handle. The second map, HTS Plat 1026, a portion of which is provided as *Figure B-2*, is made from information from a number of surveys conducted by W.D. Alexander and Monsarrat between 1872-1879. 'A'apueo is shown as a single *ahupua'a*, not one divided into four parcels as referenced in LCA testimonies and later correspondence. From this map, grant numbers were obtained and the survey notes for these grants were examined.

The project area includes Grant 1167 to Aui and Grant 1829:1 to Keawe. Grant 1167 states that this area is called "Kohoilo" and is bounded by the *ahupua'a* of Makaehu on the north, Aapueo 4 on the south, and the *aupuni* (watercourse) on the eastern and western boundaries. Aui purchased the 160 acres at the cost of $2.00 per acre on February 7, 1853. Grant 1829:1 is located on Pu'u o Weli and the record states that it is located in the *ahupua'a* of Aapueo Nui. One can surmise that this is 'A'apueo 4 as well. Grant 836 is located in 'A'apueo 1 and 2 alongside these two project area grants. Grantee K. Kapaakea purchased the 683.69 acres for the price of $1.00.

Residence Patterns and Economic Development

The Chinese were among those who took advantage of the agricultural opportunities discussed earlier. During the 1840s, Chinese farmers leased lands in Kula. Their initial success motivated many Chinese to move to that region and lease land for farming. They moved from places such as Makawao, Paia, and Wailuku on Maui, Kohala on the Big Island, and from Honolulu. Some went to Kula directly from China. The vast majority of Chinese, about 95%, were Hakkas from Kwangtung Province. During the 1840s, most Kula Chinese acquired their farmland by lease or deed from the *haole* ranchers or Hawaiian homesteaders. Much of this land was owned by the Hawaiian government, which leased it to the ranchers, who in turn subleased it to the Chinese. In some cases, the farmers made their lease payments in farm produce, in lieu of monetary transaction. One family which leased land from Ulupalakua Ranch paid five bags of corn for every acre of land they farmed (Interview, Willie Fong IN Mark 1975). Although by the mid-1850s, the demand for Kula potatoes had diminished, the Chinese population continued to grow. By between 1880 and 1910 approximately 80 Chinese families had moved to Kula; by 1900 there were some 700 Chinese living there. For a period of 30 to 40 years, Kula supported

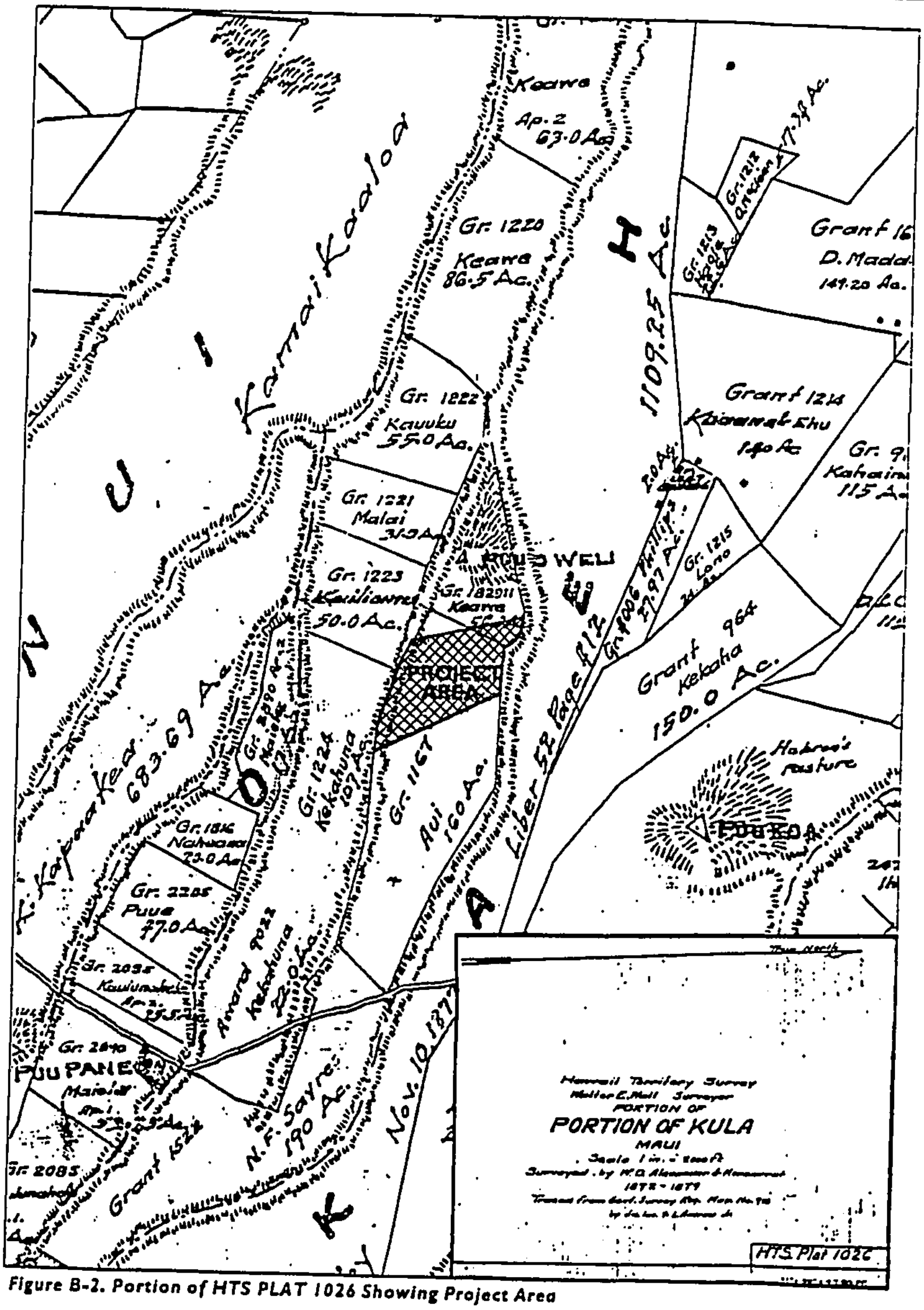

Figure B-2. Portion of HTS PLAT 1026 Showing Project Area a thriving community which included Chinese and English schools, Christian churches, a Hung Men society, gambling joints and opium dens, general stores, and dozens of operating farms and cattle ranches (Mark 1975).

In addition to Irish potatoes, the Kula farmers planted corn, beans, onions, Chinese cabbage, round cabbage, sweet potatoes, wheat and other grains, and even cotton. When the Hawaiian market showed no demand for corn, the farmers used the corn to raise pigs, ducks, and chickens, and marketed the animals instead. When the corn, potatoes, and other crops were harvested, they were packed and transported on mule teams or wagons to Kahului and Makena harbors, and were then shipped to Honolulu. Those who lived in the southern districts of Keokea and Kamaole usually brought their produce to the Makena landing. Most of Kula's produce, poultry, and beef was sent to two or three markets in Honolulu Chinatown, including Wing Hong Yuen and Sing Loy. The two stores, in turn, supplied Kula's general stores with Chinese dry goods and staples such as rice, flour, sugar, and canned milk (Mark 1975).

Early farming in Kula was adapted to the topography. In planting crops, rather than terracing the land, the farmers followed the natural contour of the land and depended on moist air and rainfall rather than irrigation. Until 1905, there was little water piped into the area, and during droughts—which occurred every several years—the farmers had to pack barrels of water on mules from Polipoli Springs, or from the beach or Olinda, both about eight miles away (Mark 1975). An article in *The Honolulu Advertiser* points out the changes in the topography in Kula and their effect on the water supply:

> Before 1850 Kula was supplied with moisture naturally through the existence of a large forest. "That forest was cut down when land was cleared in Kula to open farm plots in 1850. This was in answer to the demand for food in California during the gold rush....by ranchers clearing for pasture." Secondary result of clearing forests was destruction of existing fresh water ponds in Kihei on the Maaloaea (sic) Bay coast below Kula. When forest was cleared, water was free to rush down the mountains carrying soil from Kula and filling with mud, the ponds for which Kihei was once famous. Meanwhile Kula is dependent on pipe from Waikamoi watershed (Korte 1962 A:15).

By the 1880s the lower Kula sections, such as the project area, had largely become pasture for the booming cattle industry. Large sections of crown land were leased for grazing (Silva IN Miura 1982). In 1905 the Kula Pipeline was built during perhaps the worst drought in Kula history. The water source for the pipeline was in Olinda, northeast of Kula. The contractor who built the pipeline was a prominent Kula resident named Shim Mook, and labor was supplied by the men and women of the area (Mark 1975).

In 1911 the Hawaiian government released a large amount of public land, and it became possible for citizens to purchase property in Kula. The sale of the land was advertised in English and Hawaiian newspapers, but word was somehow not communicated to the Chinese, whose lives these land sales would most affect. According to the Hawaiian Church Chronicle (Oct. 1911:12), the Kula Chinese "were not aware of what was taking place until the land was sold and the Hawaiians came and told them that the property belonged to them. They (Chinese) had relied on the information which they had received that the disposal of the land would not take place for a considerable time." Faced with eviction, the Kula Chinese decided to remain on the land and organize themselves. Ninety-eight young residents signed a petition expressing the desire of the Chinese to be allowed to reside on certain lots their families had farmed for many years.

In a letter to the Commissioner of Public Lands dated September 27, 1911, Governor Frear suggested that leases be made to occupants of unsold lots for approximately ten years, subject to withdrawal for homestead purposes. Then, as the older children of those families reached 18 years of age, they would be able to apply for the lots as homesteads. In October 1911 the Hawaiian Church Chronicle reported that the government had promised to do so under these terms. Chinese who applied for homesteads and were granted them were given three years to improve their lot...after that period, they could apply for a "right of purchase" lease, and then buy the land outright from the government. Before this special arrangement was arrived at, however, a number of Kula farmers saw their land divided into homesteads and leased to others. These farmers, with the loss of their farmland, were forced to move out of Kula and change their livelihoods.

Contemporary Land Use (20th Century)

During the 1910s and 1920s many families left Kula for various reasons: severe drought which ruined crops and killed livestock, soil which was reaching depletion level after years of harvesting and tilling, lack of educational opportunities for children, and loss of land due to parceling homesteads. In 1918 another mass exodus occurred—some 40 families left Kula because the land they were leasing was sold to a man named Harold Rice, who intended to use the land for ranching. In the book *Mowee*, the author writes regarding the sale of farms to Rice: "The leases to the land had not expired, but the farmers were *unaware of their right to challenge* the eviction" (Speakman 1978:143).

The town of Makawao lost its rural status during World War II when military troops stationed nearby encouraged the opening of various businesses to serve the soldiers (Harden and Engledow 1988:91). After the war ended, so did most of the commerce and the town reverted to its slower pace (ibid).

A 1974 planning study for the Makawao-Pukalani-Kula area provides this modern history:

> Up until the 1960's, there was a general out-migration of residents from Maui....The Makawao-Pukalani-Kula area served as the primary ranching and small farming area on Maui....There are a variety of reasons why small farming occurred primarily in the Kula area. First, there were a large number of small parcels available, unlike most of Maui where land was held by a limited number of large landowners for the sugar, pineapple. or cattle grazing uses. Secondly, the soils in the Kula, as well as the Olinda areas, were highly adaptable to truck crop production. Thirdly, the climatic conditions in the Kula area, including sun, rain, and cool nights were also favorable to small farming activities. Major amounts of cabbage, onions, tomatoes, snap beans, and lettuce were produced in the area.
>
> The small farms served as both the place of work and residence. In order to service both the farms and the homes, public services such as roads and water were located near the farms. The old Lower Kula Road and the Upper Kula Road, as well as the Omaopio Road, helped provide convenient access for the farmers to town (Donald Wolbrink & Assoc. 1974:32).
>
> Water has historically presented a problem for the Kula area....The Kula water system was created in 1912 with the installation of a dam and intake pipe at the Waikamoi Stream and pipeline that extended across the west face of Haleakala through the Kula district to the Ulupalakua Ranch (ibid.:33).

Some statistics of Kula's vegetable production is provided in this 1971 report on an irrigation project in lower Kula:

> The general Kula area is one of the major vegetable growing areas in the 50th state, accounting for approx 35% of the State's total vegetable crop production. About 86% of the head cabbage produced in Hawaii is grown here. Approximately 83% of the State's dry onions and about 65% of the tomatoes are produced in the Kula area. Other truck crops such as carrots, head lettuce, broccoli, and snap beans area also grown....There are 35 family-operated farms with approx 480 acres under cultivation in the project area....Most of the remaining land area is devoted to livestock grazing by about 20 full-time and part-time farmers (Tri-Isle Resource Company 1971:5).

Specific to the project area, one of the sites that has been investigated, for an Intermediate School, was Grant 1829:1 on Pu'u o Weli:

> This site is located along lower Kula Road makai of the Kula 200 subdivision and below the 1,800 foot elevation as shown in Fig. 17 and 18. The site was *a former pineapple field, is currently zoned Urban but is vacant.* The owners of the site are Messrs. Munoz and Tokunaga for TMK:2-3-08:por. 5. This site has been increased to 9 acres to provide a minimum of 8 usable acres based on the 12% slope (A Staff Study on the Site Selection and EIS for an Intermediate School for the Makawao-Pukalani-Kula Area, 1977).

A 1981 environmental assessment by Maui Land and Pine Company discusses a parcel which was known as the "Filipino Camp," located along Kailua Gulch, one gulch removed from Kaluapulani Gulch, on which the project area lies. The assessment reports that:

> Several years ago pineapple was planted on a portion of the site after removal of the old houses. However, according to older ML&P employees, the results were very poor due to the heavy incidence of *Phytopthora* sp., a very serious pineapple disease which persists in the soil. Pineapple production was terminated for this reason. The site is currently vacant and used only for pasture (1981:[2]30).

Maui Land and Pine Company owned much of the land in the immediate vicinity. Donna Clayton of their land management department could not verify if the present project area was formerly controlled by the company. She suspected that it was used for pasturage (pers. comm. 2/7/96).

Maui Land and Pine Company has its roots in Alexander and Baldwin, one of the original "Big 5" corporations in Hawaii. The inception of this company is documented in the book *Mowee*:

> A company called Baldwin Packers was acquired by "H.P." along with its lands at Kapalua on the northwest coast of Maui. Baldwin Packers eventually became Maui Pineapple Company, the largest producer of pineapple on Maui. Its development was watched over carefully by J. Walter Cameron who had married Frances Baldwin, granddaughter of "H.P." Taking over Maui Pineapple, of which A & B owned controlling interest, he led the Maui company

> as it developed over the 1950s and 1960s. On his father's retirement, Colin C. Cameron became manager for A & B, then resigned from Maui Pineapple as a struggle for its control ensued. In a surprise move, a multimillion dollar deal in which the Camerons traded A & B stock and cash for controlling stock in the pineapple company, the Camerons won control. Colin became president, [and] the name was changed to Maui Land & Pineapple Company (Speakman 1978:130-131).

A report on Kula would not be complete without some mention of Kula Sanatorium, founded for the care of tuberculosis sufferers. The sanatorium is located near the project area at an elevation of 3,000 feet (*The Honolulu Advertiser* 9/20/85, B:3). Land for the sanatorium was requested by Bill Pogue in 1909. Initially the sanatorium consisted of two tent-houses which accommodated 12 patients. The tent-houses, which included kitchen and dining facilities, was financed by the County and Territory and cost $500.00. The first permanent ward was built by W.E. Foster, former patient and superintendent. Around 1932, the Hawaiian Homes Commission granted 100 acres to the sanatorium, and in 1937 a new sanatorium was constructed (Jones 1940).

PREVIOUS ARCHAEOLOGICAL RESEARCH

No archaeological reports were found for ʻAʻapueo. Reports for neighboring Kalialinui, and reports on the Kula vicinity were examined. Although the project area falls within the district of Makawao, most reports for this district refer to the coastal areas of Wailea and Makena. It was determined that the information in these reports was not relevant to this report. If a report has already been cited and discussed earlier in this report, it will not be included in this section.

The earliest archaeological surveys conducted in the current project area have already been discussed (in discussion of *heiau*). The State Inventory of Historic Places has on file a number of sites near the project area as a result of a 1973 survey. The Hamakua Burial Cave (50-50-05-1264) is located at the southwestern edge of Pukalani town, along the cliffs of the Kalialinui Gulch (Kennedy 1991:7):

> In 1973 Robert Connolly mapped and registered this 33 meter long lava tube which divided into two 3 meter wide chambers. In it, he found the disarticulated remains of 30-50 individuals, along with 3 pieces of worked wood, and 8 water worn stones. At the time of his inspection, the site may have been vandalized in historic times for nearly all crania and mandibles were removed from their skeletons. It is equally possible that these abnormalities were prehistoric in origin (ibid.)

Three petroglyph sites along the cliffs in ʻAʻapueo are registered on the State inventory. Two sets of petroglyphs were located, one containing 191 figures (50-50-10-1061) and the other 31 figures (50-50-10-1231). The petroglyphs were predominately of single and double canoes, and human figures (ibid.)

Connolly visited the Puʻu Pane, south of the project area in 1973 and found possible remnants of a *heiau*. Kennedy reports that Puʻu Pane is a sacred hill and the *heiau* was that of the high chiefs (Kennedy 1991:7).

An archaeological report was prepared for the Pukalani Highland Subdivision project area, located in the *ahupua'a* of Kailua (Kennedy 1991). In his report Kennedy maintains that LCA testimonies for 'A'apueo shows that the primary usage of the land at that time was for pasturage (ibid.:5). Kennedy identifies a possible *heiau* site in Kailua (ibid.:8). He suggested preservation of the remains.

Later the same year, Demaris L. Fredericksen and Walter M. Fredericksen conducted additional archaeological data collection in the same parcel primarily to address the dispute over the remnants identified by Kennedy as a possible *heiau* and burial site (Fredricksen and Fredericksen 1991). After Kennedy's recommendation, State Historic Preservation Officer Annie Griffin examined the sites and concluded that several anomalies concerning the features were present and requested further testing and data collection. As a result of oral interviews, the Fredericksens concluded that the features (outcroppings) were the result of historic agriculture.

ORAL INTERVIEWS

Oral interviews were not conducted for this project; however, those conducted by Kennedy and Fredericksen are discussed here. Kennedy interviewed George Fernandez, who lived in the Kailua project area for over 80 years (Kennedy 1991:5). Mr. Fernandez recalled that that land had been used for growing pineapples until the 1930's, and that after that it was used for pig farming and pasture for horses (ibid.)

When Fredericksen and Fredericksen conducted their archaeological data collection project later the same year, they were confronted with Hawaiian activist Charles Maxwell who claimed he informed Kennedy that the outcroppings were sacred and that he was not to "touch a stone" on them (Frederickson and Fredrickson1991:1). Fredericksen and Fredericksen interviewed five informants who were *kama'aina* of the area. Through the informants it was learned that the outcroppings were built by Portuguese farmers and were "agricultural clear piles," and that many had accounts of collecting *'ulu maika* and adzes in the area. Some also recounted that there were Hawaiian graves in the vicinity (ibid. 4,5).

SUMMARY AND CONCLUSION

It is difficult to confirm how project area land was used in the past because there is no information specific to the *ahupua'a*. One can, however, postulate on activities and the remains that may be found in the project area based on studies of nearby areas.

The remains of a *heiau* in 'A'apueo was identified by Walker in 1931; however, no other survey searched for or located it. A site identified in 1991 as a possible *heiau* in the adjoining *ahupua'a* of Kailua, turned out to be a result of modern agricultural clearing.

Winslow Walker maintains that villages were customarily located at the mouths of gulches. Since the project area is far from the mouth of the gulch, the likelihood of prehistoric remains are diminished. However, according to LCA information, there were once housesites in the project area, and these, along with agricultural remnants, may be located.

In 1973 Connolly discovered a burial cave located along the cliffs of Kalialinui Gulch and vast numbers of petroglyphs. Based on his findings, it is possible that either one of these features will be found in the project area.

In early times the Kula area was recognized for sweet potato and dryland taro cultivation. By the mid 1800s, most of the land in 'A'apueo was used for pasturage and agriculture. During the late 19th and during the 20th century the vicinity was utilized primarily for pasturage and pineapple cultivation. Due to agricultural clearing it is highly likely that the terrain in the project area has been significantly altered in modern times.

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Appendix B-2

Archaeological Reconnaissance Survey

Report 1707-020996

Archaeological Reconnaissance Survey 250-Acre Pukalani Project Area

Land of Aapueo, Makawao District
Island of Maui

PHRI

Paul H. Rosendahl, Ph.D., Inc.
Archaeological • Historical • Cultural Resource Management Studies & Services

Report 1707-020996

Archaeological Reconnaissance Survey 250-Acre Pukalani Project Area

Land of Aapueo, Makawao District Island of Maui (TMK: 2-3-08:Por. 5)

BY

Blair McPhatter, B.A. • Crew Chief

AND

Paul H. Rosendahl, Ph.D. • Principal Archaeologist

PREPARED FOR

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FEBRUARY 1996

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SUMMARY

At the request of Mr. Don Fujimoto, Vice President of Dowling Company, Inc., Paul H. Rosendahl, Ph.D., Inc. (PHRI), conducted Archaeological Reconnaissance of a 250-acre parcel located in the Land of Aapueo, Makawao District, Island of Maui (TMK:2-3-08:Por.5). The purpose of an Archaeological Reconnaissance survey is to identify all sites of potential archaeological significance present within the specific project area and assign each site a tentative significance evaluation.

Two sites were identified during the survey, a petroglyph (Site 1707-1), and a wall (Site 1717-2). In addition, a number of land-clearing piles associated with historic pineapple cultivation were also noted.

The wall site (Site 1707-2) is tentatively evaluated as significant solely for information content and further data collection only is recommended for this site. The petroglyph site (Site 1707-1) is significant for information content and for cultural value. Because this site is near the project area boundary, it is recommended this site be preserved with interpretive development.

Contents

Illustrations

Tables

INTRODUCTION

BACKGROUND

At the request of Mr. Don Fujimoto, Vice President of Dowling Company, Inc., Paul H. Rosendahl, Ph.D., Inc. (PHRI), conducted an archaeological reconnaissance of the 250-acre Pukalani project area (TMK:2-3-08:Por.5), situated in the Land of Aapueo, Makawao District, Island of Maui (*Figure 1*).

Most of the project area is primarily former pineapple lands. Two large gulches (Kaluapulani and Kalialinui Gulch) are also present in the general area, and the State of Hawai'i has identified several archaeological sites within those gulches (letter of March 7, 1994 from Don Hibbard, Administrator, DLNR-SHPD, to Brian Miskae, Director, Maui Planning Department). In addition to work in the 250-acre Pukalani project area, Dowling Company, Inc. would like to excavate and place a culvert through a swale within the project area without affecting any previously identified archaeological sites

The overall objective of the present reconnaissance survey was to locate and identify all archaeological sites in conjunction with a due diligence investigation. The reconnaissance survey does not generate sufficient information to qualify as an inventory survey. An inventory survey would provide information appropriate and sufficient to satisfy all current historic preservation regulatory review requirements of the Department of Land and Natural Resources-State Historic Preservation Division (DLNR-SHPD) as contained within Hawaii Administrative Rules, Title 13, Department of Land and Natural Resources, Subtitle 6, State Historic Preservation Division Rules (DLNR Draft Rules 1994).

SCOPE OF WORK

The basic purpose of a reconnaissance survey is to identify all sites and features of potential archaeological significance present within a specified project area. A reconnaissance survey is the initial level of archaeological investigation and is conducted with the basic aim of determining the presence or absence of archaeological resources within a specified project area. Finally, it indicates both the general nature and variety of archaeological remains present, and the general distribution and density of such remains.

The basic objectives of the survey were fourfold: (a) to identify all sites and site complexes present within the project area; (b) to evaluate the preliminary significance of all identified archaeological remains; (c) to determine the possible impacts of proposed development upon the identified remains; and (d) to define the general scope of any subsequent further inventory, data collection, and/or other mitigation work that might be necessary or appropriate.

Based on a review of readily available background literature, basic familiarity with the general project area, and extensive familiarity with the current requirements of pertinent review authorities, the following specific tasks were determined to constitute an adequate and appropriate scope of work to comply with current reconnaissance level survey requirement:

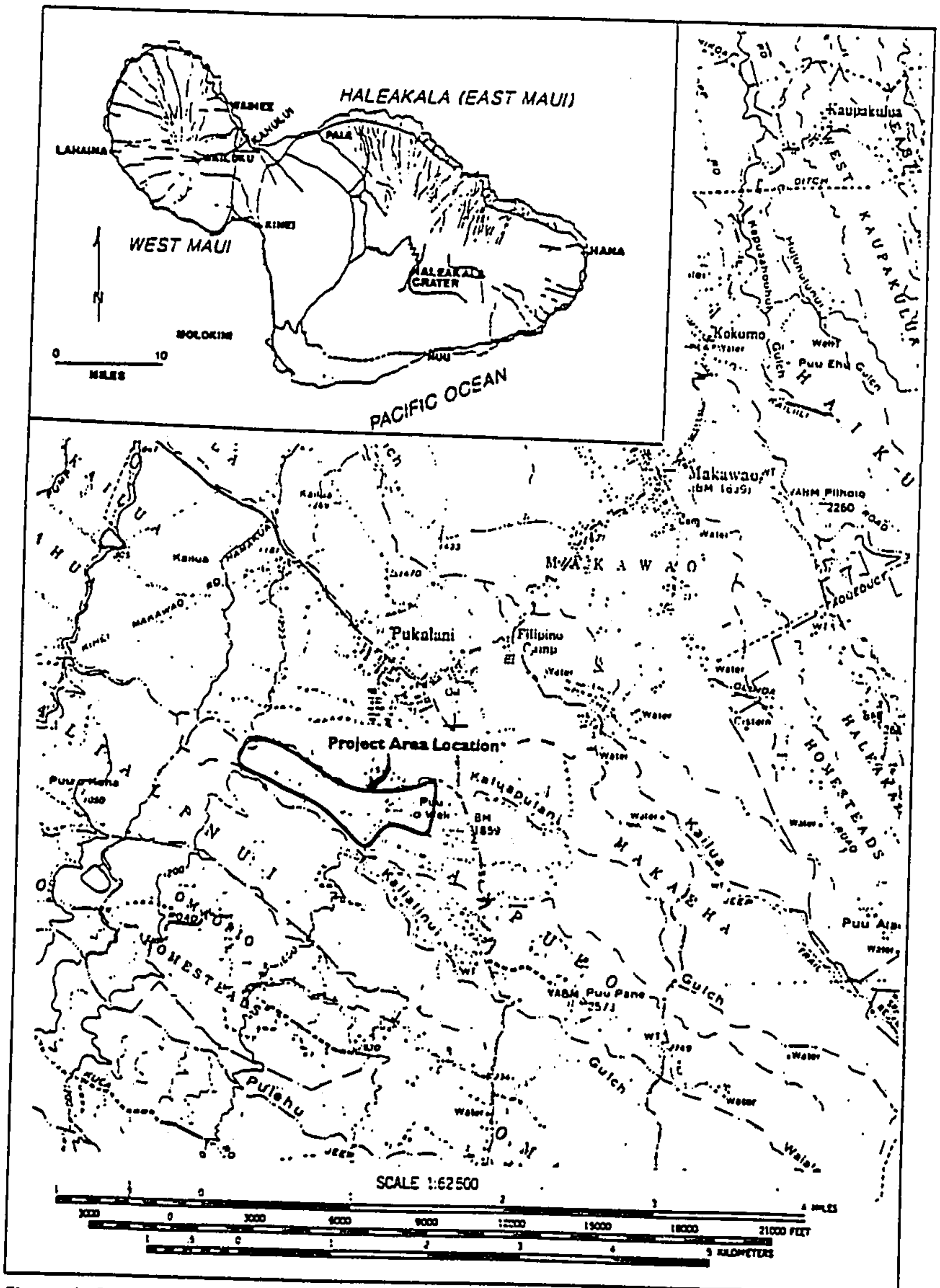

Figure 1. Project Area Location

1. Review archaeological literature relevant to the project area (emphasis on readily available literature);

2. Conduct 100% coverage, high-intensity ground survey of the entire project area, to find and list (a) any previously identified sites and features, and (b) any previously unidentified sites and features; and

3. Analyze field data, and prepare appropriate reports.

The preliminary significance of all archaeological remains identified within the project area is tentatively assessed in terms of (a) the National Register criteria contained in the Code of Federal Regulations (36 CFR Part 60), and (b) the criteria for evaluation of traditional cultural values prepared by the National Park Service (1990). DLNR-SHPD uses these criteria to evaluate eligibility for both the Hawaii Sate and National Registers of Historic Places.

To further facilitate client management decisions regarding the subsequent treatment of resources, the preliminary significance of all archaeological remains identified during the survey is evaluated in terms of three cultural resource management value modes, which are derived from the previously mentioned federal evaluation criteria. Sites are evaluated in terms of potential scientific research, interpretive, and/or cultural values. Scientific research value refers to the potential of archaeological resources for producing information useful in the understanding of culture history, past lifeways, and cultural processes at the local, regional, and interregional levels of organization. Interpretive value refers to the potential of archaeological resources for public education and recreation. Cultural value, within the framework for significance evaluation used here, refers to the potential of archaeological resources for the preservation and promotion of cultural and ethnic identity and values.

PROJECT AREA DESCRIPTION

The parcel consists of c. 250 acres, situated in the Land of Aapueo, Makawao District, Island of Maui (*Figure 1*). The project area is bounded by the Kula Highway on the east, by Kaluapulani Gulch (Kaakakai Gulch on Tax maps) on the north, by the Pukalani Golf Course on the west, and by undeveloped land to the south. Historical information has shown that approximately 75% of the project area was planted in pineapple in AD 1979 (by Maui Land and Pine Company) and is now used as pasture for cattle (H.W. Smith, pers. comm.). The eastern 25% of the project area consists of two golf holes for the Pukalani Golf Course and intervening areas of short grass.

The elevation in the project area ranges from c. 1,190 ft above mean sea level (AMSL), on the western end, to c. 1,810 ft AMSL, at the eastern end of the parcel. Rainfall in the general vicinity of the project area averages 75 inches per year, and the mean annual temperature is 70-75 degrees F (Armstrong 1983).

Terrain within the project area slopes moderately from the east end towards the west. Soils are comprised primarily of Keahua silty clay loam (3%-5% slopes and 7% -15% slopes), Keahua silty clay (7%-15% slopes), Keahua cobbly silty clay (7%-15% slopes), and Keahua cobbly silty clay loam (15%-25% slopes). An abandoned quarry is present in the eastern portion of the project area and is comprised of Keahua cobbly silty clay loam soil. Kaluapukani Gulch is comprised of rough broken lands (Foote et al. 1972). The Keahua Series is comprised of "...well drained soils on uplands on the island of Maui. These soils developed in material weathered from basic igneous rock" (Foote et al. 1972:65). The Keahua soils are used for sugar cane, pasture, and wildlife habitat, with smaller lands used for home sites, pineapple, and truck crops.

The vegetation of the Pukalani project area is dominated by grasses and low growing shrubs, including guinea grass (*Panicum maximum*), lantana (*Lantana camara* L.), sensitive plant (*Mimosa pudica*), prickly pear (*Opuntia ficus-indica*), agave (*Agave sisalana*), and *koa-haole* (*Leucaena leucocephala*), and other unidentified grasses and weeds. The fringes of the former pineapple fields exhibit a few trees including a some large *koa-haole*, silver oak (*Grevillea robusta*), eucalyptus, and Christmas-berry (*Schinus terebinthifolius*).

PREVIOUS ARCHAEOLOGICAL WORK

Other than the DLNR-SHPD letter to Mr. Miskae, there are no records indicating that archaeological work has previously been conducted in the parcel examined during this survey. The DLNR-SHPD letter indicates that there are several petroglyph sites and a burial site within Kaluapulani and Kalialinui Gulches (*Figure 2, at end*). The letter states that Site 1061 (Kalialinui Petroglyphs) and Site 1062 (Kaluapulani Petroglyphs) are present immediately outside the present project area. The DLNR-SHPD letter also goes on to state that Sites 1061 and 1062 are significant for information content, as excellent examples of traditional Hawaiian petroglyph art, and are culturally significant. The letter also states that Sites 1231 (Pukalani Petroglyphs), and 1264 (Hamakua Burial Cave) are located slightly downslope of the project area. In the letter, DLNR-SHPD states that these final two sites (Sites 1231 and 1264) could be impacted by future development or use of the current project area.

FIELD METHODS AND PROCEDURES

The 100% pedestrian survey was undertaken between January 29 and February 2, 1996, by Crew Chief Blair McPhatter, B.A., and Field Archaeologist Harley Lanham, B.A. Principal Archaeologist Dr. Paul H. Rosendahl and Hawai'i Projects Director Mr. Alan T. Walker, B.A., provided overall guidance for the project. The surface reconnaissance survey of the project area was accomplished by using a systematic series of transects, nearly all oriented at 120-300 degrees, approximately parallel to the long axis of the project area. The intervals between the crew members were 10 meters in the western portion of the project area (specifically Land Grants 1829 and 1220 to Keawe). Because of the excellent visibility in the eastern portion (Land Grants 1221 to Malai, 1222 to Kauuku, and 1829, Apana 1 to Keawe), the intervals were increased there to 20 meters. The terrain in Kaluapulani Gulch (Kaakakai Gulch) was mostly composed of vertical cliffs, and pedestrian survey was impossible. Mr. Don Fujimoto of Dowling Company, Inc., confirmed that this area would not be developed.

During the pedestrian survey, all transects were identified sequentially and plotted on the project area map, in order to monitor the daily progress of the project. Pink and blue- and -white flagging were used by field personnel throughout the project area to mark the start and termination points of each transect. As sites were identified during the pedestrian survey, they were marked with pink flagging tape and assigned sequential PHRI temporary numbers prefixed by "1707-" beginning with "1707-1." Sites were tagged with an aluminum strip bearing the site number, PHRI project number (96-1707), and the date. All sites were plotted onto a 1"= 300' scale project map (10-ft contours) supplied by Austin, Tsutsumi & Associates, Inc.

A PHRI site record form was completed for each site, along with a site map (excluding Site 1707-2, a petroglyph), and notes on each site were kept in a field book. The site map was produced using a metric tape and compass, with the scale dependent upon the size of the site. A complete 35 mm black-and-white photographic record of field work was kept. No subsurface excavation was undertaken.

FINDINGS

During the present reconnaissance survey, two sites containing two component features were identified (*Table 1*). Both were newly recorded sites. They included Site 1707-1, a petroglyph, and Site 1707-2, a wall (*Figure 2*). No archaeological sites were identified in the area proposed for a culvert crossing. Numerous land clearing piles associated with prior pineapple cultivation were also noted but not recorded as sites. Below are descriptions of the two sites.

SITE 1707-1

Site 1707-1 is a petroglyph of what appears to be a canoe with a "crab claw" sail. It measures approximately 0.32 m (N-S) in length, by 0.28 m (E-W) wide, with the bow facing south. The hull of the canoe is c. 0.03 m wide and it contains a raised and pointed bow. The entire hull is clearly etched, but the stern appears less distinct. Two separate rigging lines are present on each side of the sail and appear to be mirror images of each other. The southernmost line is attached to the point of the bow, while the stern line is attached to the hull. Both of these outside lines are attached to the top of the sail and the two interior lines are attached to the middle part of the sail. This appears to be a prehistoric petroglyph. The petroglyph appears unaltered and no portable remains were observed in the area. This site is located on the northern side of the gully in Land Grant 1829, Apana 1, and is south of the quarry. It is likely that a few other petroglyphs are present.

SITE 1707-2

Site 1707-2 is a boundary wall on the north side of Kalialinui Gulch. The wall measures c. 184.0 m long (E-W), by 0.5 m wide, by 0.8-1.4 m high. It consists of a loosely stacked alignment of small-to-large basalt cobbles and boulders with sections of the wall being collapsed. The wall is not constructed in a straight line, but meanders north and south along its length. The wall is generally oriented approximately 100-280 degrees. The west side of this wall merges into the natural cliff line on the project-area side of the gulch. On the east end, the wall curves to the north for c. 3.5 m and abuts the natural cliff line of the gulch. This short north-south section is oriented approximately 60-240 degrees. This wall is located at the only available point of entry into the gulch in this portion of the project area. The wall appears to be historic in age, given its loose construction.

Table 1. Summary of Identified Sites and Features

PHRI Temp. Site Number	Formal Site/Feature Type	Functional Interpretation	*CRM Value Mode Assess. R	I	C	Completed Field Work Tasks DR	SC	EX
1707-1	Petroglyph	Rock art	M	L	M	+	-	-
1707-2	Wall	Boundary	L	L	L	+	-	-

*** *Cultural Resource Management Value Mode Assessment***

–Nature: R = *Scientific research*
I = *Interpretive*
C = *Cultural*
–Degree: H = *High*
M = *Moderate*
L = *Low*

Completed Field Work Tasks:

DR = *Detailed recording (scaled drawings, photographs, and written descriptions),*
SC = *Surface collections,*
EX = *Test excavations.*

CONCLUSION

DISCUSSION

The present reconnaissance survey has shown that the parcel was cultivated in pineapple during the historic period, and this explains why so few archaeological sites were identified. The two remaining sites consist of a prehistoric petroglyph (Site 1707-1) and a historic wall (Site 1707-2). Given the location on Maui of the project area (rainfall, elevation, soil, etc.), it is likely that this area was used for the cultivation of dryland agricultural crops and habitation during the Prehistoric Period. The presence of Site 1707-1 is not unusual, since several other petroglyph sites are already known to be in the area (Sites 1061, 1062, 1231). Occupation of the general area is also evidenced by Site 1264 (Hamakua Burial Cave). All petroglyph sites and the burial cave are tentatively assigned a prehistoric age. Early Historic/Historic occupation is also suggested by the presence of Site 1707-2, a wall. No archaeological features were identified in the swale area proposed for a culvert crossing. It must be noted here that because no radiocarbon age determination analysis has been done within the project area, the conclusions regarding the age of sites presented here are tentative.

TENTATIVE GENERAL SIGNIFICANCE ASSESSMENTS AND RECOMMENDED GENERAL TREATMENTS

The sites located within the boundaries of the 250-acre Pukalani project area have been tentatively assessed for significance based on the National Register Criteria for Evaluation, as outlined in the Code of Federal Regulations (36 CFR Part 60). The Department of Land and Natural Resources-State Historic Preservation Division (DLNR-SHPD) uses these criteria for evaluating cultural resources. To be assessed as significant a site must possess integrity of location, design, setting, materials, workmanship, feeling, and association and must be characterized by one or more of the following four criteria:

(A) It must be associated with events that have made a significant contribution to the broad patterns of our history;

(B) It must be associated with the lives of persons significant in the past;

(C) It must embody distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic value or represent a significant and distinguishable entity whose components may lack individual distinction; or

(D) It must have yielded or may be likely to yield, information important in prehistory or history.

Sites are also assessed for cultural significance using: (a) guidelines prepared by the National Park Service (1990), and (b) guidelines established by the State of Hawaii ("Draft Rules

Governing Procedures for Historic Preservation Review" [DLNR Draft Rules 1994]). The Hawaii State guidelines utilize this additional fifth criteria (Criterion E) which defines significant cultural resources as ones that "have an important traditional cultural contribution or value to the native Hawaiian people or to other ethnic groups of the state" (DLNR Draft Rules 1994).

Most archaeological sites are initially evaluated as significant under Criterion D. After the evaluative process of an inventory survey, or the data recovery process of a mitigation program, the research potential of some sites may be exhausted (i.e., after extensive mapping, testing, surface collection, historical research, etc.). In these cases, the sites may maintain their information content value but lose their information content significance. Hence, the sites would be considered as "No Longer Significant" (NLS).

Based on the federal criteria described above, Sites 1707-1 and 1707-2 are tentatively assessed as significant for information content (*Table 2*). However, Site 1707-1 is also assessed as being culturally significant. Both sites are recommended for inventory survey (detailed recording and mapping), and historical documentary research should be conducted on the parcel.

The four sites located outside the project area noted by DLNR-SHPD and discussed above in the section on previous archaeological work (Sites 1061, 1062, 1231, and 1264) (letter of March 7, 1994 from Don Hibbard, Administrator, DLNR-SHPD, to Brian Miskae, Director, Maui Planning Department), should not be impacted by proposed development of the present parcel. To insure they are not impacted, a monitoring plan should be prepared and implemented prior to any construction in the area.

Table 2. Summary of Tentative General Significance Assessments and Recommended General Treatments

PHRI Temp. Site No.	Site Type	Significance Evaluations						General Recommendations			
		A	B	C	D	E	NLS	FDC	NFW	PID	PAI
1707-1	Petroglyph	-	-	-	+	+	-	+	-	+	-
1707-2	Wall	-	-	-	+	-	-	+	-	-	-
Total:		0	0	0	2	1	0	2	0	1	0

General Significance Categories:

A = *Associated with events that have made a significant contribution to the broad patterns of history*
B = *Associated with the lives of persons significant in our past*
C = *Excellent example of site type at local, regional, island, state, or national level (PHRI=interpretive value); and*
D = *Important for information content, further data collection necessary (PHRI=research value);*
E = *Culturally significant (PHRI=cultural value);*
NLS = *Important for information content, no further data collection necessary (PHRI=research value, DLNR-SHPD=not significant).*

Recommended General Treatments:

FDC = *Further data collection necessary (detailed recording, surface collections, and limited excavations, and possibly subsequent data recovery/mitigation excavations);*
NFW = *No further work of any kind necessary, sufficient data collected archaeological clearance recommended, no preservation potential;*
PID = *Preservation with some level of interpretive development recommended (including appropriate related data recovery work);*
PAI = *Preservation "as is," with no further work (and possible inclusion into landscaping), or possibly, minimal further data collection necessary.*

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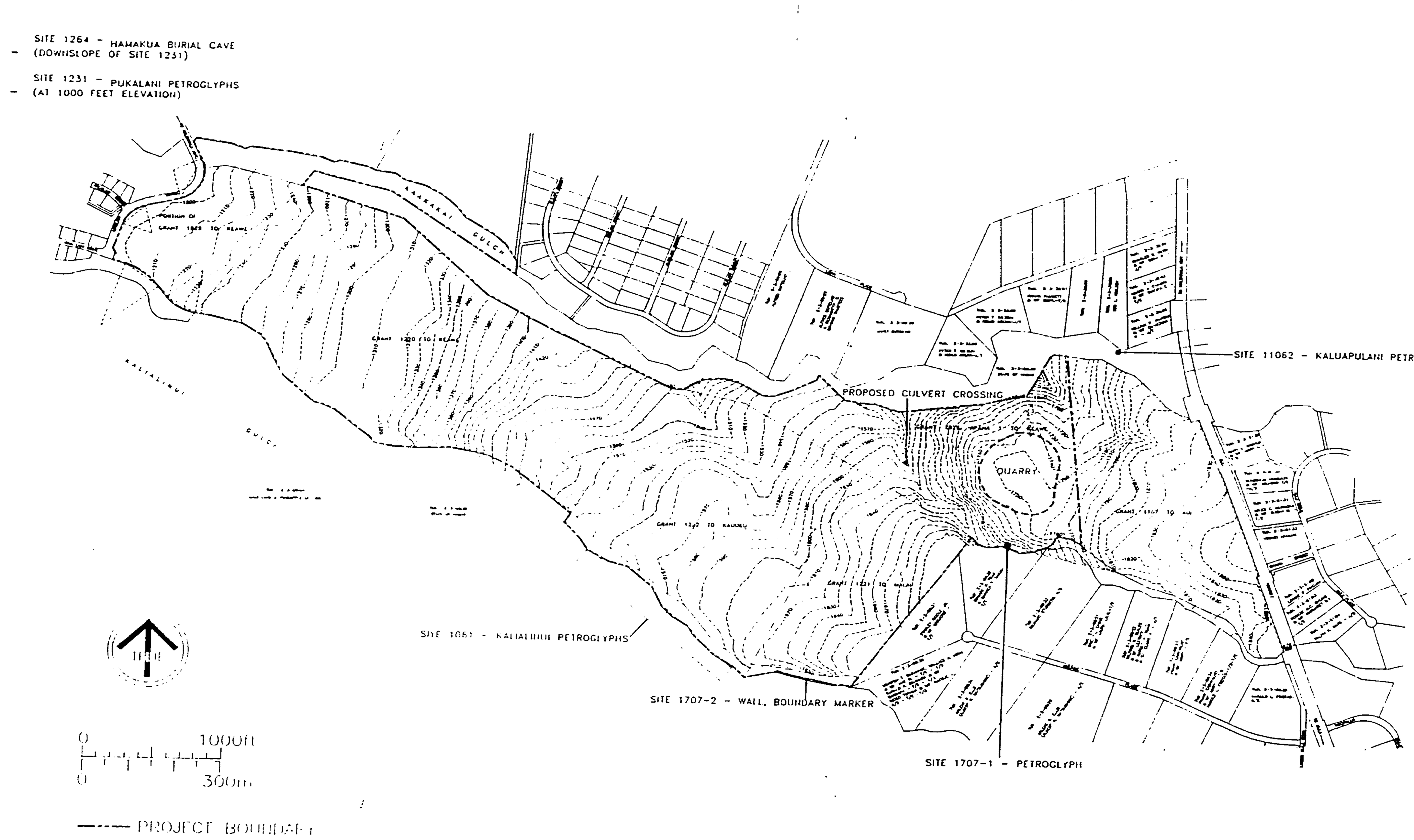
OVERSIZED DRAWING/MAP

PLEASE SEE 35MM ROLL

0023



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Archaeological Reconnaissance Survey
250 Acre Pukalani Project Area
PHRI Project 96-1707

Figure 2.
SITE LOCATIONS

0023

Appendix B-3

Addendum to Archaeological Inventory Survey

PHRI

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Letter 1803-041597

April 15, 1997

Dowling Company, Inc.
c/o Mr. Milton Arakawa
Munekiyo & Arakawa, Inc.
305 High Street, Suite 104
Wailuku, Hawai'i 96793

Subject: Addendum to PHRI Report 1700-030196, Archaeological Inventory Survey, 44-Acre Pukalani Terrace Subdivision III

At the request of Mr. Don Fujimoto, Vice President of Dowling Company, Inc., Paul H. Rosendahl, Ph.D., Inc. (PHRI) conducted and previously reported (Wulzen and Rosendahl 1996b) archaeological inventory of a 44-acre parcel. The project area was a portion of the 305-acre former Pukalani Terrace Subdivision Unit III (the project is now known as Kalumalu Subdivision) that was [reviously subjected to reconnaissance survey (McPhatter and Rosendahl 1996; Wulzen and Rosendahl 1996a). As shown on the revised *Figure 2*, this addendum expands the inventory survey to include an additional 9.67 acres, for a total of 53.67 acres.

The subject property is located in the Land of 'A'apueo, Makawao District, Island of Maui (TMK:2-3-08:Por.5), and is depicted on two topographic maps, "Kilohana, Hawaii" (USGS 1983a), and "Puu O Kali, Hawaii" (USGS 1983b). The parcel is primarily former pineapple land, bounded on the north and south by branches of Kaluapulani Gulch (Kaakakai Gulch on tax maps). The eastern project boundary is the Kula Highway (Hawaii State Route 37). On the west, the project area now extends approximately to the 1740 foot contour, the west edge of the cinder cone known as Pu'u O Weli, which had been used until recently as a cinder quarry.

During the archaeological reconnaissance surveys on February 1 and 2, 1996, the entire 305 acres were subjected to surface inspection of equal intensity. Later, additional survey, along with site recording and subsurface testing of Site 50-50-10-4181, was conducted on February 6 through 9, 1996. This survey covered the entire east portion of the 305-acre project area, including Pu'u O Weli. Neither phase of the survey revealed any evidence of any other sites in the 53.52 acre parcel, as indicated on *Figure 2*.

Prior to the reconnaissance surveys (McPhatter and Rosendahl 1996; Wulzen and Rosendahl 1996a), no previous archaeological work had been conducted in the Pukalani Terrace Subdivision Unit III project area, and no other archaeological surveys in 'A'apueo are known. One site, 05-50-50-4181, was identified during the inventory survey. Features of the site included two agricultural clearing piles and two rock alignments. The site was subjected to subsurface testing, and assigned a function of late historic to modern agriculture, based on artifacts. This site was evaluated as not eligible for the National Register of Historic Places (NRHP) (Wulzen and Rosendahl 1996b).

During the surface survey of the contiguous portion of the 305 acre parcel, one previously unrecorded site was identified just south and outside of the current project boundary. Site 50-50-10-4179 is located in a branch of Kaluapulani Gulch at the southern foot of Pu'u O Weli and consists of two petroglyph panels containing at least five elements of canoes and crab claw sails (McPhatter and Rosendahl 1996). This site may require protection during land clearing and grading of the expanded project area. Two land-clearing piles associated with prior pineapple cultivation have been noted near the northwest and southwest corners of the present project area, but are not considered sites (McPhatter and Rosendahl 1996). Two other previously recorded petroglyph sites (50-50-10-1061; 50-50-10-1062) are located in Kalialinui Gulch and Kaluapalani Gulch. respectively. Neither of these sites should be affected by the expansion of the project area.

If you have any questions, or if we can be of further service to you, please call me at our main Hilo office (808) 969-1763.

Sincerely yours,

Paul H. Rosendahl, Ph.D.
President and Principal
Archaeologist

Attachment: Revised Figure 2

WW/ww

References Cited

McPhatter, B., and P.H. Rosendahl

1996 Archaeological Reconnaissance Survey, 250-Acre Pukalani Project Area, Land of Aapueo, Makawao District, Island of Maui (TMK: 2-3-08:Por. 5). PHRI Report 1707-020996. Prepared for Dowling Company, Inc., Wailuku, HI 96793.

U.S. Geological Survey (USGS)

1983a *Kilohana, Hawaii*, Scale 1:24,000. Denver: USGS.

1983b *Puu o Kali, Hawaii*, Scale 1:24,000. Denver: USGS.

Wulzen, W., and P.H. Rosendahl

1996a Archaeological Reconnaissance Survey, 44-Acre Pukalani Terrace Subdivision III, Land of Aapueo, Makawao District, Island of Maui (TMK: 2-3-08:Por. 5). PHRI Report 1700-021696. Prepared for Dowling Company, Inc., Wailuku, HI 96793.

1996b Archaeological Inventory Survey, 44-Acre Pukalani Terrace Subdivision III, Land of Aapueo, Makawao District, Island of Maui (TMK: 2-3-08:Por. 5). PHRI Report 1700-030196. Prepared for Dowling Company, Inc., Wailuku, HI 96793.

OVERSIZED
DRAWING/MAP

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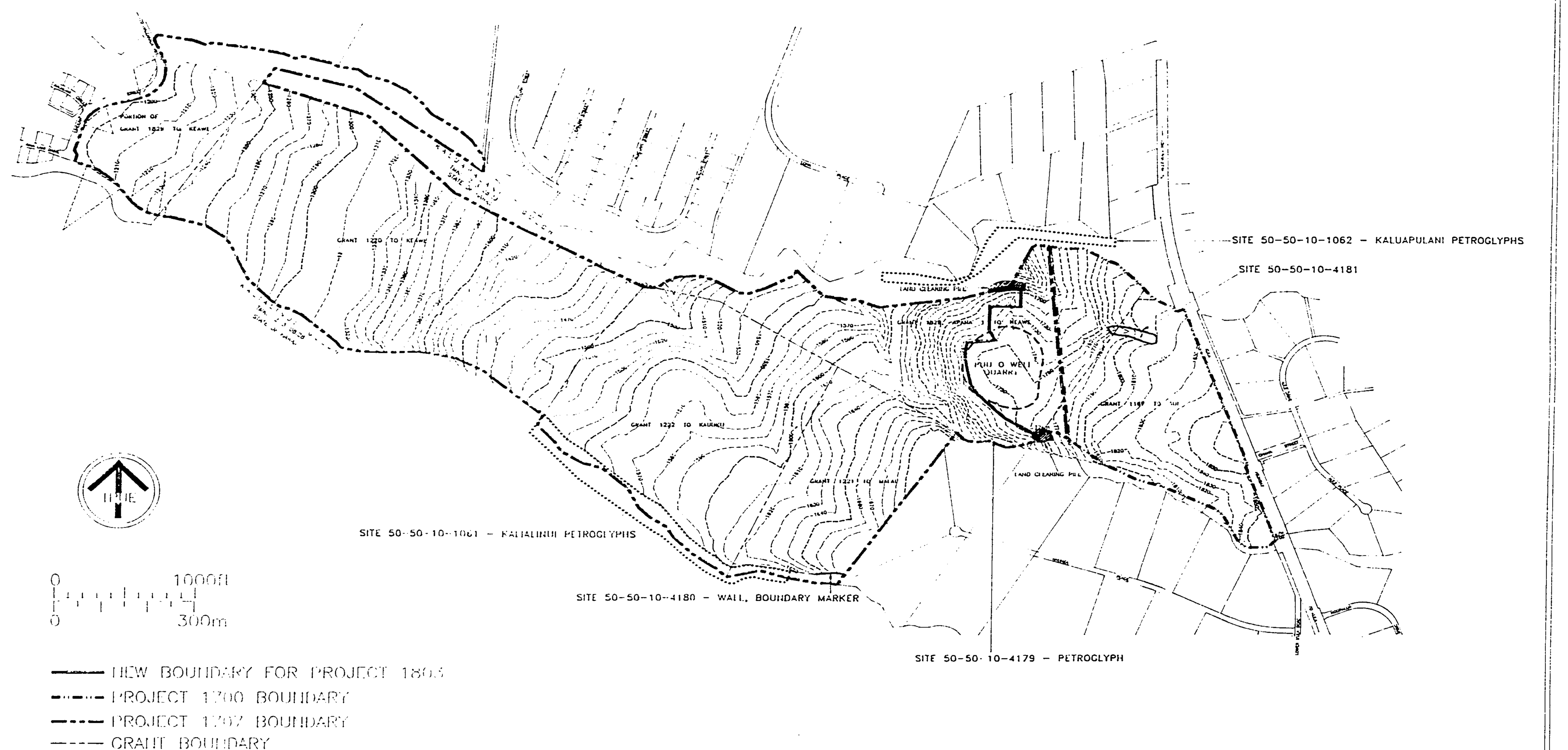

PHRI PAUL H. ROSENDAHL, PH.D., INC.
ARCHAEOLOGICAL • HISTORICAL • CULTURAL
RESOURCE MANAGEMENT STUDIES & SERVICES

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Archaeological Inventory Survey
Pukalani Terrace Subdivision Unit III Project Area
PHRI Project 97-1803

Figure 2.
SITE LOCATIONS

Appendix C

Market Study

JOHN CHILD & COMPANY
REAL ESTATE CONSULTANTS & APPRAISERS

Report to

Dowling Company, Inc.

Covering the

KULAMALU COMMERCIAL MARKET STUDY

Pukalani, Maui, Hawaii

March 1996

JOHN CHILD & COMPANY
REAL ESTATE CONSULTANTS & APPRAISERS

March 22, 1996

Karen Char, MAI, CRE
Robert J. Vernon, MAI
Paul D. Cool, MAI
Leon Y. Ewan, MAI
May M. S. Wong-Fu
Cynthia C. Nakamura
Curt A. Wakatsuki
Andrew B. Furuta
Burton S. Yuen
Michael J. Robinson

Mr. Everett R. Dowling
Dowling Company, Inc.
1997 East Main Street
Wailuku, Maui, Hawaii 96793

Dear Everett:

Re: Kulamalu Commercial Market Study

At your request, John Child & Company has provided real estate consulting services to estimate and project the market support for commercial retail and ancillary office development at Kulamalu. This letter summarizes our findings that are presented in the accompanying report.

BACKGROUND

Dowling Company, Inc. (DCI) owns Kulamalu, a 300-acre parcel in Pukalani, Maui, Hawaii. The property is zoned R-2 Residential. The County may approve the rezoning of about 20 acres of the property from R-2 to Commercial, provided an additional 20 acres are offered for Park use.

The 20-acre Kulamalu commercial site accounts for about 77% of the undeveloped commerical land in Upcountry Maui. The remaining sites are smaller, non-contiguous properties that would not have the same potential as a major retail center in the region.

DCI is evaluating the feasibility of commercial retail and ancillary office development on the 20-acre portion of Kulamalu. In this regard, you have asked us to assist you by assessing the current and projected market support for commercial retail and ancillary office development at Kulamalu.

STUDY OBJECTIVE AND PURPOSE

The objective of our assistance is to assess the market support for commercial retail and ancillary office development on the 20-acre portion of Kulamalu.

The purpose of our assistance is to provide market assessments and projected market support that can be used for internal information and decision-making.

John Child & Company, Inc.
1100 Alakea Street, 30th Floor
Honolulu, Hawaii 96813
Telephone 808-533-2951
Telecopier 808-521-7672

EFFECTIVE DATE OF REPORT

The effective date of this report is March 15, 1996.

STUDY APPROACH

The study approach to complete our assistance is as follows:

Orientation

1. Met with you to review the study objective and approach.
2. Reviewed any relevant studies or plans for Kulamalu.
3. Visited Kulamalu and its surrounding neighborhood.

Commercial Market Assessment

1. Identified the competitive market area for commercial development.
2. Updated retail market trends in the competitive market area in terms of:
    - Demographic trends
    - Market demand
    - Historical and projected occupancy rates
    - Tenant profile
    - Minimum and percentage rents
    - Lease characteristics.
3. Identified planned and proposed developments in the competitive market area.
4. Projected the demand for commercial retail and ancillary office space in terms of:
    - Annual additional space requirements
    - Tenant profile
    - Minimum and percentage rents
    - Lease characteristics.

Projected Market Support

1. Evaluated Kulamalu's competitive advantages and disadvantages for commercial development.

2. Projected the market support for the commercial retail and ancillary office development at Kulamalu in terms of:

   - Target markets
   - Market share
   - Physical characteristics
   - Tenant profile
   - Rents and other lease characteristics
   - Projected occupancy rates.

REPORT FORMAT

This report is presented in a summary appraisal report that is intended to comply with the reporting requirements set forth under Standards Rule 2-2(b) of the Uniform Standards of Professional Appraisal Practice for a Summary Appraisal Report.

The report summarizes the data, reasoning and analyses that were used in the appraisal process to develop the projected market support. Supporting documentation concerning the data, reasoning and analyses is available in our files. The summary appraisal report format is specific to the needs of the client and for the intended use stated in this report.

STUDY CONDITIONS

This report is subject to the study conditions that are presented in Section I of this report.

PROJECTED MARKET SUPPORT

The evaluation of the competitive advantages and disadvantages of the Kulamalu commercial site and the estimated market support are discussed under the following subheadings.

Competitive Advantages

The Kulamalu commercial site has competitive advantages for commercial retail development, including:

- Large land area
- Extensive frontage along Kula Highway for advertising prominence
- Generally level topography
- Within residential growth area of Pukalani
- Currently no new competing large retail and ancillary office facilities planned.

Competitive Disadvantages

The Kulamalu commercial site has competitive disadvantages, including:

- No direct access from Kula Highway
- Close proximity to major retailing areas of Kahului and Wailuku
- Traffic passing by would largely be limited to residents of Kula, Pulehu, Waiakoa and Keokea or visitors to the Upcountry area.[1]

Estimated Market Share

Upcountry Maui is under-serviced in terms of neighborhood shopping facilities. Because of the limited retail facilities in the Upcountry area, goods and services for day-to-day living needs that normally would be purchased in the area, are largely purchased in Kahului.

Kahului has historically been the major retail hub serving the residential communities of Central and Upcountry Maui. Kahului offers a wide array of retail facilities for residents in relatively close proximity of each other.

---

[1] This condition may ultimately be mitigated with the completion of the County's proposed bypass linking Kihei to Kula. However, the development timetable has not been determined.

Major retail outlets in Kahului that could be most competitive to a neighborhood shopping facility in Upcountry Maui include:

- K-Mart and Costco
- Maui Mall (Star Market)
- Foodland, Safeway and Longs
- Kahului Shopping Center.

The *recent introduction* of K-Mart and Costco have provided Maui consumers a variety of products at extremely competitive prices. This has afforded residents significant savings and has reduced the profit margins for other retailers in Kahului. The proposed Maui Marketplace, an outlet mall to feature Eagle Hardware, Sports Authority, Border Books & Music, and Office Max, will continue to place pressures on retailers to lower margins or find newer market niches.

The Kulamalu commercial site is a major component of the proposed 300-acre master-planned community. The 20-acre site accounts for 77% of the undeveloped commercial land in Upcountry Maui. Alternative commercial sites suitable for large scale retail development are not available in the area. As a result, retail development at Kulamalu could have a significant competitive advantage to capture a significant share of the projected retail demand. The demand for retail facilities in Upcountry Maui would continue to exceed the available supply, even after the completion of the retail development at Kulamalu.

Kulamalu could benefit from the additional market support from visitors in the region. This segment could account for up to about 10% of the total demand at Kulamalu.

Groceries

Residents of Upcountry Maui are virtually limited to Foodland and Pukalani Superette for grocery items. Therefore, additional grocery stores in Upcountry Maui could capture a significant share of resident grocery expenditures. Considering its competitive position, the projected grocery expenditures could support a grocery store of about 45,000sf to 55,000sf at the Kulamalu commercial site.

Other Retail Goods

Between 45% and 60% of demand for all other retail goods is currently satisfied by existing retail facilities in Upcountry Maui. Based on its competitive advantages, the Kulamalu commercial site could capture about 25% of total demand for other retail goods. Based on the estimated market share, the Kulamalu commercial site could capture about 75,000sf to 95,000sf in 1995. The Kulamalu commercial site could capture an additional 15,000sf to 20,000sf every five years thereafter, as shown in Exhibit II-P.

Target Markets

The target market is projected to be the residents of Upcountry Maui, primarily dual income families with children. The 1995 median household income of the area is estimated to be about $46,900, about 4% to 5% above the 1995 median household income of Maui County.

The residents of Upcountry Maui have discretionary purchasing power and are quality and cost conscious. A large number of the residents are estimated to have limited time available for shopping and are likely to make planned rather than spontaneous shopping trips. Therefore, residents would likely shop at one retail facility if it offered a variety of retail goods as well as services, including medical and professional services.

Visitors to the area would be a secondary target market for the site. After the planned park and amphitheatre are developed, the market share for the visitor market could increase.

Tenant Profile

Based on the characteristics of the target markets and retail trends in the area, the shopping facility could be anchored by a full-service supermarket and drug/variety store. Other tenants could include:

- Entertainment, such as video, records or electronic/computer games
- Theatres
- Restaurants, including fast food
- Medical and dental offices
- Other personal services, such as hair styling or dry cleaning.

In addition, the center could probably support a gas station to service both residents and visitors.

Space requirements for the major tenants of the center are estimated as follows:

Type	Area (ft²)	% of Total
Grocery	45, 000 - 55,000	25 - 30
Drug/variety	20,000 - 30,000	15 - 20
Theatres	15,000 - 20,000	8 - 10
Entertainment	5,000 - 8,000	3 - 4
Gas station	12,000 - 15,000	[1]

[1] Land area required.

In addition to retail space, the Kulamalu commercial site could support medical/dental and other office uses. A large health care provider, such as Kaiser Permanente or Straub Clinic, could have a local clinic in the facility as they have in other retail facilities on Oahu.

Rents and Lease Characteristics

Rents in Upcountry Maui generally range between about $1.55/ϕ and $2.00/ϕ for ground floor spaces that typically range from 500ϕ to 2,000ϕ in size. Second floor rents typically range from about $1.25/ϕ to $1.45/ϕ for similar size spaces. Common area maintenance charges typically range from about $0.30/ϕ to $0.45/ϕ. Percentage rents on retail space range from about 8% to 9%, although currently, many centers do not charge percentage rents.

Lease terms typically range from three to five years for smaller tenants. Lease terms for grocery stores, other anchor tenants and large restaurants could range from about 15 to 30 years.

Projected Occupancy Rates

The anchor tenants could occupy about 50% to 65% of the facility's gross leasable area; therefore, occupancy rates could be relatively high. Assuming prudent marketing and preleasing, the facility could be about 75% preleased at opening. Based on the estimated additional space requirements the retail facility the Kulamalu commercial site could be fully leased by 2000.

* * * * *

We appreciate having the opportunity to assist you on this interesting assignment. Please contact us if you have any questions.

Sincerely,

JOHN CHILD & COMPANY, INC.

Paul D. Cool

Paul D. Cool, MAI
Vice President

Cynthia C. Nakamura

Cynthia C. Nakamura
Appraiser

KULAMALU COMMERCIAL MARKET STUDY

Exhibit II-L

Projected Total Retail Expenditures in Upcountry Maui
1995 - 2010

	1995	2000	2005	2010
Residents:				
Groceries	$97,600,000	$117,800,000	$137,400,000	$157,300,000
Other retail	89,500,000	108,000,000	126,000,000	144,200,000
Subtotal - residents	187,100,000	225,800,000	263,400,000	301,500,000
Visitors:				
Groceries	3,200,000	3,900,000	4,500,000	5,100,000
Other retail	24,200,000	30,100,000	34,800,000	39,000,000
Subtotal - visitors	27,400,000	34,000,000	39,300,000	44,100,000
Total:				
Groceries	100,800,000	121,700,000	142,000,000	162,400,000
Other retail	113,700,000	138,200,000	160,800,000	183,300,000
Total retail expenditures	$214,500,000	$259,900,000	$302,800,000	$345,700,000

Source: John Child & Company.

Retail Land Use Inventory in Upcountry Maui

Land use	Building area (sf)	% of Total
Shopping center	47,149	18%
Grocery stores	44,323	17
General retail	89,736	35
Restaurants, including fast food	35,052	14
Auto service, including gas stations	6,631	3
Office, including banks	36,269	14
Total	259,160	100%

Source: John Child & Company based on online data from REsearch/TMK, MLS Hawaii, Inc. March 13, 1996.

Projected Demand Satisfied and Unsatisfied by Retail Facilities in Upcountry Maui
1995 - 2010

	Total	Satisfied Demand Low		Satisfied Demand High	Unsatisfied Demand Low		Unsatisfied Demand High
Grocery:							
1995	$100,800,000	$15,000,000	-	$20,000,000	$80,800,000	-	$85,800,000
2000	121,700,000	15,000,000	-	20,000,000	101,700,000	-	106,700,000
2005	142,000,000	15,000,000	-	20,000,000	122,000,000	-	127,000,000
2010	162,400,000	15,000,000	-	20,000,000	142,400,000	-	147,400,000
All other retail:							
1995	113,700,000	51,000,000	-	69,000,000	44,700,000	-	62,700,000
2000	138,200,000	51,000,000	-	69,000,000	69,200,000	-	87,200,000
2005	160,800,000	51,000,000	-	69,000,000	91,800,000	-	109,800,000
2010	183,300,000	51,000,000	-	69,000,000	114,300,000	-	132,300,000
Total:							
1995	214,500,000	66,000,000	-	89,000,000	125,500,000	-	148,500,000
2000	259,900,000	66,000,000	-	89,000,000	170,900,000	-	193,900,000
2005	302,800,000	66,000,000	-	89,000,000	213,800,000	-	236,800,000
2010	345,700,000	66,000,000	-	89,000,000	256,700,000	-	279,700,000

Source: John Child & Company.

Projected Additional Retail Space Requirements in Upcountry Maui
1995 - 2010
(In Square Feet)

Time Period	Grocery Low		Grocery High	All Other Retail Low		All Other Retail High	Total Low		Total High
1995	224,000	-	288,000	284,000	-	379,000	508,000	-	667,000
1995 - 2000	47,000	-	60,000	61,000	-	82,000	108,000	-	142,000
2000 - 2005	45,000	-	58,000	57,000	-	75,000	102,000	-	133,000
2005 - 2010	45,000	-	58,000	56,000	-	75,000	101,000	-	133,000
Cumulative:									
1995	224,000	-	288,000	284,000	-	379,000	508,000	-	667,000
2000	271,000	-	348,000	345,000	-	461,000	616,000	-	809,000
2005	316,000	-	406,000	402,000	-	536,000	718,000	-	942,000
2010	361,000	-	464,000	458,000	-	611,000	819,000	-	1,075,000

Source: John Child & Company.

Appendix D

Traffic Impact Study

KULAMALU TRAFFIC STUDY

Prepared For

KULAMALU LIMITED PARTNERSHIP

MARCH 1997

REVISED JULY 1997

Prepared By

ATA

Austin, Tsutsumi & Associates, Inc.
Civil Engineers • Surveyors
501 Sumner Street, Suite 521
Honolulu, Hawaii 96817-5031
Telephone: (808) 533-3646
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Honolulu • Wailuku • Hilo, Hawaii

KULAMALU TRAFFIC STUDY

Prepared For

KULAMALU LIMITED PARTNERSHIP

MARCH 1997

REVISED JULY 1997

Prepared By

Austin, Tsutsumi & Associates, Inc.
Civil Engineers • Surveyors
501 Sumner Street, Suite 521
Honolulu, Hawaii 96817-5031

PREFACE

This traffic study for the Kulamalu development was originally initiated in Year 1996 and has been revised as the project land uses have evolved, as part of the normal development process. The Final Report was completed in March 1997; however, the Kulamalu land uses continue to be refined. The most recent modification includes a reduction of the expected student enrollment of the private school from 500 to 200 students for kindergarten to the eighth grade. In addition, as much as 75% of the students will be bused to the school from various parts of the island. These changes would decrease the project-generated traffic volumes and lessen the traffic impact of the project on the external roadway system. Thus, despite the recent project land use modification, the study findings and recommendations are conservative and remain relevant.

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

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(Continued)

AUSTIN, TSUTSUMI & ASSOCIATES, INC. CIVIL ENGINEERS • SURVEYORS
CONTINUING THE ENGINEERING PRACTICE FOUNDED BY H. A. R. AUSTIN IN 1934

TED S. KAWAHIGASHI, P.E.
KENNETH K. KUROKAWA, P.E.
IVAN K. NAKATSUKA, P.E.
LAMBERT J. YAMASHITA, P.E.
HOWARD H W MAU, P.E.

KULAMALU TRAFFIC STUDY

I. INTRODUCTION

This report documents the findings of the traffic study conducted by Austin, Tsutsumi & Associates, Inc. to evaluate the potential traffic impacts of the development of the Kulamalu Conceptual Planning Area, in Pukalani, Maui. Rezoning for the Kulamalu Project, a 53.67-acre portion of the Conceptual Planning Area along Kula Highway, is being requested by Kulamalu Limited Partnership for the development of commercial uses, elderly dwelling units, a park, amphitheater, and public/quasi-public uses. The Kulamalu Project is adjacent to a larger 251.04-acre area; the total 304.71 acres is herein designated as the Kulamalu Conceptual Planning Area. Additional uses in the 251.04-acre area include single-family residential units and a private school which are currently permissible under the existing zoning of this property. Although the extent and timing of the 251.04-acre area is uncertain and predicated by market conditions, this report addresses the traffic impacts of the requested rezoning area of 53.67 acres for the Kulamalu Project as a part of the Kulamalu Conceptual Planning Area.

A. Project Description

Kulamalu Limited Partnership proposes to develop the Kulamalu Project, which will include approximately 65 elderly dwelling units, a 140,000 square foot shopping center, a public park site of 14.74 acres and a separate area of 5.03 acres for halau use. The project also contains a public/quasi-public area of 5.10 acres. Possible uses for this public/quasi-public area include a church, day care center, and/or other public uses. The Kulamalu Project area would need to be rezoned to implement these proposed land uses.

REPLY TO:
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OFFICES IN:
HONOLULU, HAWAII
WAILUKU, MAUI, HAWAII • HILO, HAWAII

The adjacent 251.04-acre area could include as much as 324 single-family dwelling units, 65 multi-family dwelling units, and a private school for about 500 students. The single-family residential uses and the private school are allowable under the existing zoning. Although actual buildout schedule is dependent on market conditions, for this study, the entire Kulamalu development is assumed to be completed by the Year 2010.

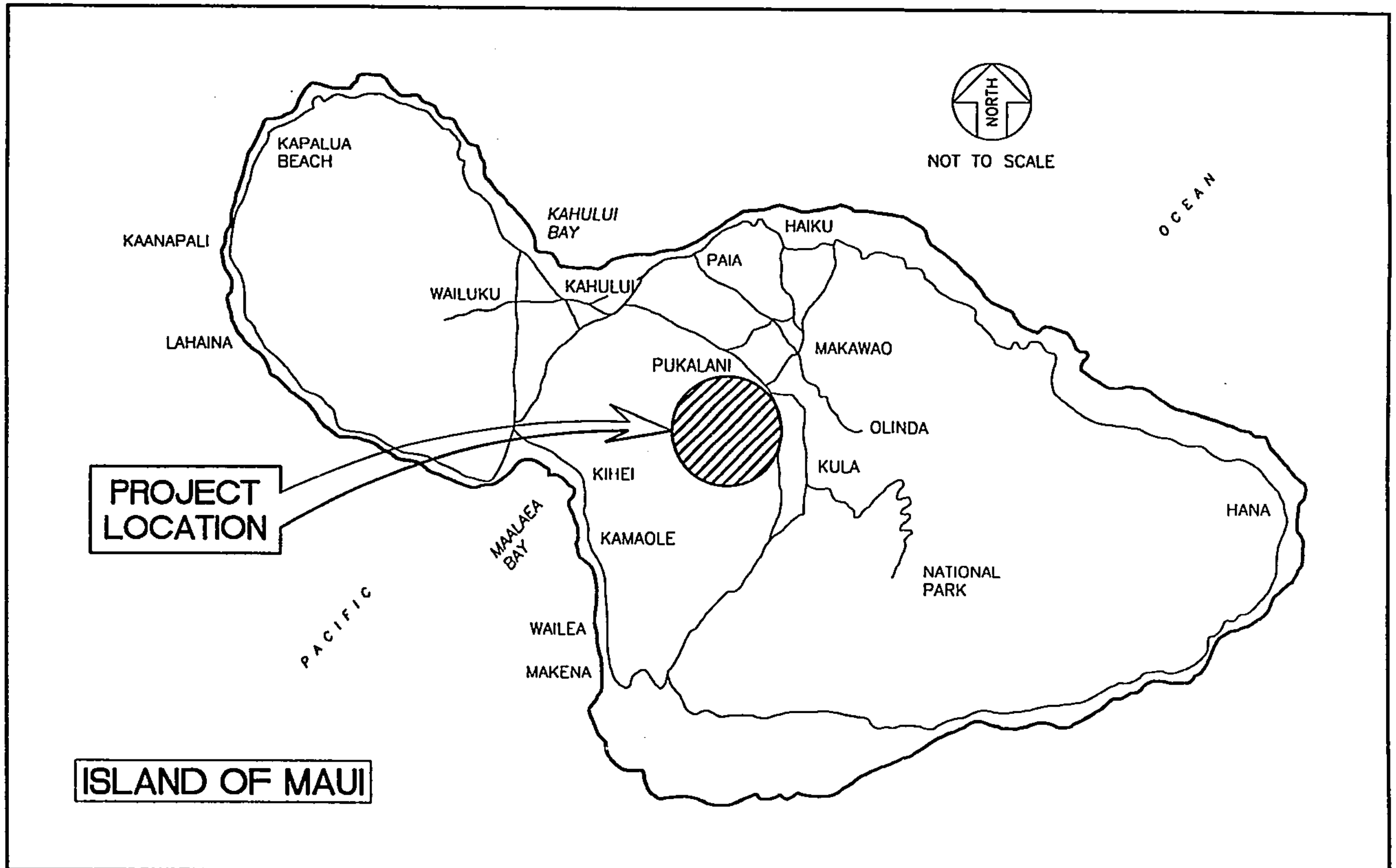
The general location of the Kulamalu development is shown in Figure 1. The development is situated south of Pukalani town and west of Kula Highway, as depicted by the vicinity map in Figure 2. A preliminary layout of the project land uses in relation to the boundary of the conceptual planning area is provided in Figure 3. The Kulamanu project site is specifically identified as TMK: 2-3-8 portions of 5, 38 and 39.

The Kulamalu development will access the existing roadway system at two locations. The primary access for the project will be located at a new intersection on Kula Highway, which will be located approximately 1,100 feet north of the Ohana Street intersection. The project road will also connect to the intersection of Liholani Street and Aina Lani Drive; project traffic utilizing this access would travel onto Pukalani Street to reach Haleakala Highway.

B. Study Methodology

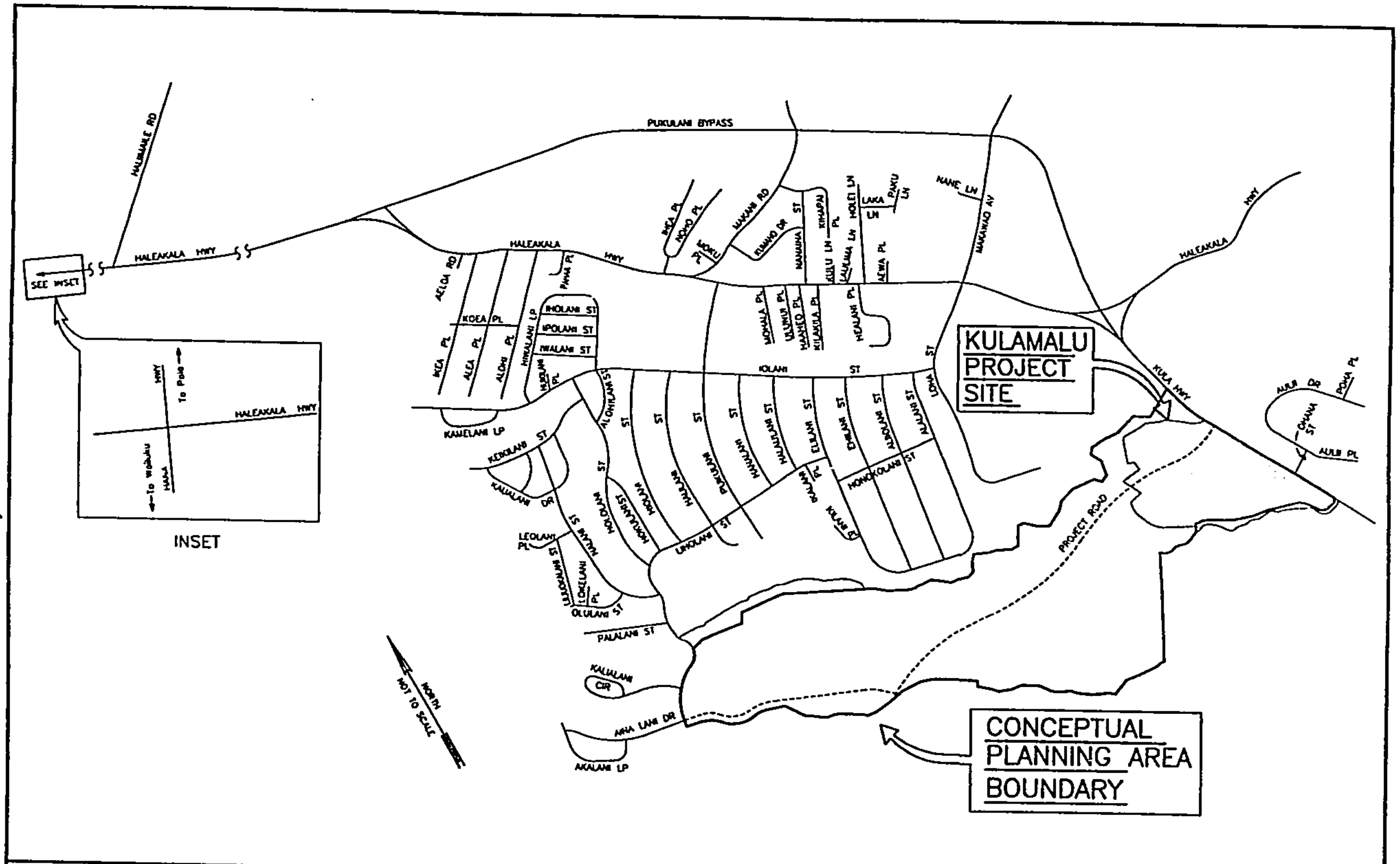
The purpose of the study is to analyze the potential conceptual planning area traffic impacts on the roadway system within the study area. Proposed roadway improvements, which are required to allow the street system to accommodate the regional growth in future traffic volumes without, as well as with the development of the conceptual planning area, are identified in this study, as needed.

Traffic volume counts and observations were taken at the key intersections to identify existing traffic conditions. Nine existing intersections and one future intersection along the major roadways in the study area, which are listed below, were analyzed during the morning and afternoon peak hours of traffic.



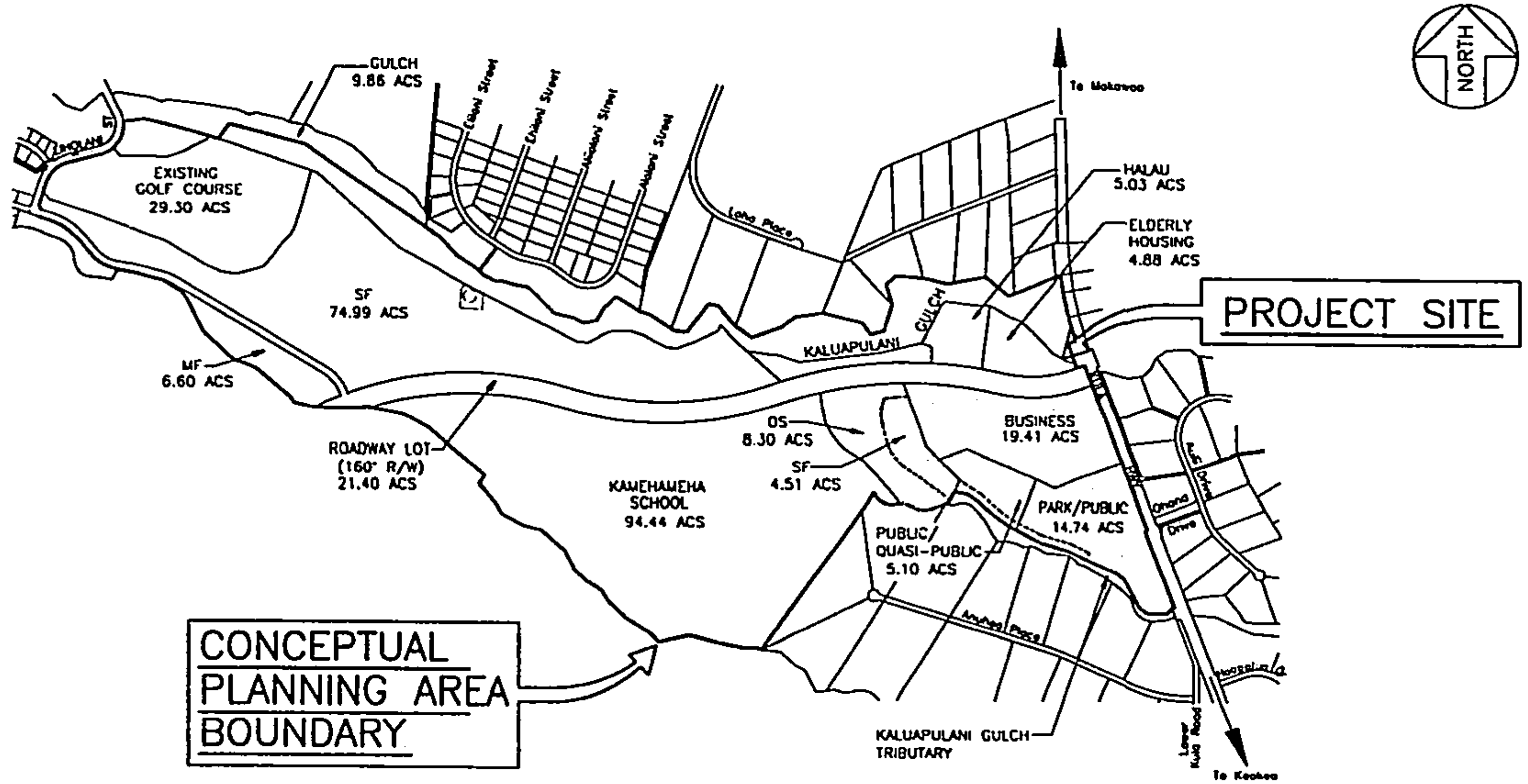
KULAMALU LIMITED PARTNERSHIP **KULAMALU PROJECT**	ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS,SURVEYORS • HONOLULU,HAWAII PROJECT LOCATION	FIGURE 1

FILE NAME: Z:\USERS\EVERYONE\KULAMALU\FIG-1.DWG



KULAMALU LIMITED PARTNERSHIP **KULAMALU PROJECT**	ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII VICINITY MAP	FIGURE 2

FILE NAME: Z:\USERS\EVERYONE\KULAMALU\FIG-2.DWG
DATE: 3-27-97



NOTE:
ACREAGE OF INDIVIDUAL LAND USES ARE SUBJECT TO CHANGE

KULAMALU CONCEPTUAL PLANNING AREA

SCALE: 1" = 1400'-0"

KULAMALU LIMITED PARTNERSHIP KULAMALU PROJECT	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS, SURVEYORS • HONOLULU, HAWAII SITE MAP	FIGURE 3

FILE NAME: Z:\USERS\EVERYONE\KULAMALU\FIG-3.DWG
DATE: 3-27-97

1. Hana Highway and Haleakala Highway
2. Haleakala Highway and Pukalani Bypass Road (West Terminus)
3. Pukalani Bypass Road and Makani Road
4. Pukalani Bypass Road and Makawao Avenue
5. Haleakala Highway, Pukalani Bypass Road and Kula Highway (Five Trees)
6. Haleakala Highway and Pukalani Street
7. Haleakala Highway, Makawao Avenue and Loha Street
8. Pukalani Street and Iolani Street
9. Kula Highway and Project Road (Future Intersection)
10. Kula Highway and Ohana Street

In order to assess the traffic impacts of the Kulamalu Conceptual Planning Area in context with other growth expected to occur in the region, two future year traffic assignments were developed for Year 2010 when the conceptual planning area is anticipated to be completed. First, the future base conditions were established by estimating future traffic volumes without the Kulamalu-generated traffic. For the second future traffic assignment, the forecasted traffic volumes generated by the Kulamalu Conceptual Planning area were added to future base traffic volumes. Traffic impacts are identified through the comparison of the analyzed results of these two future Year 2010 traffic assignments.

II. EXISTING CONDITIONS

A field investigation was undertaken to develop a description of existing conditions and infrastructure at the study intersections. Information relevant to the study includes land use, an inventory of streets, traffic volumes, and the current operating conditions of traffic on the roadway system.

A. Existing Roadway System

This section describes the existing circulation system serving the area, including number of travel lanes, street classifications, and traffic control devices. Brief descriptions of the roadway facilities addressed in this study are described below.

- Hana Highway: Hana Highway is a major State highway which links Kahului and Hana. Hana Highway is a four-lane, divided highway with channelization at major intersections between Kahului and the Haleakala Highway intersection. North of the Haleakala Highway intersection, Hana Highway serves as a two-lane highway to Hana.

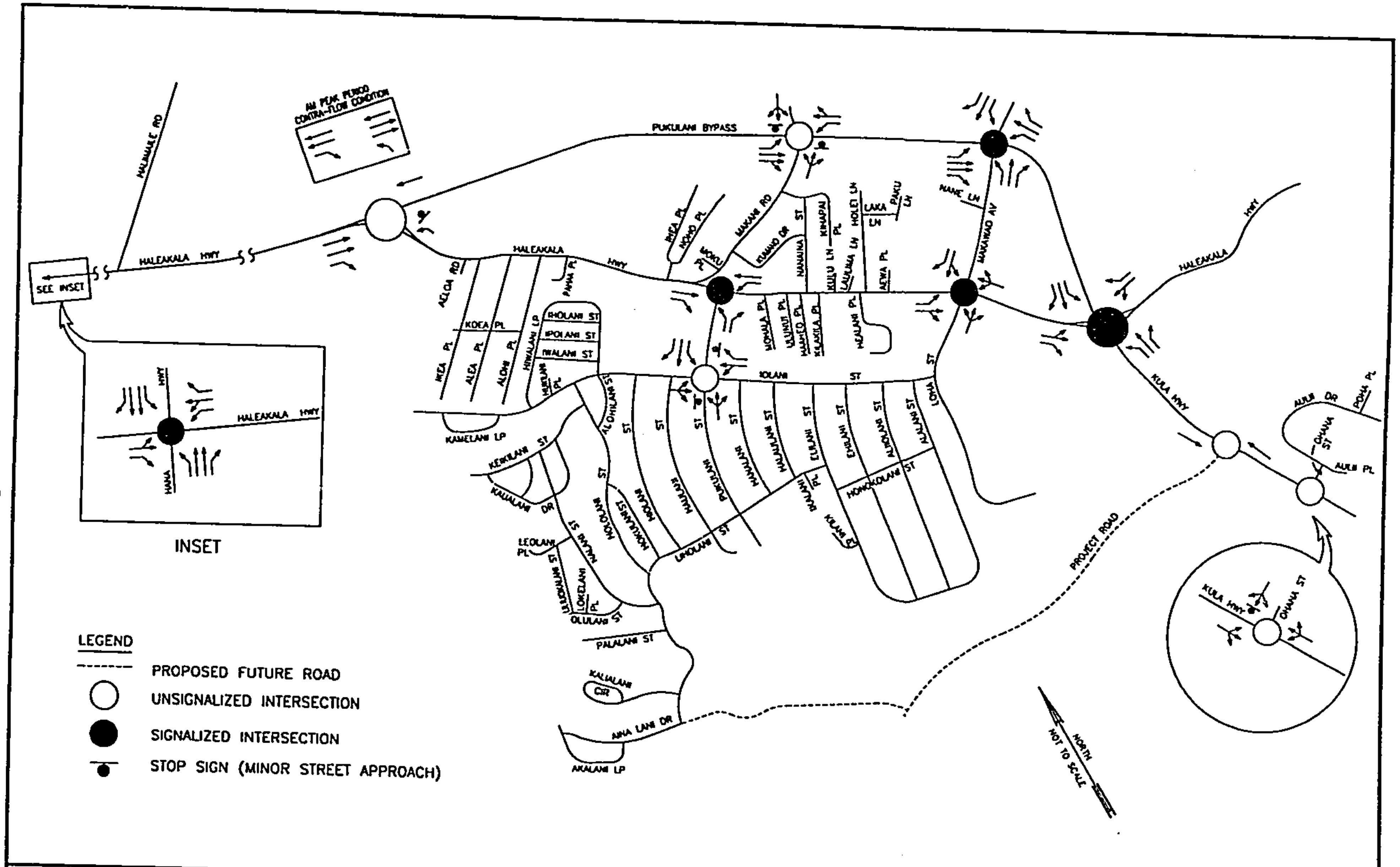
- Haleakala Highway: Haleakala Highway is a major arterial between Hana Highway and the Haleakala National Park and passes through the town of Pukalani. The section of Haleakala Highway between Hana Highway and the Pukalani Bypass Road is striped for two lanes in the east-bound (mauka) direction and one lane in the west-bound (makai) direction. During the morning peak period of traffic, Haleakala Highway is coned to provide a contra-flow lane from Pukalani Bypass Road to Hana Highway with two lanes in the west-bound direction and one lane in the east-bound direction. East of the Pukalani Bypass Road, Haleakala Highway continues as a two-lane road through Pukalani Town to the Haleakala National Park.

- Pukalani Bypass Road: In the vicinity of Pukalani town, the Pukalani Bypass Road, a limited access roadway, serves as an alternative route to Haleakala Highway with its western terminus at the intersection with Haleakala Highway and the eastern terminus at the intersection of Kula Highway and Haleakala Highway (Five Trees). The Pukalani Bypass Road is a three-lane highway, between the Haleakala Highway intersection (west terminus) and Makawao Avenue, providing two lanes in the east-bound direction and one lane in the west-bound direction. South of Makawao

Avenue, the Pukalani Bypass Road reduces to a two-lane highway with one travel lane in each direction.

- Makawao Avenue: Within the study area, Makawao Avenue is a two-lane County collector road serving Pukalani town and Makawao town. Makawao Avenue originates within Pukalani, at its intersection with Haleakala Highway, and extends northeasterly through Makawao town. At the intersection with Baldwin Avenue, Makawao Avenue continues as Kaupakulua Road and eventually connects with Hana Highway in the vicinity of Ulumalu. Baldwin Avenue extends in a northwesterly direction and connects with Hana Highway in Paia town.
- Kula Highway: Kula Highway is a two-lane arterial highway serving the Upcountry area from its intersection with Haleakala Highway and the Pukalani Bypass Road (Five-Trees) to the Kula area. Kula Highway is a north-south arterial serving mainly residential/agricultural uses.
- Pukalani Street: Pukalani Street is a local two-lane collector roadway serving residential and commercial areas in Pukalani town and connects to Haleakala Highway in a T-intersection.
- Iolani Street: Iolani Street serves as a two-lane collector roadway within the residential area of Pukalani town.
- Ohana Street: Ohana Street, a two-lane roadway, provides access to a local residential area and connects to Kula Highway. An existing gated private driveway to the Kulamalu site is situated directly across the Ohana Street intersection on Kula Highway.

The existing laneage configurations at the study intersections are illustrated in Figure 4. The types of traffic controls at each study intersection, including signalization or stop-controlled approaches at unsignalized intersections, are also identified in Figure 4.



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STUDY INTERSECTION CONFIGURATIONS

FIGURE
4

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B. Existing Traffic Operations

The following sections present the existing intersection peak hour traffic volumes and a description of the methodology utilized to analyze the intersection operating conditions at each of the nine existing key intersections.

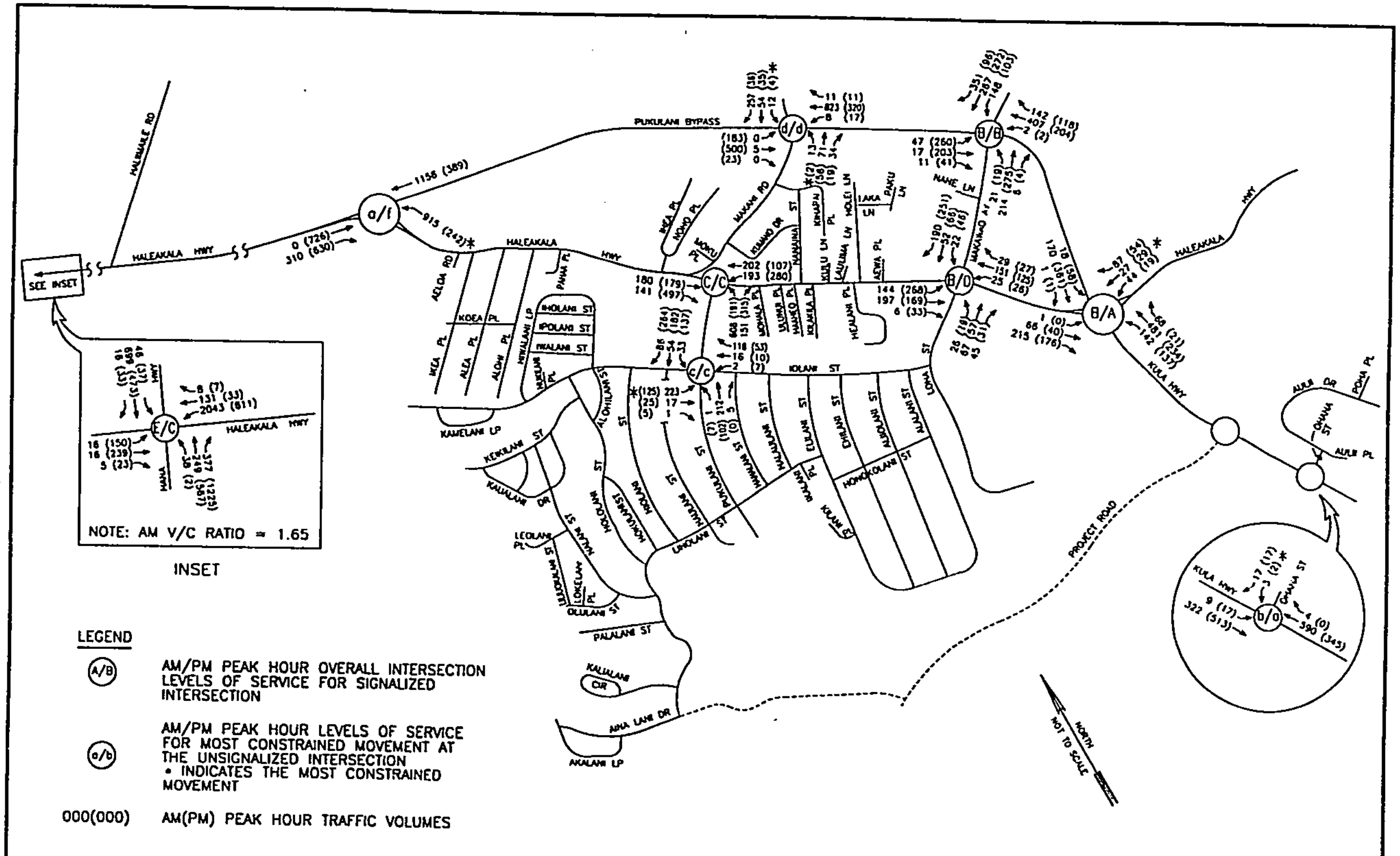
1. Existing Traffic Volumes

Manual turning movement counts at the key intersections were conducted by ATA during weekday morning (AM) and afternoon (PM) peak periods on February 7, 8 and 29, 1996, except for the traffic counts at the Pukalani Bypass Road/Makani Road intersection and at the Pukalani Street/Iolani Street intersection, which were collected on July 1, 1996. For the Makani Road intersection, the counted through traffic volumes on Pukalani Bypass Road were increased to correlate to the higher February 1996 peak hour traffic counts. The count data are provided in Appendix A and the peak hour volumes are presented in Figure 5.

Generally, the traffic flows are heavy on Haleakala Highway and the Pukalani Bypass Road with noticeable delays at intersections. At the signalized intersection of Hana Highway and Haleakala Highway, extensive queuing during the morning peak period was observed for the makai-bound double left-turn movement. During the afternoon peak period, queuing was also observed for the Hana-bound right-turn movement from Hana Highway to Haleakala Highway.

Traffic on Kula Highway is relatively light, with little delays at the intersections.

The three-lane section of Haleakala Highway between the Hana Highway intersection and the Pukalani Bypass Road intersection, as well as the Pukalani Bypass Road, are striped to provide two mauka-bound



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YEAR 1996 EXISTING TRAFFIC CONDITIONS

FIGURE 5

FILE NAME: Z:\USERS\EVERYONE\KULAMALU\FIG-5.DWG

and one makai-bound travel lanes. During the morning peak period, the center mauka-bound lane is coned to provide a contraflow lane in the makai-bound direction. At the intersection of Haleakala Highway and Pukalani Bypass Road, the mauka-bound through movement is diverted to Haleakala Highway into Pukalani town. This mauka-bound diversion eliminates the conflicting movements and traffic flows smoothly through this unsignalized intersection during the morning peak period. However, during the afternoon peak period, the makai-bound left-turn movement on Haleakala Highway at the Pukalani Bypass Road intersection experiences delays due to the heavy traffic on mauka-bound Pukalani Bypass Road.

2. Technical Analysis

The technical analysis of traffic conditions is described in this section for signalized and unsignalized intersections. Level of service (LOS) is a qualitative measure used to describe the condition of traffic flow, ranging from free-flow conditions at LOS A to congested conditions at LOS F.

The 1994 Highway Capacity Manual, Special Report 209, Operational Method for signalized intersections was applied to each of the signalized intersections analyzed in this study; this method provides results in terms of stopped delay per vehicle, LOS and the volume-to-capacity (v/c) ratio. The stopped delay per vehicle and LOS reflect the delay and discomfort to motorists. The capacity of a signalized intersection is calculated, based upon laneage configuration and the traffic signal operations (in terms of phasing and timing) of the intersection. The v/c ratio quantifies the utilization of capacity; a v/c ratio greater than 1.00 indicates that traffic volumes exceed the calculated capacity of the signalized intersection.

Unsignalized intersections are controlled by stop signs or yield signs on minor street approach(es). The "Two-Way Stop Control" method described in the 1994 Highway Capacity Manual (Transportation Research Board, 1994) was employed to determine the available reserve capacity and corresponding level of service for each of the constrained movements (approaches from minor streets and left-turn movements from major streets) at the unsignalized intersections.

Level of service definitions for both signalized and unsignalized intersections are included in Table 1 and Table 2, respectively.

3. **Analysis Results**

This section describes the current levels of service at the nine existing intersections. Four of the study intersections are signalized, including the intersections of Hana Highway with Haleakala Highway, Pukalani Bypass Road with Makawao Avenue, Haleakala Highway with Pukalani Bypass Road/Kula Highway, Haleakala Highway with Pukalani Street and Haleakala Highway with Makawao Avenue/Loha Street. The remaining intersections are unsignalized with stop controls on the minor approaches. Figure 5 and Table 3 present the existing level of service at each of the nine existing key intersections.

- Hana Highway and Haleakala Highway - During the morning peak hour, this intersection operates at overall Level of Service E with the westbound (makai-bound) approach at Level of Service F. The field observation noted that the queue on the makai-bound Haleakala Highway approach extends about one mile from the intersection in the morning peak period. The overall intersection v/c ratio is at 1.65 and 0.64 during the morning and afternoon peak hours, respectively.

- Haleakala Highway and Pukalani Bypass Road (West Terminus) - The coning for the contraflow lane eliminates conflicting movements at this intersection with a Level of Service A designation during the morning peak hour. However, during the afternoon peak hour, the left-turn movement from the makai-bound Haleakala Highway experiences long delays at Level of Service F and the overall intersection operation is at Level of Service C.

TABLE 1
LEVEL OF SERVICE DEFINITIONS FOR SIGNALIZED INTERSECTION

LEVEL OF SERVICE	DELAY (SECONDS/VEHICLE)	DESCRIPTION
A	0.0 - 5.0	Little or no delay
B	5.1 - 15.0	Short traffic delay
C	15.1 - 25.0	Moderate traffic delay
D	25.1 - 40.0	Long traffic delay
E	40.1 - 60.0	Very long traffic delay
F	> 60.0	Failure - extreme congestion

SOURCE: "Highway Capacity Manual", Transportation Research Board, 1994.

TABLE 2
LEVEL OF SERVICE DEFINITIONS FOR UNSIGNALIZED INTERSECTION

LEVEL OF SERVICE	DELAY (SECONDS/VEHICLE)	DESCRIPTION
A	0.0 - 5.0	Little or no delay
B	5.1 - 10.0	Short traffic delay
C	10.1 - 20.0	Moderate traffic delay
D	20.1 - 30.0	Long traffic delay
E	30.1 - 45.0	Very long traffic delay
F	> 45.0	Failure - extreme congestion

SOURCE: "Highway Capacity Manual", Transportation Research Board, 1994.

Table 3
EXISTING YEAR 1996 TRAFFIC CONDITIONS

Intersection	Type of Intersection	AM Peak Hour v/c Ratio	AM Peak Hour Delay (Seconds)	AM Peak Hour Level of Service	PM Peak Hour v/c Ratio	PM Peak Hour Delay (Seconds)	PM Peak Hour Level of Service
1. Hana Highway and Haleakala Highway	Signalized						
Northbound Approach		--	16.1	C	--	17.4	C
Southbound Approach		--	29.4	D	--	21.2	C
Eastbound Approach		--	17.4	C	--	19.4	C
Westbound Approach		--	66.0	F	--	45.4	E
Overall Intersection		1.65	52.5	E	0.64	24.3	C
2. Pukalani Bypass Road (West Terminus) and Haleakala Highway	Unsignalized						
Northbound Left Turn		--	*	A	--	130.5	F
Overall Intersection		--	*	A	--	17.3	C
3. Pukalani Bypass Road and Makani Road	Unsignalized						
Northbound Approach		--	18.0	C	--	21.5	D
Southbound Approach		--	28.4	D	--	15.5	C
Eastbound Approach		--	0.0	A	--	1.3	A
Westbound Approach		--	0.0	A	--	0.2	A
Overall Intersection		--	9.7	B	--	3.5	A
4. Pukalani Bypass and Makawao Avenue	Signalized						
Northbound Approach		--	7.7	B	--	10.6	B
Southbound Approach		--	9.0	B	--	11.4	B
Eastbound Approach		--	13.2	B	--	17.4	C
Westbound Approach		--	9.3	B	--	9.8	B
Overall Intersection		0.44	9.1	B	0.43	13.0	B
5. Pukalani Bypass (East Terminus), Haleakala Highway and Kula Highway ("Five Trees" Intersection)	Signalized						
Northbound Approach		--	2.8	A	--	2.7	A
Southbound Approach		--	1.6	A	--	2.0	A
Eastbound Approach		--	13.6	B	--	12.4	B
Westbound Approach		--	13.0	B	--	12.1	B
Overall Intersection		0.40	5.5	B	0.33	4.2	A

* Note: Contraflow coning during AM peak period eliminates conflicting movements at this intersection.

Table 3
EXISTING YEAR 1996 TRAFFIC CONDITIONS
(continued)

Intersection	Type of Intersection	AM Peak Hour v/c Ratio	AM Peak Hour Delay (Seconds)	AM Peak Hour Level of Service	PM Peak Hour v/c Ratio	PM Peak Hour Delay (Seconds)	PM Peak Hour Level of Service
6. Haleakala Highway and Pukalani Street	Signalized						
Northbound Approach		--	26.0	D	--	5.8	B
Eastbound Approach		--	10.7	B	--	30.1	D
Westbound Approach		--	6.7	B	--	7.8	B
Overall Intersection		0.65	17.3	C	0.55	17.0	C
7. Haleakala Highway, Makawao Avenue and Loha Street	Signalized						
Northbound Approach		--	6.7	B	--	6.0	B
Southbound Approach		--	6.4	B	--	5.9	B
Eastbound Approach		--	15.0	C	--	51.6	E
Westbound Approach		--	5.0	A	--	6.2	B
Overall Intersection		0.36	9.6	B	0.58	29.1	D
8. Pukalani Street and Iolani Street	Unsignalized						
Northbound Approach		--	0.0	A	--	0.3	A
Southbound Approach		--	0.6	A	--	0.7	A
Eastbound Approach		--	12.1	C	--	10.4	C
Westbound Approach		--	4.0	A	--	4.0	A
Overall Intersection		--	5.1	B	--	2.7	A
9. Kula Highway and Project Road	Not Applicable	--	--	--	--	--	--
10. Kula Highway and Ohana Street	Unsignalized						
Northbound Approach		--	0.0	A	--	0.0	A
Southbound Approach		--	0.1	A	--	0.1	A
Westbound Approach		--	6.4	B	--	4.8	A
Overall Intersection		--	0.2	A	--	0.2	A

- Pukalani Bypass Road and Makani Road - During the morning peak hour, traffic on the southbound approach operates at Level of Service D; and, overall, the unsignalized intersection operates at Level of Service B in the morning peak hour. During the afternoon peak hour, the northbound approach left turn is at Level of Service D with overall intersection operations at Level of Service A.

- Pukalani Bypass Road and Makawao Avenue - Overall, this signalized intersection operates at Level of Service B in the morning and afternoon peak hours of traffic.

- Pukalani Bypass Road (East Terminus), Haleakala Highway and Kula Highway (Five Trees intersection) - When the traffic counts were conducted, this intersection operated as an unsignalized intersection. Subsequently, traffic signals were installed and became operable in April 1996. Overall, this signalized intersection operates at Level of Service B during the morning peak hour and at Level of Service A during afternoon peak hour.

- Haleakala Highway and Pukalani Street - During the morning peak hour, the traffic exiting at Pukalani Street from the residential areas results in Level of Service D operation for the Pukalani Street approach, with an overall operational Level of Service C intersection. During the afternoon peak hour, Haleakala Highway eastbound (mauka-bound approach) operates at Level of Service D with the overall intersection operating at Level of Service C.

- Pukalani Street and Iolani Street - Overall, during the morning peak hour, this intersection experiences Level of Service B conditions and operates at Level of Service A during the afternoon peak hour.

- Haleakala Highway, Makawao Avenue and Loha Street - This signalized intersection operates at an overall Level of Service B during the morning peak hour. The Haleakala Highway eastbound (mauka-bound) approach is at Level of Service E in the afternoon peak hour with the overall intersection operating at Level of Service D.

- Kula Highway and Ohana Street - This intersection was analyzed as an unsignalized T-intersection. Overall, this intersection operates at Level of Service A in the morning and afternoon peak hours.

In summary, under existing traffic conditions, there are three study intersections where traffic operates with long delays (LOS E or LOS F conditions) or traffic volumes exceed the intersection capacity (v/c ratio > 1.00). At the Hana Highway/Haleakala Highway intersection, the traffic on the westbound approach experiences LOS F conditions during the morning peak hour and LOS E conditions during the afternoon peak hour; also, queuing is observed for the Hana-bound right-turn movement to Haleakala Highway, mauka-bound, during the afternoon peak hour. At the intersection of Pukalani Bypass Road/Haleakala Highway, traffic operations on the northbound approach are at LOS F during the afternoon peak hour. Also, the eastbound traffic at the Haleakala Highway/Makawao Avenue/Loha Street intersection operates at LOS E during the afternoon peak hour. Possible roadway improvements to improve traffic operation are discussed in Section III. D, Base Roadway Improvements.

III. FUTURE BASE PROJECTIONS AND ANALYSIS

In order to properly evaluate the potential impact of the project on the local traffic conditions, forecasts of future traffic volumes in the study area under conditions both with and without the traffic generated by the proposed Kulamalu conceptual planning area were developed. The methodologies and key assumptions used to develop these forecasts are described below.

The future base traffic forecasts for Year 2010 without the proposed conceptual planning area-generated traffic are based on the background traffic growth of existing traffic volumes and proposed related development projects expected to be completed by the Year 2010 which could contribute traffic to the roadway system within the study area.

A. Background Traffic Growth

The background growth rate, which was applied to existing traffic volumes to estimate Year 2010 future conditions, is based on the preliminary projections from the Maui Long-Range Land Transportation Plan by Kaku Associates (Draft Final Report, February 1996) and historical traffic counts obtained from the State Department of Transportation.

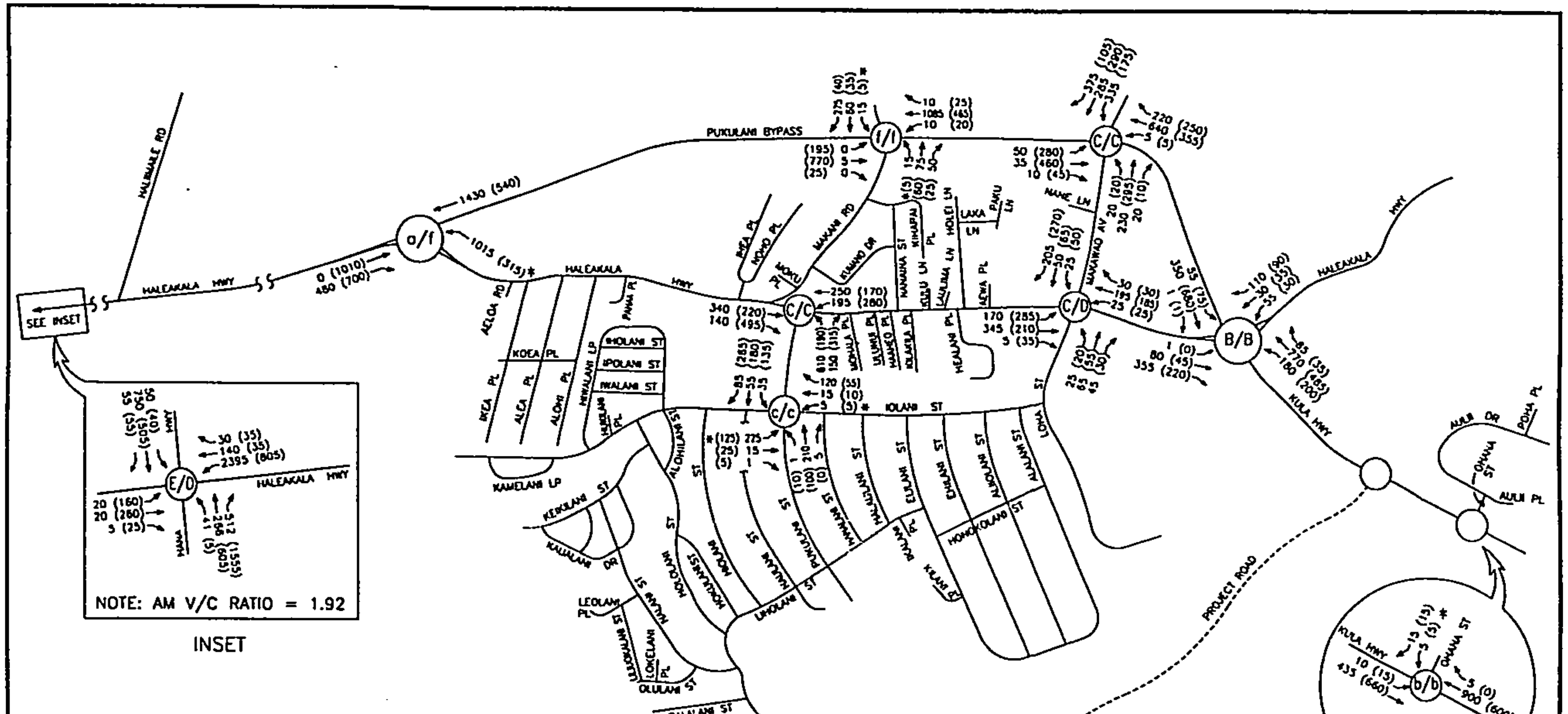
The average annual traffic growth rate of approximately 0.5 percent per year in the Upcountry area was utilized to forecast the Year 2010 future base traffic conditions.

B. Traffic from Nearby Development

Traffic generated by two nearby developments, the King Kekaulike (Upcountry) High School and the Department of Hawaiian Home Lands (DHHL) Kula Residence Lots, Unit 1 are included in this study. The trip generation and distribution of the high school traffic were obtained from the November 1992 "Final Report, Traffic Impact Study, Upcountry Maui High School," prepared by Parsons Brinckerhoff Quade & Douglas, Inc. For the DHHL project, the estimate of project traffic developed by ATA as identified in ATA's August 1995 "Traffic Impact Analysis Report, Kula Residence Lots, Unit 1," was utilized for this study.

C. Future Base Volumes and Level of Service Analysis

The future Year 2010 base traffic volumes for the nine existing study intersections are shown in Figure 6. For future conditions, the widening of Haleakala Highway to four lanes, between Hana Highway and the Pukalani Bypass intersections, is the only construction project proposed in the study area during the next few years; this improvement would provide two permanent travel lanes in each direction and eliminate the need for the contraflow lane on



LEGEND

(A/B) AM/PM PEAK HOUR LEVELS OF SERVICE FOR SIGNALIZED INTERSECTION

(a/b) AM/PM PEAK HOUR LEVELS OF SERVICE FOR MOST CONSTRAINED MOVEMENT AT THE UNSIGNALIZED INTERSECTION
• INDICATES THE MOST CONSTRAINED MOVEMENT

000(000) AM(PM) PEAK HOUR TRAFFIC VOLUMES, ROUNDED TO THE NEAREST FIVE VEHICLES PER HOUR

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FUTURE BASE TRAFFIC VOLUMES (WITHOUT BASE ROADWAY IMPROVEMENTS)

FIGURE 6

FILE NAME: Z:\USERS\EVERYONE\KULAMALU\FIG-6.DWG

Haleakala Highway during the morning peak period. The Haleakala Highway widening project has initiated the processing for environmental requirements; however, the future laneage configurations for the intersections of Hana Highway/Haleakala Highway and Pukalani Bypass Road (West Terminus)/ Haleakala Highway have yet to be determined. Therefore, the analysis of future base conditions assumes the widening of Haleakala Highway without improvements to the existing intersection laneage configurations. The results of the overall intersection Level of Service analysis are summarized in Figure 6 and more detailed LOS results for the intersection approaches are provided in Table 4.

Generally, the analysis indicates the increases in traffic volumes due to the growth in the future base traffic volumes would result in longer delays at the study intersections. A review of the Table 4 analysis results show that traffic operations at the existing intersections, listed below, are expected to experience long delays and to operate at Level of Service E or F conditions during the morning or afternoon peak hours:

- Hana Highway and Haleakala Highway
- Pukalani Bypass Road (West Terminus) and Haleakala Highway
- Pukalani Bypass Road and Makani Road
- Haleakala Highway, Makawao Avenue and Loha Street

D. Base Roadway Improvements

The following roadway improvements are necessary to alleviate the Level of Service F operating conditions expected for future base traffic conditions. These improvements are consistent with the roadway improvements recommended in the February 1996 Draft Final Report of the Maui Long-Range Land Transportation Plan.

Haleakala Highway: Widen to four travel lanes, two in each direction, between Hana Highway and Pukalani Bypass Road. The processing of

Table 4
FUTURE BASE TRAFFIC CONDITIONS
YEAR 2010 WITHOUT THE CONCEPTUAL PLANNING AREA

	Future Conditions without Base Roadway Improvements							Future Conditions with Base Roadway Improvements						
		AM Peak Hour			PM Peak Hour				AM Peak Hour			PM Peak Hour		
Intersection	Type of Intersection	v/c Ratio	Delay (Seconds)	Level of Service	v/c Ratio	Delay (Seconds)	Level of Service	Type of Intersection	v/c Ratio	Delay (Seconds)	Level of Service	v/c Ratio	Delay (Seconds)	Level of Service
1. Hana Highway and Haleakala Highway	Signalized							Signalized						
Northbound Approach		--	16.2	C	--	17.7	C		--	11.8	B	--	16.4	C
Southbound Approach		--	35.4	D	--	22.0	C		--	17.2	C	--	14.3	B
Eastbound Approach		--	17.4	C	--	62.5	F		--	13.1	B	--	14.5	B
Westbound Approach		--	68.0	F	--	26.5	D		--	49.9	E	--	14.1	B
Overall Intersection		1.92	54.4	E	0.74	29.7	D		1.31	38.9	D	0.69	14.8	B
2. Pukalani Bypass Road (West Terminus) and Haleakala Highway	Unsignalized							Signalized						
Northbound Approach		--	--	A	--	779.0	F		--	11.3	B	--	11.5	B
Eastbound Approach		--	--	--	--	--	--		--	5.5	B	--	3.3	A
Westbound Approach		--	--	--	--	--	--		--	10.1	B	--	2.7	A
Overall Intersection		*	*	A	--	103.2	F		0.73	10.0	B	0.37	4.5	A
3. Pukalani Bypass Road and Makani Road	Unsignalized							Signalized						
Northbound Approach		--	96.9	F	--	78.8	F		--	7.6	B	--	10.7	B
Southbound Approach		--	124.2	F	--	47.9	F		--	9.1	B	--	7.3	B
Eastbound Approach		--	0.0	A	--	1.4	A		--	4.3	A	--	2.8	A
Westbound Approach		--	0.0	A	--	0.2	A		--	6.0	B	--	9.1	B
Overall Intersection		--	39.0	E	--	8.0	E		0.43	6.4	B	0.32	5.4	B
4. Pukalani Bypass Road and Makawao Avenue	Signalized							Signalized						
Northbound Approach		--	7.8	B	--	10.8	B		--	14.0	B	--	11.4	B
Southbound Approach		--	29.7	D	--	34.6	D		--	7.4	B	--	9.6	B
Eastbound Approach		--	12.2	B	--	17.0	C		--	8.8	B	--	8.6	B
Westbound Approach		--	18.9	C	--	11.1	B		--	12.1	B	--	13.1	B
Overall Intersection		0.70	22.4	C	0.54	18.6	C		0.46	9.7	B	0.46	10.3	B
5. Pukalani Bypass Road (East Terminus), Haleakala Highway and Kula Highway ("Five Trees" Intersection)	Signalized							Signalized						
Northbound Approach		--	2.6	A	--	2.5	A		--	6.3	B	--	2.6	A
Southbound Approach		--	6.5	B	--	6.9	B		--	4.9	A	--	6.9	B
Eastbound Approach		--	9.0	B	--	10.8	B		--	11.1	B	--	10.8	B
Westbound Approach		--	13.3	B	--	14.3	B		--	12.9	B	--	14.3	B
Overall Intersection		0.44	5.4	B	0.48	5.8	B		0.53	6.6	B	0.48	5.8	B

* Note: Contraflow coning during AM peak period eliminates conflicting movements at this intersection.

Table 4
FUTURE BASE TRAFFIC CONDITIONS
YEAR 2010 WITHOUT THE CONCEPTUAL PLANNING AREA
(continued)

	Future Conditions without Base Roadway Improvements							Future Conditions with Base Roadway Improvements						
		AM Peak Hour			PM Peak Hour				AM Peak Hour			PM Peak Hour		
Intersection	Type of Intersection	v/c Ratio	Delay (Seconds)	Level of Service	v/c Ratio	Delay (Seconds)	Level of Service	Type of Intersection	v/c Ratio	Delay (Seconds)	Level of Service	v/c Ratio	Delay (Seconds)	Level of Service
6. Haleakala Highway and Pukalani Street	Signalized							Signalized						
Northbound Approach		--	26.0	D	--	5.8	B		--	4.5	A	--	10.4	B
Eastbound Approach		--	14.3	B	--	28.9	D		--	11.5	B	--	4.1	A
Westbound Approach		--	7.6	B	--	8.8	B		--	14.0	B	--	4.2	A
Overall Intersection		0.71	17.4	C	0.56	16.8	C		0.59	8.6	B	0.37	5.6	B
7. Haleakala Highway, Makawao Avenue and Loha Street	Signalized							Signalized						
Northbound Approach		--	6.7	B	--	8.0	B		--	8.0	B	--	12.4	B
Southbound Approach		--	6.4	B	--	5.9	B		--	7.9	B	--	9.7	B
Eastbound Approach		--	35.1	D	--	54.4	E		--	4.5	A	--	2.6	A
Westbound Approach		--	5.2	B	--	6.6	B		--	4.9	A	--	8.0	B
Overall Intersection		0.56	20.1	C	0.74	30.2	D		0.23	6.1	B	0.32	6.0	B
8. Pukalani Street and Iolani Street	Unsignalized							Unsignalized						
Northbound Approach		--	0.0	A	--	0.3	A		--	0.0	A	--	0.3	A
Southbound Approach		--	0.6	A	--	0.7	A		--	0.6	A	--	0.7	A
Eastbound Approach		--	12.1	C	--	10.4	C		--	12.1	C	--	10.4	C
Westbound Approach		--	4.0	A	--	4.0	A		--	4.0	A	--	4.0	A
Overall Intersection		--	5.1	B	--	2.7	A		--	5.1	B	--	2.7	A
9. Kula Highway and Project Road	Not Applicable	--	--	--	--	--	--	Not Applicable	--	--	--	--	--	--
10. Kula Highway and Ohana Street	Unsignalized							Unsignalized						
Northbound Approach		--	0.0	A	--	0.0	A		--	0.0	A	--	0.0	A
Southbound Approach		--	0.1	A	--	0.1	A		--	0.1	A	--	0.1	A
Westbound Approach		--	10.0	B	--	7.0	B		--	10.0	B	--	7.0	B
Overall Intersection		--	0.2	A	--	0.2	A		--	0.2	A	--	0.2	A

E 4, PAGE 2

this widening project through the environmental regulatory requirements has already been initiated.

Pukalani Bypass Road: Widen this roadway to four lanes to provide two mauka-bound lanes and two makai-bound lanes.

Intersection of Pukalani Bypass Road (West Terminus) and Haleakala Highway: Signalize the intersection and reconfigure the intersection laneage to provide two westbound lanes on the Pukalani Bypass Road approach, double left-turn lanes with optional right-turn movement on the Haleakala Highway northbound approach and two through lanes with a separate right-turn lane on the Haleakala Highway eastbound approach.

Intersection of Pukalani Bypass Road and Makani Road: Widen, reconfigure and signalize this intersection to provide two mauka-bound lanes and two makai-bound lanes on Pukalani Bypass Road.

Intersection of Pukalani Bypass Road and Makawao Avenue: Widen and reconfigure this signalized intersection to provide two mauka- and two makai-bound lanes on Pukalani Bypass Road.

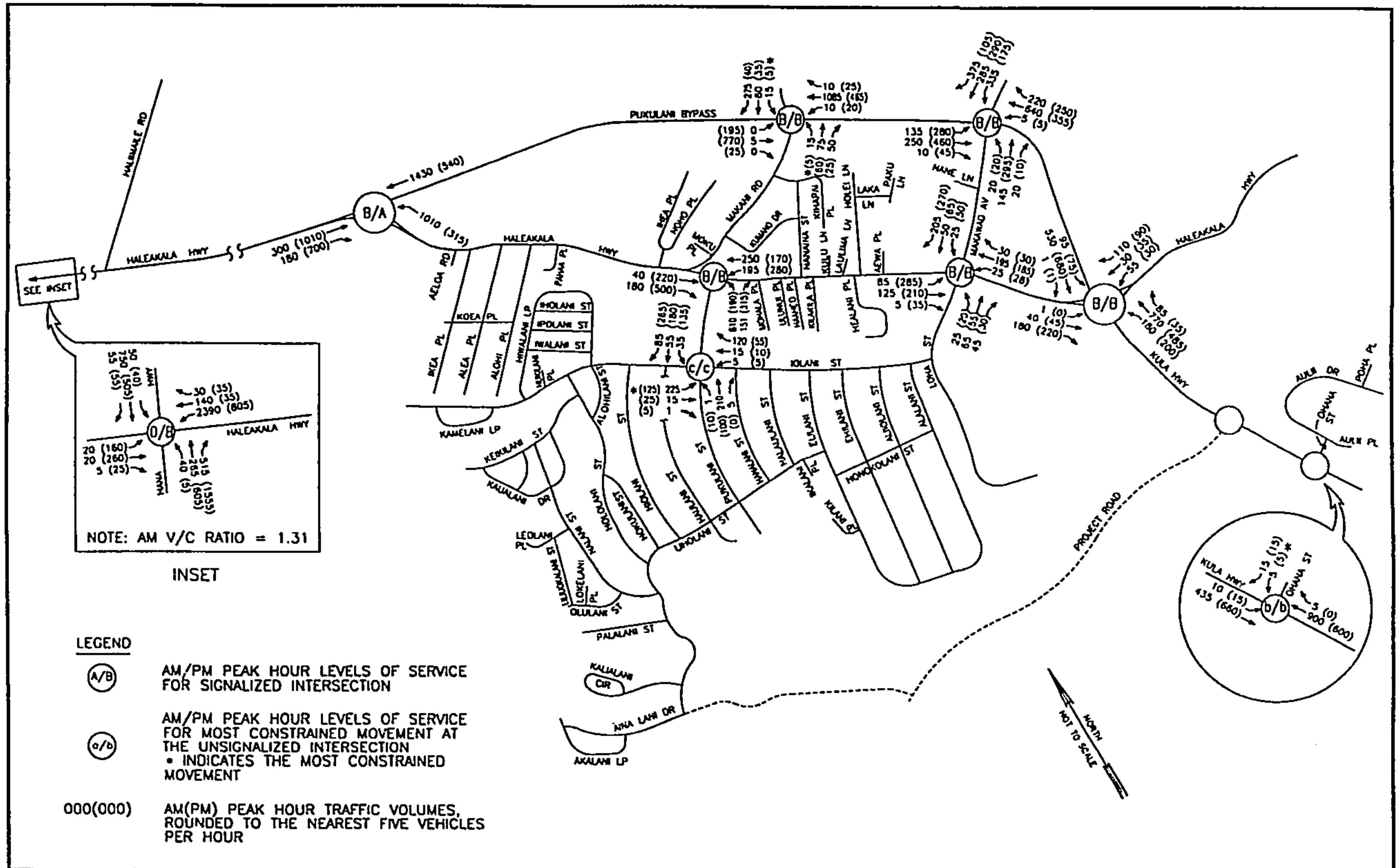
Optimization of Traffic Signal Operations: Adjust traffic signal timing as traffic volumes increase to better accommodate the increased traffic flows and to reduce delays at the signalized intersection. In addition, the proposed traffic signal system at the Pukalani Bypass Road/Makani Road intersection should be interconnected with the existing traffic signal systems at the Pukalani Bypass Road/Makawao Avenue intersection and the Haleakala Highway/Pukalani Bypass Road/Kula Highway (Five Trees) intersection to provide for efficient traffic progression.

With these improvements, the coning of the contraflow lane during the morning peak period of traffic would not be needed. In addition, mauka-bound (eastbound) traffic in the morning peak period would be permitted to remain on the Pukalani Bypass Road without having to divert through Pukalani town.

Accordingly, the future morning peak hour traffic volumes would increase on the Pukalani Bypass Road and the traffic volumes on Haleakala Highway travelling through Pukalani town would be expected to decrease. The afternoon peak hour volumes are not expected to change significantly with the proposed base roadway improvements since there is no contraflow operation and the diversion of mauka-bound traffic only occurs during the morning peak period. Figure 7 shows the traffic assignment for the Year 2010 base traffic volumes with the base roadway improvements.

The results of analysis of the future base traffic volumes with the base roadway improvements are shown in Table 4. At the intersection of Hana Highway and Haleakala Highway, the AM peak hour v/c ratio would exceed 1.0, however, the analysis shows that the overall traffic conditions at the study intersections would improve to Level of Service D or better when the base roadway improvements are implemented.

Long-term solutions are needed to alleviate the traffic congestion at the intersection of Hana Highway and Haleakala Highway. Possible roadway improvements include grade separation structure(s), such as a flyover connector from westbound Haleakala Highway to southbound Hana Highway, or the provision of alternate access routes to the Upcountry area. A grade-separated connector ramp for the Haleakala Highway makai-bound left-turn would reduce conflicting movements at the Hana Highway intersection, but it would not decrease the traffic demand on Hana Highway. The introduction of new routes could be accomplished through the construction of new roadways, such as the proposed Upcountry-Kihei Road or through the upgrade/realignment of existing rural, winding roads, such as Omaopio Road and Pulehu Road. New Upcountry routes to other areas would reduce travel time and decrease traffic demand on Haleakala Highway and Hana Highway.



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FUTURE BASE TRAFFIC VOLUMES WITH BASE ROADWAY IMPROVEMENTS

FIGURE 7

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IV. PROJECT AND CONCEPTUAL PLANNING AREA GENERATED TRAFFIC VOLUMES

The development of traffic projections for the proposed project involves trip generation, trip distribution, and traffic assignment. A description of each process follows:

A. Trip Generation Rates

The traffic expected to be generated by the conceptual planning area was estimated by applying the trip generation rates for the appropriate land uses, which are shown in the table below:

Table 5
TRIP GENERATION RATES

Land Use	Parameter	Daily Rate	AM Peak Hour			PM Peak Hour		
			Rate	Enter	Exit	Rate	Enter	Exit
Residential								
Single-Family	dwelling units	9.55	0.74	26%	74%	1.01	64%	36%
Multi-Family	dwelling units	n/a	0.66	25%	75%	0.83	57%	43%
Elderly	dwelling units	4.29	0.19	58%	58%	0.27	44%	56%
Shopping Center	thousand square feet	64.77	1.47	63%	37%	6.03	50%	50%
Government Office	thousand square feet	68.93	5.88	84%	16%	6.22	15%	85%
Day Care	thousand square feet	79.26	13.02	53%	47%	13.62	47%	53%
Church	thousand square feet	9.32	0.74	64%	36%	0.72	54%	46%
Private School	students	n/a	0.93	63%	37%	0.13	33%	67%
Park	acres	n/a	2.87	72%	28%	3.14	35%	65%

These trip rates are based upon data from Trip Generation, Fifth Edition, Institute of Transportation Engineers (ITE), 1991 except for the elderly residential dwelling units rates which are from Site-Oriented Trip Generation Rates for Oahu User's Manual, 1988, prepared by ATA. The application of these rates provides an estimate of the total increases in future traffic expected to be generated by the conceptual planning area. The trip generation estimates are given in Table 6.

For the Kulamalu shopping center, some of the trips would be from motorists already travelling on Kula Highway who stop at the shopping center then continue to their original destination. While these types of trips would increase turning movements entering and exiting the shopping center driveway, these passby trips would not increase the highway traffic volumes. Approximately 25 percent of the morning and 35 percent of the afternoon peak hour shopping center traffic were estimated to be passby trips. Accordingly, the total conceptual planning area traffic assigned on the external highway system was adjusted for the shopping center passby trips.

Due to the mixed land uses within the Kulamalu conceptual planning area, some trips would be expected to remain within the Kulamalu site; trips between the residential units to the shopping center, office, day care center, school or park would be considered as internal trips. These internal trips, which is estimated to be about 8 percent of the total Kulamalu conceptual planning area trips, were deducted from the total trips prior to assigning the conceptual planning area traffic to the external roadway system.

B. Traffic Distribution

The direction distribution pattern developed for the Kulamalu development was based on the existing traffic distribution pattern as well as consideration of future residential and employment areas on the island of Maui. The general distribution pattern used to distribute external traffic is identified in Figure 8.

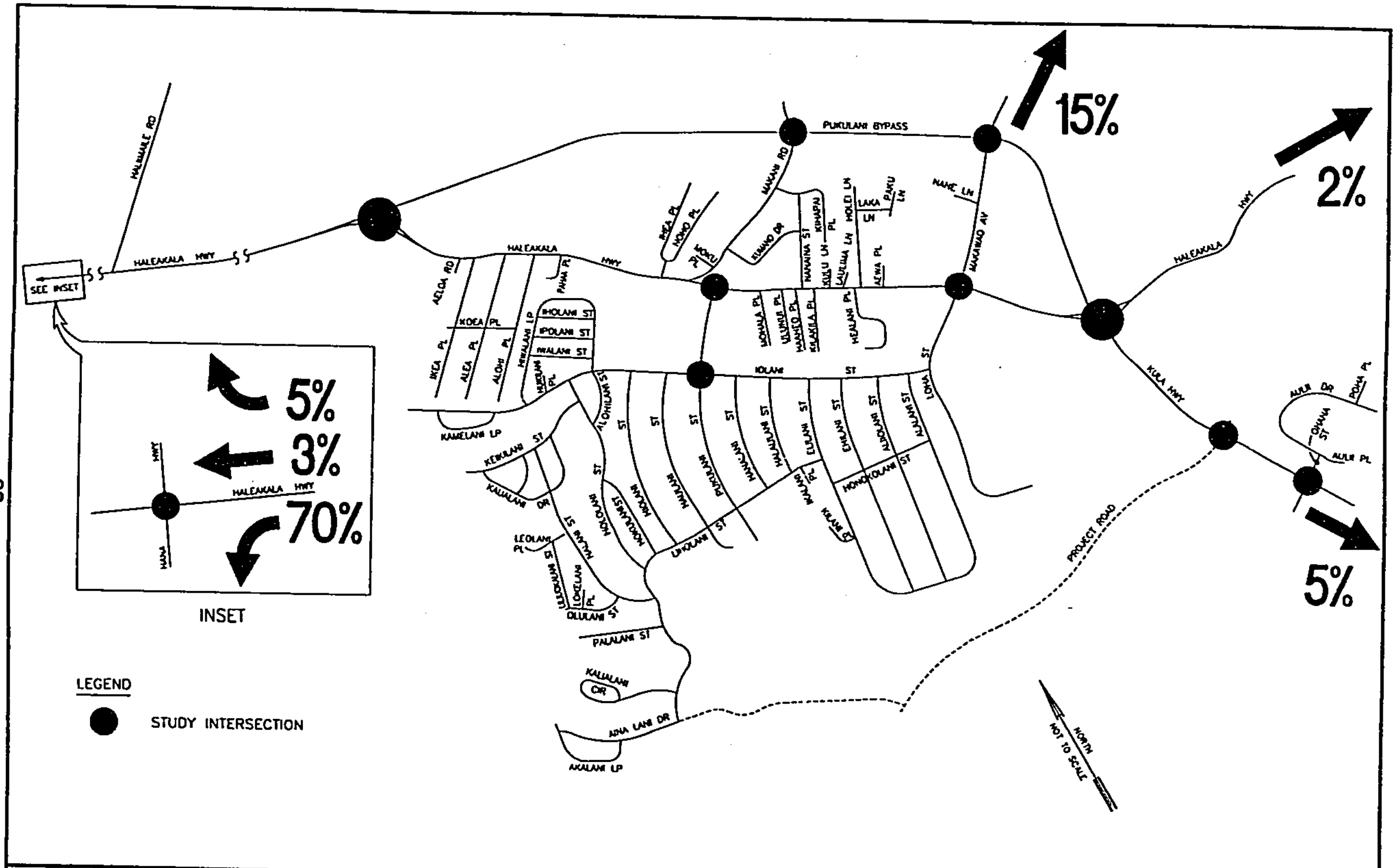
Table 6

CONCEPTUAL PLANNING AREA TRIP GENERATION

	CONCEPTUAL PLANNING AREA				
Land Use	Parameter	AM Peak Hour		PM Peak Hour	
		Enter	Exit	Enter	Exit
Project Area					
Residential					
Elderly	65 dwelling units	7	5	8	10
Shopping Center	140,000 square feet	129	75	419	419
Government Office	13,000 square feet	64	12	12	69
Day Care	9,000 square feet	62	55	58	65
Church	4,000 square feet	2	1	2	1
Park	14.74 acres	30	12	16	30
Park (Halau)	5.03 acres	11	4	6	10
Subtotal		305	164	521	604
Adjacent Planning Area					
Residential					
Single-Family	324 dwelling units	62	178	209	118
Multi-Family	80 dwelling units	13	40	38	28
Private School	500 students	293	172	21	44
Subtotal		368	390	268	190
Total Conceptual Planning Area Trips		673	554	789	794
Deductions					
Internal Trips		49	49	64	64
Commercial Passby Trips		26	26	148	148
Subtotal		75	75	212	212
Net External Trips		598	479	577	582

C. Traffic Assignment

The trip distribution pattern identified in Figure 8 was used to assign the conceptual planning area-generated traffic to the local street network. The



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EXTERNAL TRAFFIC DISTRIBUTION PATTERN

FIGURE 8

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traffic assignment to specific streets and intersections was based on the available access into and out of the site and the availability of local routes to access the regional highway system. The resulting estimated conceptual planning area-generated peak hour traffic volumes at each of the study intersections without and with the base roadway improvements are shown in Figures 9 and 10, respectively.

V. FUTURE WITH CONCEPTUAL PLANNING AREA ANALYSIS

This section discusses the traffic operating conditions when the conceptual planning area-generated traffic volumes are added to the future base traffic volumes.

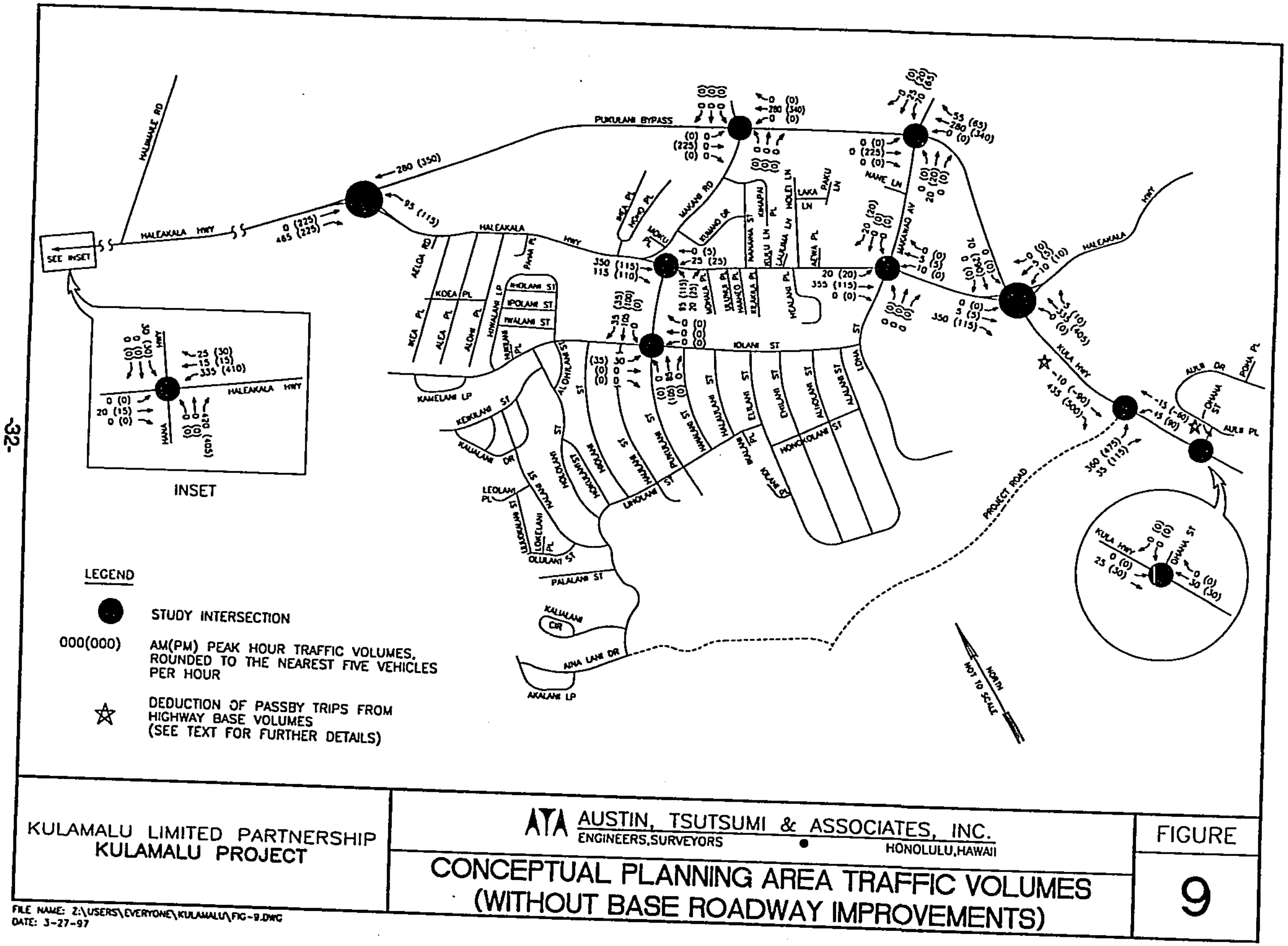
A. Future Traffic Volumes With Conceptual Planning Area-Generated Traffic

For the future Year 2010 traffic volumes with the conceptual planning area, two sets of traffic assignments were developed, without and with the base roadway improvements, and are shown in Figures 11 and 12, respectively. The base roadway improvements, which are described in detail in the previous Section III. D., primarily involve the widening of Haleakala Highway to four lanes between Hana Highway and Pukalani Bypass Road and the widening of the Pukalani Bypass Road to four lanes and associated intersection modification.

B. Level of Service Analysis

The results of the analysis of the future traffic volumes with the conceptual planning area-generated traffic are shown in Table 7. Without the base roadway improvements, traffic operations at the existing intersections, identified below, would be expected to be at Level of Service E or F, or poor operating conditions with long delays for the future conditions with the conceptual planning area-generated traffic.

- Hana Highway and Haleakala Highway
- Pukalani Bypass Road (West Terminus) and Haleakala Highway
- Pukalani Bypass Road and Makani Road
- Pukalani Bypass Road and Makawao Avenue



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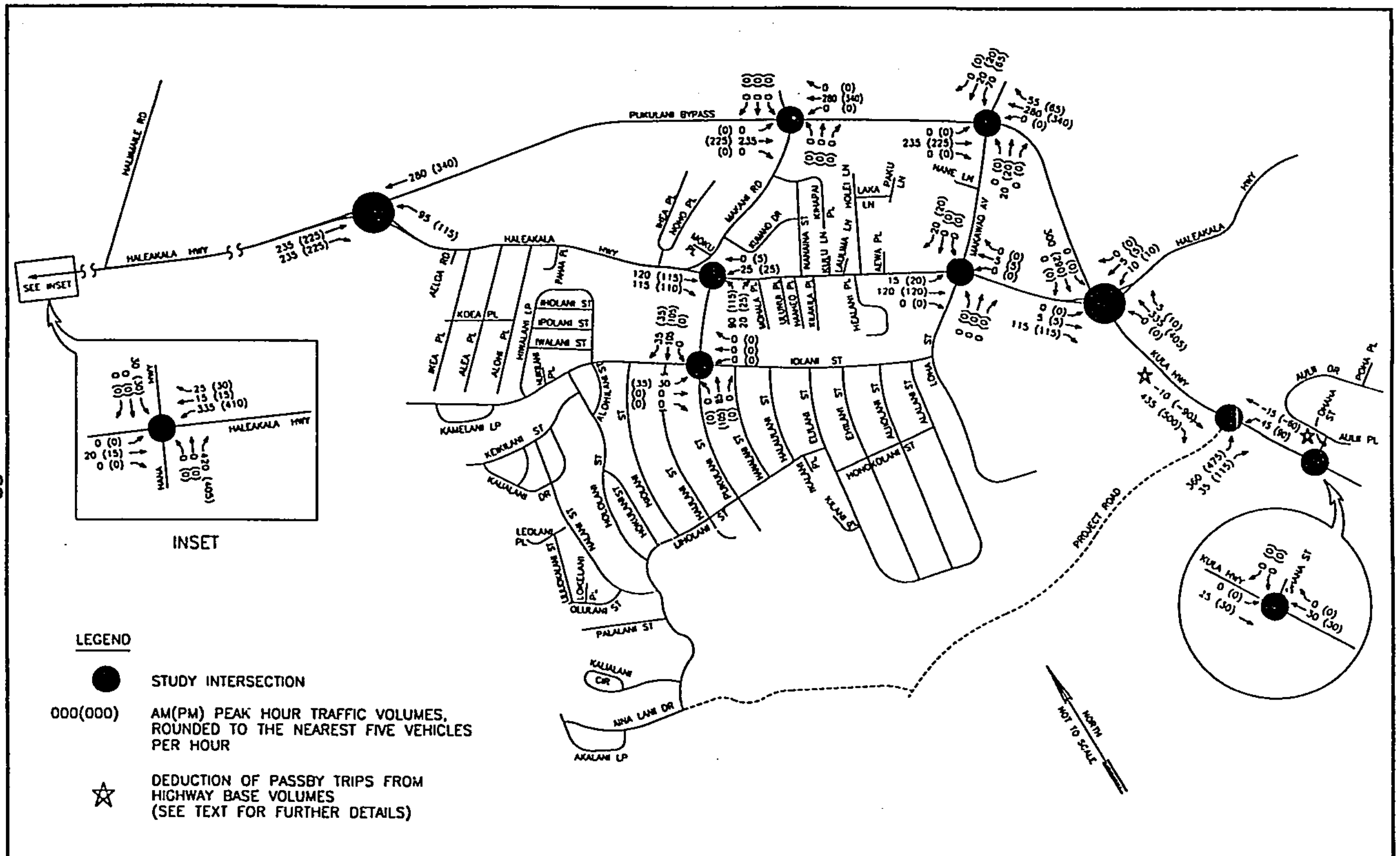

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FIGURE 10

CONCEPTUAL PLANNING AREA TRAFFIC VOLUMES WITH BASE ROADWAY IMPROVEMENTS

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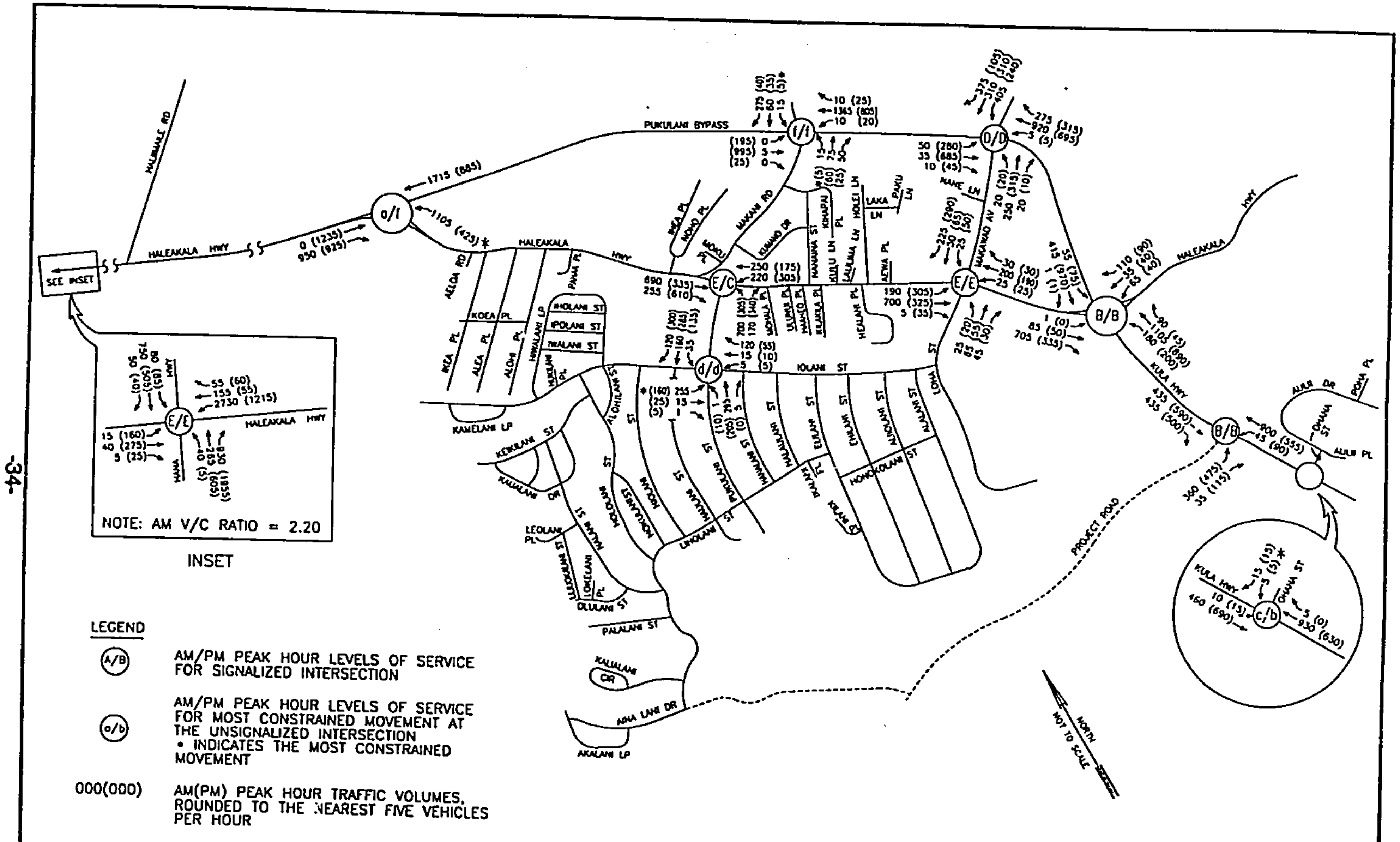

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FIGURE 11

FUTURE YEAR 2010 WITH CONCEPTUAL PLANNING AREA (WITHOUT BASE ROADWAY IMPROVEMENTS)

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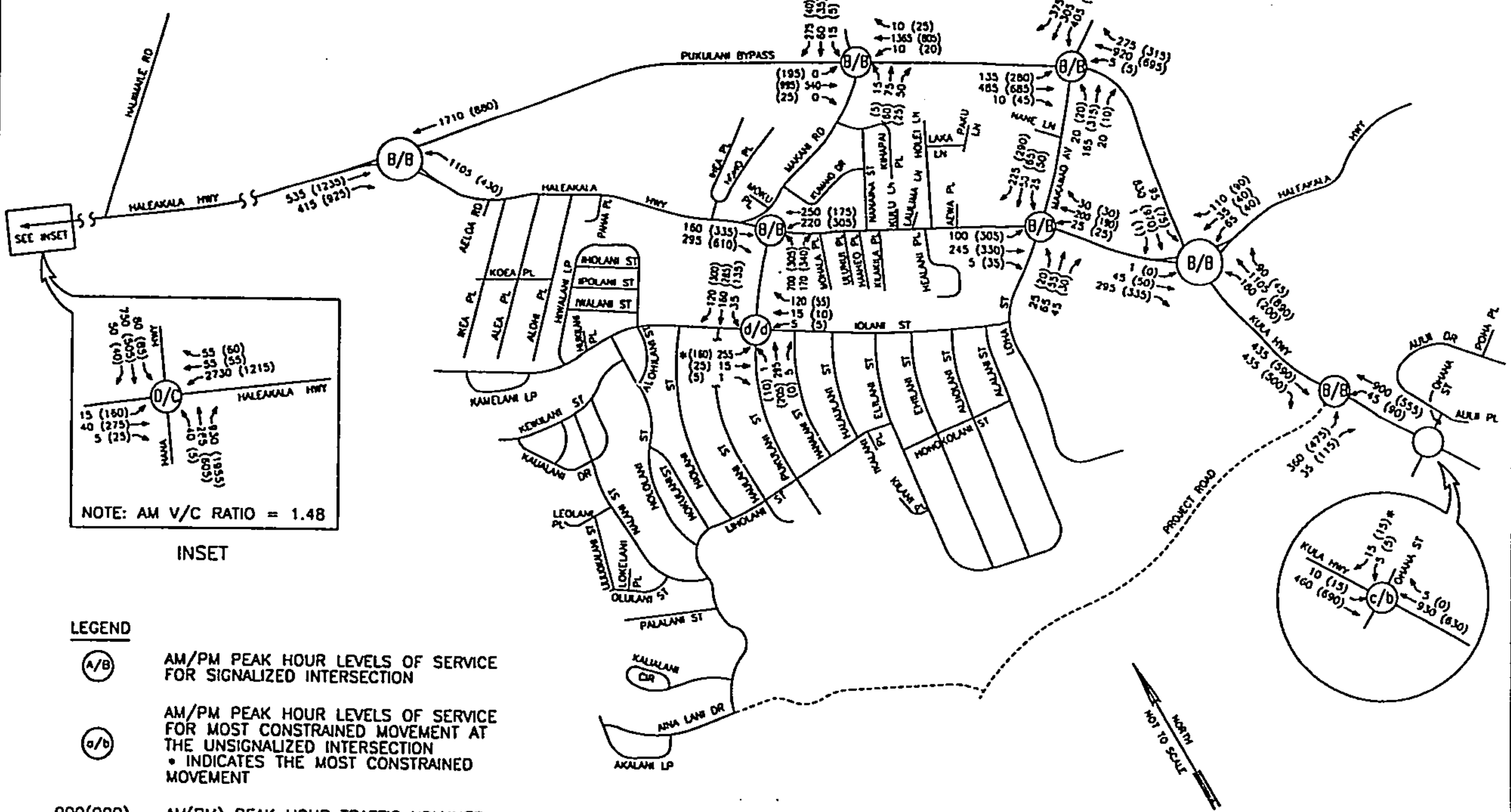

LEGEND

(A/B) AM/PM PEAK HOUR LEVELS OF SERVICE FOR SIGNALIZED INTERSECTION

(a/b) AM/PM PEAK HOUR LEVELS OF SERVICE FOR MOST CONSTRAINED MOVEMENT AT THE UNSIGNALIZED INTERSECTION
• INDICATES THE MOST CONSTRAINED MOVEMENT

000(000) AM(PM) PEAK HOUR TRAFFIC VOLUMES, ROUNDED TO THE NEAREST FIVE VEHICLES PER HOUR

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FUTURE YEAR 2010 WITH CONCEPTUAL PLANNING AREA AND WITH BASE ROADWAY IMPROVEMENTS

FIGURE 12

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Table 7
FUTURE YEAR 2010 TRAFFIC CONDITIONS WITH THE CONCEPTUAL PLANNING AREA

	Future Conditions without Base Roadway Improvements							Future Conditions with Base Roadway Improvements						
		AM Peak Hour			PM Peak Hour				AM Peak Hour			PM Peak Hour		
Intersection	Type of Intersection	v/c Ratio	Delay (Seconds)	Level of Service	v/c Ratio	Delay (Seconds)	Level of Service	Type of Intersection	v/c Ratio	Delay (Seconds)	Level of Service	v/c Ratio	Delay (Seconds)	Level of Service
1. Hana Highway and Haleakala Highway	Signalized							Signalized						
Northbound Approach		--	16.2	C	--	17.7	C		--	11.8	B	--	24.6	C
Southbound Approach		--	35.6	D	--	23.0	C		--	17.1	C	--	18.5	C
Eastbound Approach		--	17.6	C	--	68.8	F		--	13.3	B	--	23.6	D
Westbound Approach		--	66.0	F	--	66.0	F		--	49.9	E	--	19.5	C
Overall Intersection		2.20	55.1	E	0.94	47.4	E		1.48	39.5	D	0.84	21.0	C
2. Pukalani Bypass (West Terminus) and Haleakala Highway	Unsignalized							Signalized						
Northbound Approach		--	*	A	--	3031.2	F		--	16.3	C	--	11.7	B
Eastbound Approach		--	--	--	--	--	--		--	5.5	B	--	4.1	A
Westbound Approach		--	--	--	--	--	--		--	14.3	B	--	3.3	A
Overall Intersection		--	*	A	--	404.1	F		0.81	13.6	B	0.49	5.1	B
3. Pukalani Bypass Road and Makani Road	Unsignalized							Signalized						
Northbound Approach		--	0.0	A	--	--	F		--	8.8	B	--	10.7	B
Southbound Approach		--	343.8	F	--	--	F		--	10.9	B	--	7.3	B
Eastbound Approach		--	0.0	A	--	2.2	A		--	3.8	A	--	3.2	A
Westbound Approach		--	0.0	A	--	0.2	A		--	5.7	B	--	10.8	B
Overall Intersection		--	68.5	F	--	93.9	F		0.50	6.2	B	0.48	6.6	B
4. Pukalani Bypass and Makawao Avenue	Signalized							Signalized						
Northbound Approach		--	7.9	B	--	11.0	B		--	17.3	C	--	13.7	B
Southbound Approach		--	32.6	D	--	44.0	E		--	9.0	B	--	12.2	B
Eastbound Approach		--	12.2	B	--	16.1	C		--	5.8	B	--	8.3	B
Westbound Approach		--	51.5	E	--	46.2	E		--	13.1	B	--	12.4	B
Overall Intersection		0.95	36.2	D	0.77	30.6	D		0.55	10.3	B	0.57	11.1	B
5. Pukalani Bypass (East Terminus), Haleakala Highway and Kula Highway ("Five Trees" Intersection)	Signalized							Signalized						
Northbound Approach		--	8.1	B	--	15.8	C		--	12.4	B	--	12.4	B
Southbound Approach		--	7.2	B	--	12.4	B		--	15.8	C	--	15.8	C
Eastbound Approach		--	19.2	C	--	3.3	A		--	6.6	B	--	11.3	B
Westbound Approach		--	13.3	B	--	11.3	C		--	13.2	B	--	3.3	A
Overall Intersection		0.69	10.0	B	0.67	8.1	B		0.73	10.9	B	0.67	8.1	B

* Note: Contraflow coning during AM peak period eliminates conflicting movements at this intersection.

Table 7
FUTURE YEAR 2010 TRAFFIC CONDITIONS WITH THE CONCEPTUAL PLANNING AREA
(continued)

	Future Conditions without Base Roadway Improvements							Future Conditions with Base Roadway Improvements						
		AM Peak Hour			PM Peak Hour				AM Peak Hour			PM Peak Hour		
Intersection	Type of Intersection	v/c Ratio	Delay (Seconds)	Level of Service	v/c Ratio	Delay (Seconds)	Level of Service	Type of Intersection	v/c Ratio	Delay (Seconds)	Level of Service	v/c Ratio	Delay (Seconds)	Level of Service
6. Haleakala Highway and Pukalani Street	Signalized							Signalized						
Northbound Approach		--	49.8	E	--	6.5	B		--	10.4	B	--	8.4	B
Eastbound Approach		--	58.8	E	--	36.0	D		--	10.5	B	--	6.4	B
Westbound Approach		--	8.6	B	--	19.6	C		--	14.0	B	--	7.7	B
Overall Intersection		1.03	43.0	E	0.68	23.3	C		0.67	11.7	B	0.49	7.3	B
7. Haleakala Highway, Makawao Avenue and Loha Street	Signalized							Signalized						
Northbound Approach		--	6.7	B	--	6.0	B		--	7.7	B	--	12.6	B
Southbound Approach		--	6.4	B	--	5.9	B		--	7.7	B	--	9.4	B
Eastbound Approach		--	67.3	F	--	66.6	F		--	5.0	B	--	2.6	A
Westbound Approach		--	5.2	B	--	6.6	B		--	5.2	B	--	7.8	B
Overall Intersection		1.08	43.4	E	0.87	39.3	E		0.27	6.1	B	0.35	5.6	B
8. Pukalani Street and Iolani Street	Unsignalized							Unsignalized						
Northbound Approach		--	0.0	A	--	0.2	A		--	0.0	A	--	0.2	A
Southbound Approach		--	0.5	A	--	0.6	A		--	0.5	A	--	0.6	A
Eastbound Approach		--	26.0	D	--	20.2	D		--	26.0	D	--	20.2	D
Westbound Approach		--	4.5	A	--	4.9	A		--	4.5	A	--	4.9	A
Overall Intersection		--	9.3	B	--	4.3	A		--	9.3	B	--	4.3	A
9. Kula Highway and Project Road	Signalized							Signalized						
Northbound Approach		--	15.1	C	--	8.9	B		--	15.1	C	--	8.9	B
Southbound Approach		--	8.8	B	--	6.1	B		--	8.8	B	--	6.1	B
Eastbound Approach		--	12.1	B	--	17.3	C		--	12.1	B	--	17.3	C
Overall Intersection		0.72	12.6	B	0.62	10.3	B		0.72	12.6	B	0.62	10.3	B
10. Kula Highway and Ohana Street	Unsignalized							Unsignalized						
Northbound Approach		--	0.0	A	--	0.0	A		--	0.0	A	--	0.0	A
Southbound Approach		--	0.1	A	--	0.1	A		--	0.1	A	--	0.1	A
Westbound Approach		--	10.5	C	--	7.3	B		--	10.5	C	--	7.3	B
Overall Intersection		--	0.2	A	--	0.2	A		--	0.2	A	--	0.2	A

- Haleakala Highway, Makawao Avenue and Loha Street
- Haleakala Highway and Pukalani Street

With the base roadway improvements implemented, the traffic operations at these intersections is expected to improve to Level of Service D or better, except at the Hana Highway/Haleakala Highway intersection where the makai-bound (westbound) approach which would continue to operate at Level of Service E. The long-term regional impacts for traffic traveling to and from the Upcountry area must be considered in the assessment of improvements, such as grade-separated connection roadways at the Hana Highway/Haleakala Highway intersection, or construction/upgrade of alternate Upcountry routes.

VI. SUMMARY OF FINDINGS AND RECOMMENDATIONS

This section summarizes the findings and recommendations of this traffic impact assessment report for the Kulamalu Conceptual Planning Area.

A. Findings

1. Existing Conditions

Generally, traffic operates fairly well on the roadways in the study section, except at the following locations:

a. **Hana Highway/Haleakala Highway Intersection** - In spite of the double left-turn movement on the makai-bound Haleakala Highway approach, traffic desiring to head southbound on Hana Highway operates at LOS F and LOS E during the morning and afternoon peak hours of traffic, respectively. Also, queuing is observed for the Hana Highway northbound right-turn movement to Haleakala Highway, mauka-bound.

b. **Pukalani Bypass Road/Haleakala Highway Intersection** - This intersection operates with near free flow conditions during the morning peak hour of traffic due to the contraflow operations where mauka-bound traffic is directed to continue on Haleakala Highway through Pukalani town. This eliminates the conflict for makai-bound traffic from Haleakala Highway from Pukalani town to the contraflow section of Haleakala Highway. However, during the afternoon peak hour of traffic, the heavy mauka-bound traffic continuing on to the Pukalani Bypass Road causes makai-bound traffic on Haleakala Highway from Pukalani town to experience serious delays (LOS F).

c. **Haleakala Highway/Makawao Avenue/Loha Street Intersection** - Traffic on the mauka-bound approach at this intersection experiences LOS E operations during the afternoon peak hour of traffic due to the high left-turn demand to northbound Makawao Avenue.

2. **Future Base Year 2010 Traffic (Without Project-Generated Traffic)**

a. Without any new roadway improvements, the increase in traffic demand due to population growth and other developments in the area will further aggravate traffic operations at the existing locations where traffic is currently operating poorly (see Item 1 above). In addition, traffic operations at the following locations will deteriorate to LOS E or F:

- Pukalani Bypass Road/Makani Road Intersection - Traffic on the Makani Road approaches to the intersection will operate at LOS F and the overall operations of the intersection will be at LOS E.

3. **Future With Base Year 2010 With Roadway Improvements (Without Project-Generated Traffic)**

a. Under the future base conditions with the base roadway improvements, the traffic operation at the study intersections would improve and operate at Level of Service D or better, except at the Hana Highway/Haleakala Highway intersection. The traffic on the makai approach to this intersection will continue to operate at LOS F.

4. **Kulamalu Conceptual Planning Area**

a. The Kulamalu conceptual planning area will generate 1,227 morning peak hour vehicular trips and 1,583 afternoon peak hour vehicular trips. The deduction for internal traffic and commercial passby trips results in 1,077 (morning) and 1,159 (afternoon) peak hour trips on the external roadways.

b. Under Year 2010 conditions with the Kulamalu conceptual planning area traffic added to the base year traffic and without the base roadway improvements in place, the intersections listed below would operate at Level of Service E or F, or with v/c ratios greater than 1.00.

1. Hana Highway and Haleakala Highway.
2. Pukalani Bypass Road (West Terminus) and Haleakala Highway.
3. Pukalani Bypass Road and Makani Road.
4. Pukalani Bypass Road and Makawao Avenue.
5. Haleakala Highway, Makawao Avenue and Loha Street.
6. Haleakala Highway and Pukalani Street.

c. With the base roadway improvements implemented, traffic operations in the Year 2010 with the Kulamalu conceptual planning area traffic, the study intersections would operate at Level of Service D or better, with the exception of Hana Highway intersection with Haleakala Highway. Traffic on the makai-bound approach will continue to operate at LOS F.

B. Recommendations

1. Base Roadway Improvements

The base roadway improvements, described below, are required to accommodate the projected de facto growth of traffic (without the

Kulamalu generated traffic) at an acceptable level of operation (LOS D or better). The recommended intersection configurations for the study intersections are shown in Figure 13. These improvements are consistent with the recommendations of the Maui Long-Range Land Transportation Plan (Draft Final Report, February 1996).

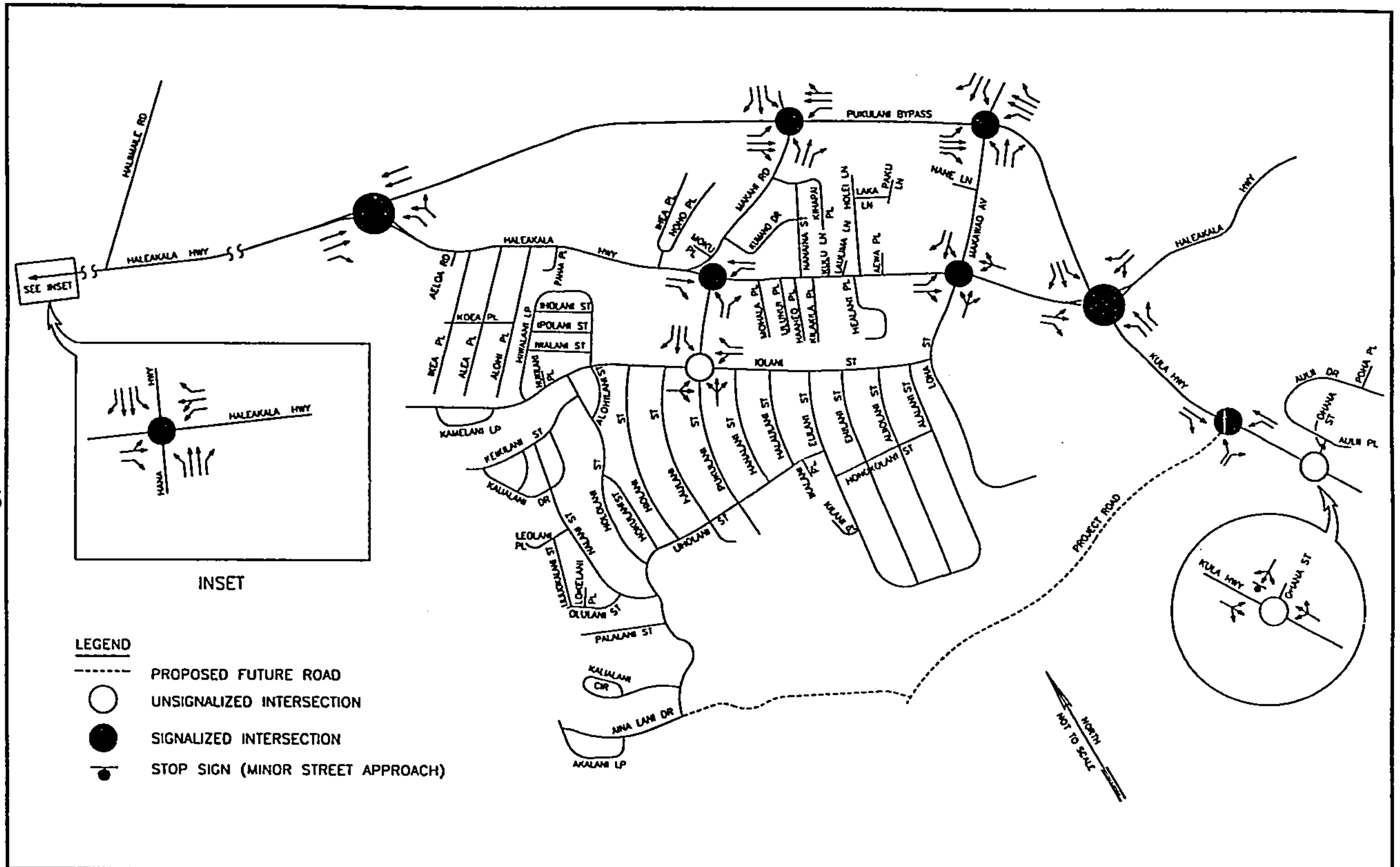
a. Haleakala Highway: Widen to four travel lanes, two in each direction, between Hana Highway and the makai (west) terminus of the Pukalani Bypass Road. This project is currently funded for preparation of the plans, specifications and construction cost estimate and is being processed to meet the environmental regulatory requirements.

b. Pukalani Bypass Road: Widen this roadway to four travel lanes to provide two mauka-bound lane and two makai-bound lanes.

c. Intersection of Pukalani Bypass Road (West Terminus) and Haleakala Highway: Widen, reconfigure and signalize the intersection to provide two makai-bound lanes on the Pukalani Bypass Road approach, double left-turn lanes on the Haleakala Highway northbound approach and two through lanes with a separate right-turn lane on the Haleakala Highway mauka-bound approach.

d. Intersection of Pukalani Bypass Road/Makani Road: Widen, reconfigure and signalize this intersection to provide two mauka-bound lanes, two makai-bound lanes on the Pukalani Bypass Road approaches, and separate turn lanes on the Makani Road approaches.

e. Intersection of Pukalani Bypass Road and Makawao Avenue: Widen and reconfigure to allow the widening of Pukalani Bypass Road to two maukabound and two makaibound lanes.



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RECOMMENDED INTERSECTION CONFIGURATIONS

FIGURE 13

FILE NAME: Z:\USERS\EVERYONE\KULAMALU\FIG-13.DWG
DATE: 3-5-97

f. Optimization of Traffic Signal Operations: Adjust traffic signal timing as traffic volumes increase to better accommodate the increased traffic flows and to reduce delays at signalized intersections. Also, the existing traffic signals at the intersections of Haleakala Highway/Pukalani Bypass Road/Kula Highway (Five Trees) and Pukalani Bypass Road/Makawao Avenue should be interconnected with the traffic signals at the Pukalani Bypass Road/Makani Road intersection to maintain traffic progression through Pukalani town.

g. Alternate Upcountry Access Roads: Provide alternate access routes to the Upcountry area to alleviate the traffic congestion at the intersection of Hana Highway and Haleakala Highway. The introduction of new routes could be accomplished through the construction of new roadways, such as the proposed Upcountry-Kihei Road, or through the upgrade/realignment of existing rural, winding roadways, such as Omaopio Road and Pulehu Road. While grade-separated ramps may be constructed at the intersection of Hana Highway and Haleakala Highway, the provision of new/ upgraded Upcountry routes would reduce travel times to other areas and redistribute regional traffic volumes from Haleakala Highway and Hana Highway.

2. Project Related Roadway Improvements

- Project related roadway improvements which are recommended for implementation by the developer are at the proposed intersection of Kula Highway and the Kulamalu development primary access road:

  Intersection of Kula Highway and Project Road: Provide a separate left-turn storage lane on northbound Kula Highway, and a deceleration/right-turn lane on southbound Kula Highway. Provide separate left-turn lane and right-turn lane on the Project Road approach to Kula Highway. Install a traffic signal system when traffic volumes meet the Traffic Signal Warrants of the "Manual on Uniform Traffic Control Devices".

REFERENCES

Austin, Tsutsumi & Associates, Inc., Site-Oriented Trip Generation Rates for Oahu User's Manual, September 1988.

Austin, Tsutsumi & Associates, Inc., Traffic Impact Analysis Report, Kula Residence Lots, Unit 1, August 1995.

Institute of Transportation Engineers, Trip Generation, Fifth Edition, 1991.

Kaku & Associates, Draft Final Report, Maui Long-Range Land Transportation Plan, February 1996.

Parsons Brinckerhoff Quade & Douglas, Inc., Final Report, Traffic Impact Study, Upcountry Maui High School, November 1992.

APPENDIX A

TRAFFIC COUNTS

AUSTIN, TSUTSUMI & ASSOCIATES, INC.

INTERSECTION COUNT SUMMARY
HALEAKALA HIGHWAY AND HANA HIGHWAY

AM PERIOD: February 7, 1996, Wednesday
WEATHER: Clear

TIME PERIOD	HALEAKALA HIGHWAY NORTHBOUND Left	Through	Right	Subtotal	Hourly	HALEAKALA HIGHWAY SOUTHBOUND Left	Through	Right	Subtotal	Hourly	HANA HIGHWAY EASTBOUND Left	Through	Right	Subtotal	Hourly	HANA HIGHWAY WESTBOUND Left	Through	Right	Subtotal	Hourly	INTERSECTION VOLUME Total	Hourly
6:30 - 6:45	347	26	3	376		5	1	0	6		10	55	82	147		4	125	8	137		666	
6:45 - 7:00	495	37	2	534		2	4	1	7		8	53	87	148		4	149	14	167		856	
7:00 - 7:15	508	23	3	534		4	7	3	14		10	51	94	155		5	159	5	169		872	
7:15 - 7:30	508	25	1	534	1978	4	2	1	7	34	8	61	98	167	617	5	218	6	229	702	937	3331
7:30 - 7:45	532	46	2	580	2182	6	3	0	9	37	12	84	98	194	664	2	173	21	196	781	979	3644
7:45 - 8:00	410	43	3	456	2104	6	2	3	11	41	10	90	105	205	721	3	195	13	211	805	853	3671
8:00 - 8:15	332	25	2	359	1929	5	6	4	15	42	3	83	116	202	768	2	124	2	128	764	704	3503
8:15 - 8:30	305	22	2	329	1724	7	12	4	23	56	9	123	102	234	835	4	149	6	159	694	745	3311
Hour																						
6:45 - 7:45	2043	131	8	2182		16	16	5	37		38	249	377	664		16	699	46	761		3644	
7:00 - 8:00	1958	137	9	2104		20	14	7	41		40	288	395	721		15	745	45	805		3471	

PM PERIOD: February 7, 1996, Wednesday
WEATHER: Clear

TIME PERIOD	HALEAKALA HIGHWAY NORTHBOUND Left	Through	Right	Subtotal	Hourly	HALEAKALA HIGHWAY SOUTHBOUND Left	Through	Right	Subtotal	Hourly	HANA HIGHWAY EASTBOUND Left	Through	Right	Subtotal	Hourly	HANA HIGHWAY WESTBOUND Left	Through	Right	Subtotal	Hourly	INTERSECTION VOLUME Total	Hourly
4:00 - 4:15	169	14	3	186		15	39	4	58		4	164	298	466		8	106	8	122		832	
4:15 - 4:30	141	14	4	159		24	48	6	78		2	163	292	457		11	127	12	150		844	
4:30 - 4:45	181	10	0	191		34	42	12	88		0	131	288	419		11	122	5	138		836	
4:45 - 5:00	160	17	2	179	715	39	68	11	118	342	2	124	263	389	1731	13	137	14	164	574	850	3362
5:00 - 5:15	130	3	3	136	665	46	55	9	110	384	0	138	310	448	1713	5	122	5	132	584	826	3356
5:15 - 5:30	165	7	2	174	680	53	80	6	139	455	0	127	307	434	1690	6	127	10	143	577	890	3402
5:30 - 5:45	177	12	2	191	680	41	52	3	96	463	1	148	307	454	1725	11	119	12	142	581	883	3449
5:45 - 6:00	139	11	0	150	651	10	52	5	67	412	1	156	301	458	1794	11	105	10	126	543	801	3400
Hour																						
4:45 - 5:45	632	39	9	680		179	255	29	463		3	535	1187	1725		35	505	41	581		3449	
5:00 - 6:00	611	33	7	651		150	239	23	412		2	567	1225	1794		33	473	37	543		3400	

AUSTIN, TSUTSUMI & ASSOCIATES, INC.

INTERSECTION COUNT SUMMARY
HALEAKALA HIGHWAY AND PUKALANI BYPASS

AM PERIOD: February 7, 1996, Wednesday
WEATHER: Clear

TIME PERIOD	PUKALANI BYPASS NORTHBOUND					PUKALANI BYPASS SOUTHBOUND					HALEAKALA HWY EASTBOUND					INTERSECTION VOLUME	
	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Total	Hourly
6:30 - 6:45	0	256	0	256		0	0	66	66		208	0	0	208		530	
6:45 - 7:00	0	251	0	251		0	0	57	57		208	0	0	208		516	
7:00 - 7:15	0	338	0	338		0	0	87	87		254	0	0	254		679	
7:15 - 7:30	0	311	0	311	1156	0	0	100	100	310	245	0	0	245	915	656	2381
7:30 - 7:45	0	269	0	269	1169	0	0	96	96	340	161	0	0	161	868	526	2377
7:45 - 8:00	0	224	0	224	1142	0	0	105	105	388	150	0	0	150	810	479	2340
8:00 - 8:15	0	187	0	187	991	0	0	95	95	396	128	0	0	128	684	410	2071
8:15 - 8:30	0	191	0	191	871	0	0	94	94	390	108	0	0	108	547	393	1808
Hour																	
6:30 - 7:30	0	1156	0	1156		0	0	310	310		915	0	0	915		2377	
6:45 - 7:45	0	1169	0	1169		0	0	340	340		868	0	0	868		2340	

PM PERIOD: February 7, 1996, Wednesday
WEATHER: Clear

TIME PERIOD	PUKALANI BYPASS NORTHBOUND					PUKALANI BYPASS SOUTHBOUND					HALEAKALA HWY EASTBOUND					INTERSECTION VOLUME	
	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Total	Hourly
4:00 - 4:15	0	114	0	114		0	150	131	281		57	0	0	57		452	
4:15 - 4:30	0	94	0	94		0	167	167	334		55	0	0	55		483	
4:30 - 4:45	0	112	0	112		0	150	138	288		74	0	0	74		474	
4:45 - 5:00	0	99	0	99	419	0	165	136	301	1204	57	0	0	57	243	457	1866
5:00 - 5:15	0	87	0	87	392	0	169	166	335	1258	54	0	0	54	240	476	1890
5:15 - 5:30	0	101	0	101	399	0	182	144	326	1250	62	0	0	62	247	489	1896
5:30 - 5:45	0	92	0	92	379	0	193	167	360	1322	69	0	0	69	242	521	1943
5:45 - 6:00	0	109	0	109	389	0	182	153	335	1356	57	0	0	57	242	501	1987
Hour																	
5:00 - 6:00	0	389	0	389		0	726	630	1356		242	0	0	242		1987	

AUSTIN, TSUTSUMI & ASSOCIATES, INC.

INTERSECTION COUNT SUMMARY
PUKALANI BYPASS AND MAKANI ROAD

AM PERIOD: July 16, 1996, Tuesday
WEATHER:

TIME PERIOD	PUKALANI STREET										IOLANI STREET										INTERSECTION VOLUME	
	NORTHBOUND					SOUTHBOUND					EASTBOUND					WESTBOUND						
	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Total	Hourly
6:30 - 6:45	0	50	0	50		6	11	6	23		45	3	1	49		1	2	31	34		156	
6:45 - 7:00	0	43	4	47		10	17	21	48		48	4	0	52		0	3	36	39		186	
7:00 - 7:15	0	76	1	77		8	15	23	46		54	5	0	59		0	1	30	31		213	
7:15 - 7:30	0	50	0	50	224	9	11	24	44	161	57	5	1	63	223	1	7	31	39	143	196	751
7:30 - 7:45	1	43	0	44	218	6	11	18	35	173	64	3	0	67	241	1	5	21	27	136	173	768
7:45 - 8:00	4	31	1	36	207	8	16	24	48	173	46	9	2	57	246	0	4	19	23	120	164	746
8:00 - 8:15	2	38	3	43	173	7	16	19	42	169	37	3	2	42	229	0	1	16	17	106	144	677
8:15 - 8:30	0	25	1	26	149	5	13	27	45	170	51	6	1	58	224	0	2	22	24	91	153	634
Hour																						
7:00 - 8:00	5	200	2	207		31	53	89	173		221	22	3	246		2	17	101	120		746	
6:45 - 7:45	1	212	5	218		33	54	86	173		223	17	1	241		2	16	118	136		768	

PM PERIOD: July 16, 1996, Tuesday
WEATHER:

TIME PERIOD	PUKALANI BYPASS										IOLANI STREET										INTERSECTION VOLUME	
	NORTHBOUND					SOUTHBOUND					EASTBOUND					WESTBOUND						
	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Total	Hourly
4:00 - 4:15	1	26	0	27		26	30	59	115		31	5	0	36		0	0	18	18		196	
4:15 - 4:30	0	26	4	30		27	26	54	107		30	1	1	32		1	3	23	27		196	
4:30 - 4:45	1	21	0	22		27	42	62	131		41	7	1	49		2	4	10	16		218	
4:45 - 5:00	4	23	0	27	106	37	42	91	170	523	33	10	3	46	163	1	4	12	17	78	260	870
5:00 - 5:15	0	25	0	25	104	32	54	48	134	542	24	6	1	31	158	2	1	17	20	80	210	884
5:15 - 5:30	2	33	0	35	109	41	44	63	148	583	27	2	0	29	155	2	1	14	17	70	229	917
5:30 - 5:45	0	27	0	27	114	34	42	54	130	582	28	4	0	32	138	0	0	15	15	69	204	903
5:45 - 6:00	0	22	0	22	109	24	35	55	114	526	26	4	1	31	123	1	8	12	21	73	188	831
Hour																						
4:30 - 5:30	7	102	0	109		137	182	264	583		125	25	5	155		7	10	53	70		917	

AUSTIN, TSUTSUMI & ASSOCIATES, INC.

INTERSECTION COUNT SUMMARY
PUKALANI BYPASS AND MAKAWAO AVENUE

AM PERIOD: February 7, 1996, Wednesday
WEATHER: Clear

TIME PERIOD	PUKALANI BYPASS										MAKAWAO AVENUE										INTERSECTION VOLUME	
	NORTHBOUND					SOUTHBOUND					EASTBOUND					WESTBOUND						
	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Total	Hourly
6:30 - 6:45	2	117	11	130		5	7	1	13		2	31	0	33		13	36	99	148		324	
6:45 - 7:00	3	107	17	127		5	4	2	11		3	45	1	49		26	40	83	149		336	
7:00 - 7:15	0	130	31	161		8	0	4	12		1	44	1	46		23	48	114	185		404	
7:15 - 7:30	0	97	42	139	557	20	5	2	27	63	6	53	1	60	188	37	64	102	203	685	429	1493
7:30 - 7:45	1	98	46	145	572	14	6	5	25	75	6	61	3	70	225	48	81	67	196	733	436	1605
7:45 - 8:00	1	82	23	106	551	5	6	0	11	75	8	56	1	65	241	40	74	68	182	766	364	1633
8:00 - 8:15	0	105	16	121	511	8	2	2	12	75	3	46	1	50	245	19	42	43	104	685	287	1516
8:15 - 8:30	1	91	18	110	482	5	4	3	12	60	8	45	3	56	241	23	53	51	127	609	305	1392
Hour 7:00 - 8:00	2	407	142	551		47	17	11	75		21	214	6	241		148	267	351	766		1633	

PM PERIOD: February 7, 1996, Wednesday
WEATHER: Clear

TIME PERIOD	PUKALANI BYPASS										MAKAWAO AVENUE										INTERSECTION VOLUME	
	NORTHBOUND					SOUTHBOUND					EASTBOUND					WESTBOUND						
	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Total	Hourly
4:00 - 4:15	1	55	17	73		53	55	10	118		6	73	0	79		25	60	33	118		388	
4:15 - 4:30	0	60	28	88		53	61	4	118		2	79	2	83		16	57	27	100		389	
4:30 - 4:45	2	57	33	92		54	49	6	109		1	70	1	72		26	76	27	129		402	
4:45 - 5:00	0	53	36	89	342	78	46	13	137	482	6	72	1	79	313	28	60	22	110	457	415	1594
5:00 - 5:15	0	43	26	69	333	59	45	10	114	478	7	69	1	77	311	28	76	22	126	465	386	1592
5:15 - 5:30	0	51	23	74	324	69	63	12	144	504	5	64	1	70	298	21	60	25	106	471	394	1597
6:30 - 6:45	1	41	17	59	291	66	60	8	134	529	3	64	0	67	293	21	50	31	102	444	362	1557
6:45 - 6:00	0	61	26	77	279	56	70	7	133	525	3	84	1	88	302	15	65	21	101	435	399	1541
Hour 4:30 - 5:30	2	204	118	324		260	203	41	504		19	275	4	298		103	272	96	471		1597	
4:45 - 5:45	1	188	102	291		272	214	43	529		21	269	3	293		98	246	100	444		1557	

AUSTIN, TSUTSUMI & ASSOCIATES, INC.

INTERSECTION COUNT SUMMARY
PUKALANI BYPASS, KULA HIGHWAY AND HALEAKALA HIGHWAY

AM PERIOD: February 5, 1996, Thursday
WEATHER: Clear

TIME PERIOD	PUKALANI BYPASS / KULA HIGHWAY										HALEAKALA HWY										INTERSECTION VOLUME	
	NORTHBOUND					SOUTHBOUND					EASTBOUND					WESTBOUND						
	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Total	Hourly
6:30 - 6:45	17	81	1	99		2	14	0	16		1	12	26	39		1	6	11	18		172	
6:45 - 7:00	18	102	3	123		7	21	0	28		0	12	36	48		1	4	13	18		217	
7:00 - 7:15	37	139	8	184		4	21	0	25		0	22	40	62		7	4	18	29		300	
7:15 - 7:30	26	102	22	150	556	2	44	1	47	116	0	15	62	77	226	7	3	31	41	106	315	1,004
7:30 - 7:45	41	129	23	193	650	4	68	0	72	172	1	13	76	90	277	14	11	22	47	135	402	1,234
7:45 - 8:00	38	111	15	164	691	8	37	0	45	189	0	16	37	53	282	16	9	16	41	158	303	1,320
8:00 - 8:15	26	80	6	112	619	3	18	0	21	185	1	15	36	52	272	4	9	19	32	161	217	1,237
8:15 - 8:30	34	92	6	132	601	2	25	0	27	165	0	9	37	46	241	1	5	13	19	139	224	1,146
Hour 7:00 - 8:00	142	481	68	691		18	170	1	189		1	66	215	282		44	27	87	158		1,320	

PM PERIOD: February 8, 1996, Thursday
WEATHER: Clear

TIME PERIOD	PUKALANI BYPASS / KULA HIGHWAY										HALEAKALA HWY										INTERSECTION VOLUME	
	NORTHBOUND					SOUTHBOUND					EASTBOUND					WESTBOUND						
	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Total	Hourly
4:00 - 4:15	26	74	3	103		8	64	1	73		0	12	45	57		4	10	19	33		266	
4:15 - 4:30	17	59	5	81		14	82	1	97		0	12	34	46		5	9	28	42		266	
4:30 - 4:45	30	63	4	97		10	80	1	91		0	8	36	44		5	9	18	32		264	
4:45 - 5:00	40	48	5	93	374	7	65	1	73	334	0	4	39	43	190	7	9	18	34	141	243	1,039
5:00 - 5:15	44	50	7	101	372	16	92	0	108	369	0	16	44	60	193	4	3	14	21	129	290	1,063
5:15 - 5:30	34	66	5	105	396	19	93	0	112	384	0	7	50	57	204	6	7	15	28	115	302	1,099
5:30 - 5:45	33	60	2	95	394	10	87	0	97	390	0	9	39	48	208	5	9	10	24	107	264	1,099
5:45 - 6:00	26	58	7	91	392	13	89	1	103	420	0	8	43	51	216	4	10	15	29	102	274	1,130
Hour 4:30 - 5:30	148	227	21	396		52	330	2	384		0	35	169	204		22	28	65	115		1,099	
5:00 - 6:00	137	234	21	392		58	361	1	420		0	40	176	216		19	29	54	102		1,130	

AUSTIN, TSUTSUMI & ASSOCIATES, INC.

INTERSECTION COUNT SUMMARY
PUKALANI STREET AND HALEAKALA HIGHWAY

AM PERIOD: February 29, 1996, Thursday
WEATHER: Clear

TIME PERIOD	PUKALANI STREET NORTHBOUND				HALEAKALA HIGHWAY EASTBOUND				HALEAKALA HIGHWAY WESTBOUND				INTERSECTION VOLUME	
	Left	Right	Subtotal	Hourly	Through	Right	Subtotal	Hourly	Left	Through	Subtotal	Hourly	Total	Hourly
6:45 - 7:00	149	33	182		56	29	85		23	55	78		345	
7:00 - 7:15	187	34	221		36	21	57		43	46	89		367	
7:15 - 7:30	161	39	200		46	40	86		62	64	126		412	
7:30 - 7:45	111	45	156	759	42	51	93	321	65	37	102	395	351	1,475
7:45 - 8:00	96	34	130	707	53	40	93	329	55	42	97	414	320	1,450
8:00 - 8:15	78	29	107	593	55	25	80	352	34	33	67	392	254	1,337
8:15 - 8:30	58	37	95	488	66	43	109	375	46	21	67	333	271	1,196
Hour														
6:45 - 7:45	608	151	759		180	141	321		193	202	395		1,475	

PM PERIOD: February 29, 1996, Thursday
WEATHER: Clear

TIME PERIOD	PUKALANI STREET NORTHBOUND				HALEAKALA HIGHWAY EASTBOUND				HALEAKALA HIGHWAY WESTBOUND				INTERSECTION VOLUME	
	Left	Right	Subtotal	Hourly	Through	Right	Subtotal	Hourly	Left	Through	Subtotal	Hourly	Total	Hourly
4:00 - 4:15	51	55	106		37	109	146		55	26	81		333	
4:15 - 4:30	54	56	110		42	110	152		59	15	74		336	
4:30 - 4:45	41	77	118		51	117	168		66	21	87		373	
4:45 - 5:00	39	73	112	446	55	131	186	652	60	32	92	334	390	1,432
5:00 - 5:15	41	80	121	461	47	126	173	679	76	24	100	353	394	1,493
5:15 - 5:30	44	64	108	459	46	129	175	702	78	33	111	390	394	1,551
5:30 - 5:45	54	82	136	477	41	110	151	685	63	26	89	392	376	1,554
5:45 - 6:00	52	89	141	506	45	132	177	676	63	24	87	387	405	1,569
Hour														
4:30 - 5:30	165	294	459		199	503	702		280	110	390		1,551	
5:00 - 6:00	191	315	506		179	497	676		280	107	387		1,569	

AUSTIN, TSUTSUMI & ASSOCIATES, INC.

INTERSECTION COUNT SUMMARY
HALEAKALA HIGHWAY AND MAKAWAO AVENUE

AM PERIOD: February 29, 1996, Thursday
WEATHER: Clear

	MAKAWAO AVENUE										HALEAKALA HIGHWAY										INTERSECTION VOLUME	
	NORTHBOUND					SOUTHBOUND					EASTBOUND					WESTBOUND						
TIME PERIOD	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Total	Hourly
6:30 - 6:45	9	10	7	26		6	4	27	37		34	41	2	77		2	19	5	26		166	
6:45 - 7:00	7	10	2	19		5	9	30	44		27	50	3	80		4	23	2	29		172	
7:00 - 7:15	6	15	10	31		6	8	34	48		34	55	0	89		5	34	4	43		211	
7:15 - 7:30	12	21	14	47	123	3	10	43	56	185	30	37	4	71	317	6	37	2	45	143	219	768
7:30 - 7:45	5	17	14	36	133	10	17	55	82	230	37	46	1	84	324	8	38	7	53	170	255	857
7:45 - 8:00	3	14	7	24	138	3	17	58	78	264	43	59	1	103	347	6	42	16	64	205	269	954
8:00 - 8:15	6	11	3	20	127	3	7	37	47	263	29	53	4	86	344	4	11	2	17	179	170	913
8:15 - 8:30	2	10	5	17	97	6	5	35	46	253	46	56	4	106	379	3	29	3	35	169	204	898
Hour																						
7:00 - 8:00	26	67	45	138		22	52	190	264		144	197	6	347		25	151	29	205		954	
7:30 - 8:30	16	62	29	97		22	46	185	253		155	214	10	379		21	120	28	169		898	

PM PERIOD: February 29, 1996, Thursday
WEATHER: Clear

	MAKAWAO AVENUE										MAKAWAO AVENUE										INTERSECTION VOLUME	
	NORTHBOUND					SOUTHBOUND					EASTBOUND					WESTBOUND						
TIME PERIOD	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Total	Hourly
4:00 - 4:15	6	7	7	20		14	12	53	79		66	38	5	109		4	31	10	45		253	
4:15 - 4:30	12	13	6	31		9	13	56	78		57	42	5	104		6	21	9	36		249	
4:30 - 4:45	6	16	6	28		5	21	59	85		73	37	11	121		2	30	8	40		274	
4:45 - 5:00	2	12	8	22	101	15	22	61	98	340	76	40	11	127	461	7	33	6	46	167	293	1,069
5:00 - 5:15	6	16	11	33	114	14	12	64	90	351	57	48	5	110	462	10	25	5	40	162	273	1,089
5:15 - 5:30	5	13	6	24	107	12	11	67	90	363	62	44	6	112	470	7	37	8	52	178	278	1,118
5:30 - 5:45	4	14	4	22	101	10	9	53	72	350	75	39	4	118	467	5	36	4	45	183	257	1,101
5:45 - 6:00	5	18	6	29	106	10	21	58	89	341	77	43	5	125	465	3	26	5	34	171	277	1,085
Hour																						
4:30 - 5:30	19	57	31	107		46	66	251	363		268	169	33	470		26	125	27	178		1,118	

AUSTIN, TSUTSUMI & ASSOCIATES, INC.

INTERSECTION COUNT SUMMARY
PUKALANI STREET AND IOLANI STREET

AM PERIOD: July 16, 1996, Tuesday
WEATHER:

	PUKALANI STREET										IOLANI STREET										INTERSECTION VOLUME	
TIME PERIOD	NORTHBOUND					SOUTHBOUND					EASTBOUND					WESTBOUND						
	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Total	Hourly
6:30 - 6:45	0	50	0	50		8	11	6	23		45	3	1	49		1	2	31	34		156	
6:45 - 7:00	0	43	4	47		10	17	21	48		48	4	0	52		0	3	36	39		186	
7:00 - 7:15	0	76	1	77		8	15	23	46		54	5	0	59		0	1	30	31		213	
7:15 - 7:30	0	50	0	50	224	9	11	24	44	161	57	5	1	63	223	1	7	31	39	143	196	751
7:30 - 7:45	1	43	0	44	218	6	11	18	35	173	64	3	0	67	241	1	5	21	27	136	173	768
7:45 - 8:00	4	31	1	36	207	8	16	24	48	173	46	9	2	57	246	0	4	19	23	120	164	746
8:00 - 8:15	2	38	3	43	173	7	16	19	42	169	37	3	2	42	229	0	1	16	17	106	144	677
8:15 - 8:30	0	25	1	26	149	6	13	27	45	170	51	6	1	58	224	0	2	22	24	91	153	634
Hour																						
7:00 - 8:00	5	200	2	207		31	53	89	173		221	22	3	246		2	17	101	120		746	
6:45 - 7:45	1	212	5	218		33	54	86	173		223	17	1	241		2	16	118	136		768	

PM PERIOD: July 16, 1996, Tuesday
WEATHER:

	PUKALANI BYPASS										IOLANI STREET										INTERSECTION VOLUME	
TIME PERIOD	NORTHBOUND					SOUTHBOUND					EASTBOUND					WESTBOUND						
	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Total	Hourly
4:00 - 4:15	1	26	0	27		26	30	59	115		31	5	0	36		0	0	18	18		196	
4:15 - 4:30	0	26	4	30		27	26	54	107		30	1	1	32		1	3	23	27		196	
4:30 - 4:45	1	21	0	22		27	42	62	131		41	7	1	49		2	4	10	16		218	
4:45 - 5:00	4	23	0	27	106	37	42	91	170	523	33	10	3	46	163	1	4	12	17	78	260	870
5:00 - 5:15	0	25	0	25	104	32	54	48	134	542	24	6	1	31	158	2	1	17	20	80	210	884
5:15 - 5:30	2	33	0	35	109	41	44	63	148	583	27	2	0	29	155	2	1	14	17	70	229	917
5:30 - 5:45	0	27	0	27	114	34	42	54	130	582	28	4	0	32	138	0	0	15	15	69	204	903
5:45 - 6:00	0	22	0	22	109	24	35	55	114	526	26	4	1	31	123	1	8	12	21	73	188	831
Hour																						
4:30 - 5:30	7	102	0	109		137	182	264	583		125	25	5	155		7	10	53	70		917	

AUSTIN, TSUTSUMI & ASSOCIATES, INC.

INTERSECTION COUNT SUMMARY
KULA HIGHWAY AND OHANA STREET

AM PERIOD: February 8, 1996, Thursday
WEATHER: Clear

TIME PERIOD	KULA HIGHWAY										OHANA STREET					INTERSECTION VOLUME	
	NORTHBOUND					SOUTHBOUND					WESTBOUND						
	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Total	Hourly
6:30 - 6:45	0	99	0	99		0	41	0	41		0	0	1	1		141	
6:45 - 7:00	1	133	2	136		3	42	0	45		0	0	5	5		186	
7:00 - 7:15	0	156	0	156		2	42	0	44		0	0	5	5		205	
7:15 - 7:30	0	131	1	132	523	0	94	0	94	224	0	0	5	5	16	231	763
7:30 - 7:45	0	153	1	154	578	4	118	0	122	305	2	0	7	9	24	285	907
7:45 - 8:00	0	150	2	152	594	3	68	1	72	332	1	0	0	1	20	225	946
8:00 - 8:15	0	102	1	103	541	3	51	0	54	342	1	0	4	5	20	162	903
8:15 - 8:30	0	121	1	122	531	2	60	0	62	310	0	0	7	7	22	191	863
Hour 7:00 - 8:00	0	590	4	594		9	322	1	332		3	0	17	20		946	

PM PERIOD: February 8, 1996, Thursday
WEATHER: Clear

TIME PERIOD	KULA HIGHWAY										OHANA STREET					INTERSECTION VOLUME	
	NORTHBOUND					SOUTHBOUND					WESTBOUND						
	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Left	Through	Right	Subtotal	Hourly	Total	Hourly
4:00 - 4:15	0	96	0	96		2	110	0	112		0	0	4	4		212	
4:15 - 4:30	0	67	1	68		4	107	0	111		2	0	1	3		182	
4:30 - 4:45	0	96	1	97		4	116	0	120		2	0	4	6		223	
4:45 - 5:00	0	82	0	82	343	6	103	0	109	452	1	0	2	3	16	194	811
5:00 - 5:15	0	85	0	85	332	4	129	0	133	473	1	0	6	7	19	225	824
5:15 - 5:30	0	94	0	94	358	4	139	0	143	505	0	0	4	4	20	241	883
5:30 - 5:45	0	84	0	84	345	3	123	0	126	511	0	0	2	2	16	212	872
5:45 - 6:00	0	82	0	82	345	6	122	0	128	530	1	0	5	6	19	216	894
Hour 5:00 - 6:00	0	345	0	345		17	513	0	530		2	0	17	19		894	

APPENDIX B

LEVEL OF SERVICE CALCULATIONS

KULAMALU
EXISTING 1996 CONDITIONS
AM PEAK HOUR

10/22/96
09:59:02

SIGNAL94/TEAPAC[VI L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & HANA HWY

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	SB	WB	NB	EB
GRADES	.0	.0	.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	0	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	46	699	16	8	131	2043	377	249	38	5	16	16
WIDTHS	12.0	24.0	12.0	12.0	12.0	12.0	12.0	24.0	12.0	12.0	12.0	.0
LANES	1	2	1	1	1	1	1	2	1	1	1	0
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	FFLW	NORM	DOPT	FFLW	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1539	3725	1770	0	1784	1770	0	3725	1770	1539	1817	0

Phasing Parameters

SEQUENCES	67				
PERMISSIVES	NO	NO	NO	NO	
OVERLAPS	NO	NO	NO	NO	
CYCLES	60	180	10		
GREENTIMES	5.00	3.00	22.00	25.00	19.00
YELLOWTIMES	4.00	4.00	.00	4.00	4.00
CRITICALS	5	5	5	9	2
EXCESS	0				

LEADLAGS	NONE	NONE
OFFSET	.00	1
PEDTIME	.0	0

KULAMALU
EXISTING 1996 CONDITIONS
AM PEAK HOUR

10/22/96
09:59:07

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - HALEAKALA HWY & HANA HWY
Degree of Saturation (v/c) 1.65 Vehicle Delay 52.5@ Level of Service E
@ expect more delay due to extreme v/c's (see EVALUATE)

```
Sq 67 | Phase 1   | Phase 2    | Phase 3    | Phase 4     | Phase 5     |
**/** --------------------------------------------------------------------
      |    +      |            | + +        |             |             |
  .   |    +      |            | + +        |             |             |
 /|\  |    +>     |            |<+ +        |      <++++  |             |
  |   |           |            |   v        |       ++++  |             |
  |   |           |            |            |        v    |++++         |
North |   <+      |    <+ +    |       +    |             |++++>        |
  |   |    +      |     + +    |       +    |             |++++         |
      |    +      |     + +    |       +    |             |  v          |
      --------------------------------------------------------------------
      | G/C= .056 | G/C= .033  | G/C= .244  | G/C= .278   | G/C= .211   |
      | G=   5.0" | G=   3.0"  | G=  22.0"  | G=  25.0"   | G=  19.0"   |
      | Y+R= 4.0" | Y+R= 4.0"  | Y+R=   .0" | Y+R= 4.0"   | Y+R= 4.0"   |
      | OFF=  .0% | OFF=10.0%  | OFF=17.8%  | OFF=42.2%   | OFF=74.4%   |
      --------------------------------------------------------------------
      C= 90 sec   G= 74.0 sec = 82.2%   Y=16.0 sec = 17.8%   Ped= .0 sec = .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
SB Approach								29.4	D+	
RT	12/1	.096	.222	239	342	48	.140	18.2	C+	47 ft
TH	24/2	.242	.222	656	828	736	.889	30.2	*D+	362 ft
LT	12/1	.078	.078	18	125	17	.123	25.0	C	25 ft
NB Approach								16.1	C+	
TH	24/2	.126	.300	979	1118	262	.234	15.3	C+	116 ft
LT	12/1	.087	.156	160	269	40	.145	21.2	*C	43 ft
WB Approach								66.0@	F	
TH	12/1-	.672	.300	433	535	1174	2.194	65.9@	*F	1040 ft
LT	12/1+	.647	.300	429	531	1115	2.100	66.0@	F	987 ft
EB Approach								17.4	C+	
RT	12/1	.074	.233	257	359	5	.014	17.1	C+	25 ft
LT+TH	12/1	.084	.233	311	424	34	.080	17.4	C+	33 ft

KULAMALU
EXISTING 1996 CONDITIONS
PM PEAK HOUR

10/22/96
09:59:45

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & HANA HWY

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	SB	WB	NB	EB
GRADES	.0	.0	.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	0	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	37	473	33	7	33	611	1225	567	2	23	239	150
WIDTHS	12.0	24.0	12.0	12.0	12.0	12.0	12.0	24.0	12.0	12.0	12.0	.0
LANES	1	2	1	1	1	1	1	2	1	1	1	0
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	FFLW	NORM	DOPT	FFLW	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1539	3725	1770	0	1783	1770	0	3725	1770	1539	1828	0

Phasing Parameters

SEQUENCES	67							
PERMISSIVES	NO	NO	NO	NO		LEADLAGS	NONE	NONE
OVERLAPS	NO	NO	NO	NO		OFFSET	.00	1
CYCLES	60	180	10			PEDTIME	.0	0
GREENTIMES	5.00	3.00	22.00	25.00	19.00			
YELLOWTIMES	4.00	4.00	.00	4.00	4.00			
CRITICALS	12	0	11	8	2			
EXCESS	0							

KULAMALU
EXISTING 1996 CONDITIONS
PM PEAK HOUR

10/22/96
09:59:50

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - HALEAKALA HWY & HANA HWY
Degree of Saturation (v/c) .64 Vehicle Delay 24.3 Level of Service C

```
        -------------------------------------------------------------------------------
Sq 67  |  Phase 1  |  Phase 2  |  Phase 3  |  Phase 4  |  Phase 5  |
**/**  -------------------------------------------------------------------------------
       |    +      |           | + +       |           |           |
       |    +      |           | + +       |           |           |
 /|\   |    +>     |           |<+ +       |    <++++  |           |
  |    |           |           |   v       |     ++++  |           |
  |    |           |           |           |     v     |++++       |
North  |   <+      |  <+ +     |     +     |           |++++>      |
  |    |    +      |   + +     |     +     |           |++++       |
       |    +      |   + +     |     +     |           |  v        |
        -------------------------------------------------------------------------------
       | G/C= .056 | G/C= .033 | G/C= .244 | G/C= .278 | G/C= .211 |
       | G=   5.0" | G=   3.0" | G=  22.0" | G=  25.0" | G=  19.0" |
       | Y+R= 4.0" | Y+R= 4.0" | Y+R=  .0" | Y+R= 4.0" | Y+R= 4.0" |
       | OFF=  .0% | OFF=10.0% | OFF=17.8% | OFF=42.2% | OFF=74.4% |
        -------------------------------------------------------------------------------
        C= 90 sec   G= 74.0 sec = 82.2%   Y=16.0 sec = 17.8%   Ped=  .0 sec =   .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
SB Approach								21.2	C	
RT	12/1	.090	.222	239	342	39	.114	18.0	C+	38 ft
TH	24/2	.184	.222	656	828	498	.601	21.2	*C	245 ft
LT	12/1	.085	.078	18	125	35	.254	25.4	D+	41 ft
NB Approach								17.4	C+	
TH	24/2	.208	.300	979	1118	597	.534	17.4	*C+	264 ft
LT	12/1	.073	.156	160	269	2	.007	20.8	C	25 ft
WB Approach								19.4	C+	
TH	12/1-	.257	.300	433	535	348	.650	19.7	C+	308 ft
LT	12/1+	.249	.300	429	531	330	.621	19.1	C+	292 ft
EB Approach								45.4	E+	
RT	12/1	.082	.233	257	359	24	.067	17.4	C+	25 ft
LT+TH	12/1	.283	.233	313	426	410	.962	47.1	*E+	398 ft

```
ATA Inc.              STOP CONTROLLED T-INTERSECTION LEVEL OF SERVICE ANALYSIS                    1994 HCM
=========================================================================================================
Major Street: PUKALANI BYPASS                                                 Print Date:    27-Mar
Minor Street: HALEAKALA HWY                                                     Analyst:        BC
   Peak Hour:        PM                                                        File Name:   HALBYP-P
   Scenario: EXISTING 1996                                                   Intersection:
---------------------------------------------------------------------------------------------------------
Peak Hour Factor:       1.00 :
--------MAJOR STREET-------- : V2      726 -----------)              (---- -----  389      V5
    Num of Lanes - V2:     2 :
   Excl RT - V3 (Y/N):     Y : V3      630 -----                           -----    0      V4
Stop/Yield - V3 (Y/N):     N :              \                            /
      % Grade - V2,V3:     3 :               v                          .        MAJOR STREET:
                             :                                                   PUKALANI BYPASS
    Num of Lanes - V5:     1 :                       (              .
   Excl LT - V4 (Y/N):     N :                        \            /
      % Grade - V4,V5:    -3 :                         :          :
                             :                         :          :                 ↑
--------MINOR STREET-------- :                        242         0              <X-  NORTH
 Num of Lanes - V7,V9:     1 :
    Shared Lane (Y/N):     N :                        V7         V9
      % Grade - V7&V9:     0 :               MINOR STREET: HALEAKALA HWY
---------------------------------------------------------------------------------------------------------
VOLUME ADJUSTMENTS
  MOVEMENT NO.                   2          3             4             5          7           9
  VOLUME, V (vph)              726        630             0           389        242           0
  VOLUME, v (pcph)             726        630             0           389        266           0
---------------------------------------------------------------------------------------------------------
STEP 1: RT FROM MINOR STREET - V9
  Conflicting Flows:     : Vc,9 = 1/2*V3+V2 =            0  +   726        =          726   vph
  Potential Capacity:    : Cp,9 =                                                     594  pcph
  Movement Capacity:     : Cm,9 = Cp,9 =                                              594  pcph
---------------------------------------------------------------------------------------------------------
STEP 2: LT FROM MAJOR STREET - V4
  Conflicting Flows:              : Vc,4 = V3+V2 =            0  +   726   =          726   vph
  Potential Capacity:             : Cp,4 =                                            699  pcph
  Movement Capacity:              : Cm,4 = Cp,4 =                                     699  pcph
  Prob. of Queue-free State:      : po,4 = 1-v4/Cm,4 =                               1.00
  Major Left Shared Lane          :
   Prob. of Queue-free State:     : p*o,4 =                                          1.00
---------------------------------------------------------------------------------------------------------
STEP 3: LT FROM MINOR STREET - V7
  Conflicting Flows:              : Vc,7 = 1/2V3+V2+V5+V4 =                          1115   vph
  Potential Capacity:             : Cp,7 =                                            229  pcph
  Capacity Adjustment Factor      :
   Due To Impeding Movements:       f7=po,4=                                         1.00
  Movement Capacity:              : Cm,7 = Cp,7 =                                     229  pcph
---------------------------------------------------------------------------------------------------------
DELAY AND LEVEL OF SERVICE SUMMARY                          csh     AVG TOTAL
     Movement                  v(pcph)        cm(pcph)    (pcph)     DELAY       LOS
  ------------               ------------     --------    ------    ------     ------
  MINOR LEFT TURN   (7)         266              229      --NA--     150.5        F
  MINOR RIGHT TURN  (9)           0              594      --NA--       6.1        B
  MAJOR LEFT TURN   (4)           0              699      ------       5.2        A
---------------------------------------------------------------------------------------------------------
     AVERAGE MINOR APPROACH DELAY =  150.5 sec/veh   :    AVERAGE TOTAL INTERSECTION DELAY =    17.3 sec/veh
             LEVEL OF SERVICE =      F                               LEVEL OF SERVICE =      C
=========================================================================================================
```

```
ATA Inc.        TWO-WAY STOP CONTROLLED INTERSECTION LEVEL OF SERVICE ANALYSIS             1994 HCM
====================================================================================================
Major Street:   PUKALANI BYPASS                                              Print Date:   25-Jul-96
Minor Street:   MAKANI ST                                                      Analyst:    BC
    Scenario:   EXISTING 1996                                                 File Name:    PUKMAK-A
   Peak Hour:        AM                                                   Intesection #:
----------------------------------------------------------------------------------------------------
                                  |           V12       V11       V10                .
      Peak Hour Factor:     1.00  |                                                  :
                                  |           257        54        12              NORTH
---------MAJOR STREET---------    |            |         |         |
    Num of Lanes - V2:         2  |            |         |         |
    Excl LT - V1 (Y/N):        Y  |           /          |          \
    Excl RT - V3 (Y/N):        N  |          <           v           >
  Stop/Yield - V3 (Y/N):       N  |
      Grade - V1,V2,V3:        0  |              ^                          ^
                                  |             /                            \
    Num of Lanes - V5:         1  | V1   0 -----                              ----   11 V6
    Excl LT - V4 (Y/N):        Y  |
    Excl RT - V6 (Y/N):        N  | V2   5 ------->                          <----  823 V5
  Stop/Yield - V6 (Y/N):       N  |
      Grade - V4,V5,V6:       -2  | V3   0 -----                              ----    8 V4
                                  |              \                            /
---------MINOR STREET---------    |               v                          v    MAJOR STREET
    Num of Lanes - V8:         1  |                                               PUKALANI BYPASS
      Grade - V7,V8,V9:        0  |           <          .          >
   Shared Lane-V7,8,9:         3  |            \         |         /
(0=N,1=LT,2=TR,3=LTR)             |             |        |        |
                                  |             |        |        |
    Num of Lanes - V11:        1  |            13        71       34
   Grade - V10,V11,V12:        0  |
Shared Lane-V10,11,12:         3  |            V7        V8       V9
(0=N,1=LT,2=TR,3=LTR)             |
                                  |          MINOR STREET - MAKANI ST
----------------------------------------------------------------------------------------------------
VOLUME ADJUSTMENTS                |
   MOVEMENT NO.                   |     1   2   3    4    5    6     7    8   9    10     11    12
   HOURLY FLOW RATE, V(vph)       |     0   5   0    8  822   11    13   71  34    12     54   257
   VOLUME, v (pcph)               |     0   5   0    9  923   11    14   78  37    13     59   283
----------------------------------------------------------------------------------------------------
STEP 1: RT FROM MINOR STREET      |                                 |
   Conflicting Flows:             |Vc9 = 1/2 V3 + V2 =       3 vhp  |  Vc12 = 1/2 V6 + V5 =    829 vhp
   Potential Capacity:            |Cp,9 =                 1381 pcph |  Cp,12 =                 527 pcph
   Movement Capacity:             |Cm,9=Cp,9=             1381 pcph |  Cm,12=Cp,12=            527 pcph
   Prb. of Queu-free State:       |po,9=1-v9/Cm,9=        0.97      |  po,12=1-v12/Cm,12=     0.46
----------------------------------------------------------------------------------------------------
STEP 2: LT FROM MAJOR STREET      |                                 |
   Conflicting Flows:             |Vc,4 = V2 + V3 =          5 vhp  |  Vc,1 = V5 + V6 =        834 vhp
   Potential Capacity:            |Cp,4 =                 1704 pcph |  Cp,1 =                  811 pcph
   Movement Capacity:             |Cm,4=Cp,4=             1704 pcph |  Cm,1=Cp,1=              811 pcph
   Prb. of Queu-free State:       |po,4=1-v4/Cm4=         1.00      |  po,1=1-v1/Cm1=         1.00
   Major Left Shared Lane         |
    Prob. of Queue-free State     |p*o,4=                   NA         p*o,1=                   NA
----------------------------------------------------------------------------------------------------
```


----continued ---

ATA Inc. TWO-WAY STOP CONTROLLED INTERSECTION LEVEL OF SERVICE ANALYSIS 1994 HCM

Major Street:	PUKALANI BYPASS	DATE:	25-Jul-96
Minor Street:	MAKANI ST	Analyst:	BC
Scenario:	EXISTING 1996	File Name:	PUKMAK-A
Peak Hour:	AM	Intesection Intesection #:	

STEP 3: TH FROM MINOR STREET

Conflicting Flows:	Vc.,8 = 1/2V3+V2+V1+V6+V5+V4 =	847 vph	Vc.,11 = 1/2V6+V5+V4+V3+V2+V1 =	842 vph
Potential Capacity:	Cp,8 =	349 pcph	Cp,11 =	351 pcph
Capacity Adj Factor:	f8 = po,4*po,1 =	1.00	f11 = po,4*po,1 =	1.00
Movement Capacity:	Cm,8 = Cp,8*f8 =	347 pcph	Cm,11 = Cp,11*f11 =	349 pcph
Prob. of Queue-free State:	po,8 = 1-v8/Cm,8 =	0.79	po,11 = 1-v11/Cm,11 =	0.83

STEP 4: LT FROM MINOR STREET

Conflicting Flows:	Vc,7 = 1/2V3+V2+V1+1/2V6+V5+V4+ 1/2(V11+V12) =	937 vph	Vc,10 = 1/2V6+V5+V4+1/2V3+V2+V1+ 1/2(V8+V9) =	877 vph
Potential Capacity:	Cp7 =	244 pcph	Cp10 =	291 pcph
Major Left, Minor Through Impedance Factor:	P''7=po,11*f11 =	0.83	P''10=po,8*f8 =	0.77
Major Left, Minor Through Adjusted Impedance Factor:	p'7 =	0.87	p'10 =	0.82
Capacity Adjustment Factor:	f7 = p'7*po,12 =	0.40	f10 = p'10*po,9 =	0.80
Movement Capacity:	Cm,7 = f7*Cp,7 =	98 pcph	Cm,10 = f10*Cp,10 =	233 pcph

DELAY AND LEVEL OF SERVICE SUMMARY

MOVEMENT	v(pcph)	cm(pcph)	csh(pcph)	AVG TOTAL DELAY	LOS
MINOR LEFT TURN (7)	14	98	SHRD	SHRD	--
MINOR THROUGH (8)	72	347	327	18.0	C
MINOR RIGHT TURN (9)	27	1381	SHRD	SHRD	----
MINOR LEFT TURN (10)	13	233	SHRD	SHRD	--
MINOR THROUGH (11)	59	349	466	23.4	D
MINOR RIGHT TURN (12)	283	527	SHRD	SHRD	--
MAJOR LEFT (1)	0	611	--NA--	5.9	B
MAJOR LEFT (4)	9	1704	--NA--	2.1	A
MINOR APPROACH (7)(8)(9)	-	-	-	18.0	C
MINOR APPROACH (10)(11)(12)	-	-	-	28.4	D
MAJOR APPROACH (1)(2)(3)	-	-	-	0.0	----
MAJOR APPROACH (4)(5)(6)	-	-	-	0.0	A
TOTAL INTERSECTION (1-12)	-	-	-	9.7	B

LEVEL OF SERVICE CRITERIA

LEVEL OF SERVICE	AVG TOTAL DELAY (SEC/VEH)
A	<=5
B	>5&<=10
C	>10&<=20
D	>20&<=30
E	>30&<=45
F	>45

```
ATA Inc.        TWO-WAY STOP CONTROLLED INTERSECTION LEVEL OF SERVICE ANALYSIS                 1994 HCM
*****************************************************************************************************
Major Street:   PUKALANI BYPASS                                                 Print Date:   26-Jul-96
Minor Street:   MAKANI ST                                                          Analyst:   BC
    Scenario:   EXISTING 1996                                                    File Name:    PUKMAK-P
   Peak Hour:       PM                                                      Intesection #:
-----------------------------------------------------------------------------------------------------
                              |                V12       V11         V10                      ^
     Peak Hour Factor:   1.00 |                                                               |
                              |                 36        35           4                    NORTH
---------MAJOR STREET-------- |                 |         |            |
    Num of Lanes - V2:      2 |                 |         |            |
    Excl LT - V1 (Y/N):     Y |                /          |             \
    Excl RT - V3 (Y/N):     N |               <           v              >
Stop/Yield - V2 (Y/N):      N |
       Grade - V1,V2,V3:    2 |           ^                                    ^
                              |          /                                      \
    Num of Lanes - V5:      1 | V1  183 -----                                    ----     11 V6
    Excl LT - V4 (Y/N):     Y |
    Excl RT - V6 (Y/N):     N | V2  500 ------->                                <----    320 V5
Stop/Yield - V6 (Y/N):      N |
       Grade - V4,V5,V6:   -2 | V3   23 -----                                    ----     17 V4
                              |              \                                  /
---------MINOR STREET-------- |               v                                v    MAJOR STREET
    Num of Lanes - V8:      1 |                                                     PUKALANI BYPASS
       Grade - V7,V8,V9:    0 |                   <         ^          >
    Shared Lane-V7,8,9:     3 |                    \        |         /
(0=N,1=LT,2=TR,3=LTR)         |                     |       |        |
                              |                     |       |        |
    Num of Lanes - V11:     1 |                      2      56       19
   Grade - V10,V11,V12:     0 |
Shared Lane-V10,11,12:      3 |                     V7      V8       V9
(0=N,1=LT,2=TR,3=LTR)         |
                              |                 MINOR STREET - MAKANI ST
-----------------------------------------------------------------------------------------------------
VOLUME ADJUSTMENTS            |
   MOVEMENT NO.               |     1    2   3    4    5    6     7    8   9    10     11    12
   HOURLY FLOW RATE, V(vph)   |   183  500  23   17  320   11     2   56  19     4     35    36
   VOLUME, v (pcph)           |   256  500  23   17  320   11     2   62  21     4     39    40
-----------------------------------------------------------------------------------------------------
STEP 1: RT FROM MINOR STREET  |                                |
   Conflicting Flows:         |Vc9 = 1/2 V3 + V2 =    262  vbp |  Vc12 = 1/2 V6 + V5 =    326 vbp
   Potential Capacity:        |Cp,9 =                1021 pcph |  Cp,12 =                  947 pcph
   Movement Capacity:         |Cm,9=Cp,9=            1021 pcph |  Cm,12=Cp,12=             947 pcph
   Prb. of Queu-free State:   |po,9=1-v9/Cm,9=       0.98      |  po,12=1-v12/Cm,12=    0.96
-----------------------------------------------------------------------------------------------------
STEP 2: LT FROM MAJOR STREET  |                                |
   Conflicting Flows:         |Vc,4 = V2 + V3 =       523  vbp |  Vc,1 = V5 + V6 =         331 vbp
   Potential Capacity:        |Cp,4 =                 832 pcph |  Cp,1 =                  1139 pcph
   Movement Capacity:         |Cm,4=Cp,4=             832 pcph |  Cm,1=Cp,1=              1139 pcph
   Prb. of Queu-free State:   |po,4=1-v4/Cm4=        0.98      |  po,1=1-v1/Cm1=        0.78
   Major Left Shared Lane     |                                |
    Prob. of Queue-free State |p"o,4=                  NA      |  p"o,1=                  NA
-----------------------------------------------------------------------------------------------------
```


----continued ----

Major Street:	PUKALANI BYPASS	DATE:	26-Jul-96
Minor Street:	MAKANI ST	Analyst:	BC
Scenario:	EXISTING 1996	File Name:	PUKMAK-P
Peak Hour:	PM	Intesection Intesection #:	

STEP 3: TH FROM MINOR STREET

Conflicting Flows:	Vc.,8 = 1/2V3+V2+V1+V6+V5+V4 =	1043 vph	Vc.,11 = 1/2V6+V5+V4+V3+V2+V1 =	1043 vph
Potential Capacity:	Cp,8 =	268 pcph	Cp,11 =	266 pcph
Capacity Adj Factor:	f8 = po,4*po,1 =	0.76	f11 = po,4*po,1 =	0.76
Movement Capacity:	Cm,8 = Cp,8*f8 =	204 pcph	Cm,11 = Cp,11*f11 =	202 pcph
Prob. of Queue-free State:	po,8 = 1-v8/Cm,8 =	0.70	po,11 = 1-v11/Cm,11 =	0.81

STEP 4: LT FROM MINOR STREET

Conflicting Flows:	Vc,7 = 1/2V3+V2+V1+1/2V6+V5+V4+ 1/2(V11+V12) =	1073 vph	Vc,10 = 1/2V6+V5+V4+1/2V3+V2+V1+ 1/2(V8+V9) =	1054 vph
Potential Capacity:	Cp7 =	218 pcph	Cp10 =	225 pcph
Major Left, Minor Through Impedance Factor:	P''7=po,11*f11 =	0.61	P''10=po,8*f8 =	0.53
Major Left, Minor Through Adjusted Impedance Factor:	p'7 =	0.70	p'10 =	0.63
Capacity Adjustment Factor:	f7 = p'7*po,12 =	0.67	f10 = p'10*po,9 =	0.62
Movement Capacity:	Cm,7 = f7*Cp,7 =	146 pcph	Cm,10 = f10*Cp,10 =	139 pcph

DELAY AND LEVEL OF SERVICE SUMMARY

MOVEMENT	v(pcph)	cm(pcph)	csh(pcph)	AVG TOTAL DELAY	LOS
MINOR LEFT TURN (7)	2	146	SHRD	SHRD	--
MINOR THROUGH (8)	62	204	251	21.5	D
MINOR RIGHT TURN (9)	21	1021	SHRD	SHRD	----
MINOR LEFT TURN (10)	4	139	SHRD	SHRD	--
MINOR THROUGH (11)	39	202	314	15.5	C
MINOR RIGHT TURN (12)	40	947	SHRD	SHRD	--
MAJOR LEFT (1)	256	1139	--NA--	4.1	A
MAJOR LEFT (4)	17	898	--NA--	4.1	A
MINOR APPROACH (7)(8)(9)	-	-	-	21.5	D
MINOR APPROACH (10)(11)(12)	-	-	-	15.5	C
MAJOR APPROACH (1)(2)(3)	-	-	-	1.3	A
MAJOR APPROACH (4)(5)(6)	-	-	-	0.2	A
TOTAL INTERSECTION (1-12)	-	-	-	3.5	A

LEVEL OF SERVICE CRITERIA

LEVEL OF SERVICE	AVG TOTAL DELAY (SEC/VEH)
A	<=5
B	>5&<=10
C	>10&<=20
D	>20&<=30
E	>30&<=45
F	>45

KULAMALU
EXISTING 1996 CONDITIONS
AM PEAK HOUR

10/22/96
10:02:57

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - PUKALANI BYPASS & MAKAWAO AV

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	SB	WB	NB	EB
GRADES	.0	-6.0	.0	6.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	33	104	1	11

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	351	267	148	142	407	2	6	214	21	11	17	47
WIDTHS	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	24.0	12.0
LANES	1	1	1	1	1	1	1	1	1	1	2	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1539	1863	815	1585	1919	1823	1539	1863	623	1493	3614	1717

Phasing Parameters

SEQUENCES	14						
PERMISSIVES	YES	NO	YES	NO	LEADLAGS	NONE	NONE
OVERLAPS	NO	NO	NO	NO	OFFSET	.00	1
CYCLES	60	180	10		PEDTIME	.0	0
GREENTIMES	25.00	8.00	25.00				
YELLOWTIMES	.00	.00	.00				
CRITICALS	0	0	0				
EXCESS	0						

KULAMALU
EXISTING 1996 CONDITIONS
AM PEAK HOUR

10/22/96
10:03:01

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - PUKALANI BYPASS & MAKAWAO AV
Degree of Saturation (v/c) .44 Vehicle Delay 9.1 Level of Service B+

```
        ------------------------------------
Sq 14  ¦  Phase 1   ¦  Phase 2   ¦  Phase 3  ¦
**/**  ------------------------------------
       ¦ + + +      ¦            ¦           ¦
       ¦ + + +      ¦            ¦      ++++¦
  /¦\  ¦<+ + +>     ¦            ¦     <++++¦
   ¦   ¦   v        ¦       ++++¦           ¦
   ¦   ¦            ¦++++    v   ¦           ¦
North  ¦    <+ + +> ¦            ¦++++>      ¦
   ¦   ¦     + + +  ¦            ¦++++       ¦
       ¦     + + +  ¦            ¦   v       ¦
       ------------------------------------
       ¦ G/C= .431  ¦ G/C= .138  ¦ G/C= .431 ¦
       ¦ G=  25.0"  ¦ G=   8.0"  ¦ G=  25.0" ¦
       ¦ Y+R=   .0" ¦ Y+R=   .0" ¦ Y+R=   .0"¦
       ¦ OFF=   .0% ¦ OFF=43.1%  ¦ OFF=56.9% ¦
       ------------------------------------
```

C= 58 sec G= 58.0 sec =100.0% Y= .0 sec = .0% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
SB Approach								9.0	B+	
RT	12/1	.254	.397	564	610	335	.549	9.5	B+	165 ft
TH	12/1	.183	.397	693	739	281	.380	8.2	B+	138 ft
LT	12/1	.246	.397	280	323	156	.483	9.4	B+	77 ft
NB Approach								7.7	B+	
RT	12/1	.009	.397	564	610	5	.008	6.8	B+	25 ft
TH	12/1	.152	.397	693	739	225	.304	7.8	B+	111 ft
LT	12/1	.000	.397	207	247	22	.089	7.1	B+	25 ft
WB Approach								9.3	B+	
RT	12/1	.044	.397	583	629	40	.064	7.0	B+	25 ft
TH	12/1	.254	.397	715	761	428	.562	9.5	B+	211 ft
LT	12/1	.004	.103	138	185	2	.011	15.1	C+	25 ft
EB Approach								13.2	B	
RT	12/1	.002	.397	546	592	1	.002	6.8	B+	25 ft
TH	24/2	.010	.397	1401	1433	18	.013	6.9	B+	25 ft
LT	12/1	.048	.103	128	173	49	.275	15.7	C+	36 ft

KULAMALU
EXISTING 1996 CONDITIONS
PM PEAK HOUR

10/22/96
10:04:18

SIGNAL94/TEAPAC|V1 L1.4| - Summary of Parameter Values

Intersection Parameters for Int # 0 - PUKALANI BYPASS & MAKAWAO AV

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	SB	WB	NB	EB
GRADES	.0	-6.0	.0	6.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	96	72	1	13

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	96	272	103	118	204	2	4	275	19	41	203	260
WIDTHS	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	24.0	12.0
LANES	1	1	1	1	1	1	1	1	1	1	2	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1539	1863	557	1585	1919	1823	1539	1863	565	1493	3614	1717

Phasing Parameters

SEQUENCES	14						
PERMISSIVES	YES	NO	YES	NO	LEADLAGS	NONE	NONE
OVERLAPS	NO	NO	NO	NO	OFFSET	.00	1
CYCLES	60	180	10		PEDTIME	.0	0
GREENTIMES	25.00	15.00	25.00				
YELLOWTIMES	.00	.00	.00				
CRITICALS	0	0	0				
EXCESS	0						

KULAMALU
EXISTING 1996 CONDITIONS
PM PEAK HOUR

10/22/96
10:05:01

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - PUKALANI BYPASS & MAKAWAO AV
Degree of Saturation (v/c) .43 Vehicle Delay 13.0 Level of Service B

```
           ----------------------------------------------
Sq 14    ¦  Phase 1   ¦  Phase 2    ¦  Phase 3   ¦
**/**    ----------------------------------------------
         ¦ + + +      ¦             ¦            ¦
  .      ¦ + + +      ¦             ¦       ++++ ¦
 /¦\     ¦<+ + +>     ¦             ¦      <++++ ¦
  ¦      ¦   v        ¦        ++++ ¦            ¦
  ¦      ¦            ¦++++     v   ¦            ¦
North    ¦    <+ + +> ¦             ¦++++>       ¦
  ¦      ¦     + + +  ¦             ¦++++        ¦
         ¦     + + +  ¦             ¦   v        ¦
         ----------------------------------------------
         ¦ G/C= .385  ¦ G/C= .231   ¦ G/C= .385  ¦
         ¦ G=  25.0"  ¦ G=  15.0"   ¦ G=  25.0"  ¦
         ¦ Y+R=   .0" ¦ Y+R=   .0"  ¦ Y+R=   .0" ¦
         ¦ OFF=   .0% ¦ OFF=38.5%   ¦ OFF=61.5%  ¦
         ----------------------------------------------
```

C= 65 sec G= 65.0 sec =100.0% Y= .0 sec = .0% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
SB Approach								11.4	B	
RT	12/1	.003	.354	488	545	1	.002	8.8	B+	25 ft
TH	12/1	.190	.354	601	659	286	.434	10.7	B	169 ft
LT	12/1	.267	.354	156	196	108	.548	13.3	B	64 ft
NB Approach								10.6	B	
RT	12/1	.007	.354	488	545	3	.006	8.8	B+	25 ft
TH	12/1	.192	.354	601	659	289	.439	10.7	B	171 ft
LT	12/1	.000	.354	159	199	20	.100	9.1	B+	25 ft
WB Approach								9.8	B+	
RT	12/1	.055	.354	504	561	48	.086	9.0	B+	28 ft
TH	12/1	.147	.354	620	679	215	.317	10.0	B+	127 ft
LT	12/1	.004	.200	297	365	2	.005	13.5	B	25 ft
EB Approach								17.4	C+	
RT	12/1	.039	.354	471	528	29	.055	8.9	B+	25 ft
TH	24/2	.081	.354	1224	1279	214	.167	9.3	B+	63 ft
LT	12/1	.198	.200	277	343	274	.799	24.6	[illegible]	200 ft

KULAMALU
EXISTING 1996 CONDITIONS
AM PEAK HOUR

10/22/96
10:06:27

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - BYPASS/KULA HWY & HALEAKALA HY

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	SB	WB	NB	EB
GRADES	3.0	.0	-3.0	.0
PEDLEVELS	MODER	MODER	MODER	MODER
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	18	31	100

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	1	170	18	87	27	44	68	481	142	215	66	1
WIDTHS	12.0	12.0	12.0	12.0	12.0	.0	12.0	12.0	.0	12.0	12.0	.0
LANES	1	1	1	1	1	0	1	1	0	1	1	0
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1385	1835	244	1406	1591	0	1427	1611	0	1406	1859	0

Phasing Parameters

SEQUENCES	11	ALL					
PERMISSIVES	YES	YES	YES	YES	LEADLAGS	NONE	NONE
OVERLAPS	NO	NO	NO	NO	OFFSET	.00	1
CYCLES	60	120	10		PEDTIME	.0	0
GREENTIMES	41.77	10.23					
YELLOWTIMES	4.00	4.00					
CRITICALS	8	10					
EXCESS	0						

KULAMALU
EXISTING 1996 CONDITIONS
AM PEAK HOUR

10/22/96
10:06:34

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - BYPASS/KULA HWY & HALEAKALA HY
Degree of Saturation (v/c) .40 Vehicle Delay 5.5 Level of Service B+

```
          ----------------------------
Sq 11   |  Phase 1  |  Phase 2  |
**/**   ----------------------------
        | + + +     |            |
        | + + +     |       ++++ |
  /|\   |<+ + +>    |      <++++ |
   |    |  v        |       ++++ |
   |    |           |++++    v   |
North   |    <* * +>|++++>       |
   |    |     * * + |****        |
        |     * * + |  v         |
        ----------------------------
        | G/C= .696 | G/C= .170  |
        | G=  41.8" | G=  10.2"  |
        | Y+R= 4.0" | Y+R= 4.0"  |
        | OFF=  .0% | OFF=76.3%  |
        ----------------------------
```

C= 60 sec G= 52.0 sec = 86.7% Y= 8.0 sec = 13.3% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
SB Approach								1.6	A	
RT	12/1	.003	.729	1002	1010	1	.001	1.4	A	25 ft
TH	12/1	.129	.729	1338	1338	179	.134	1.6	A	41 ft
LT	12/1	.000	.729	153	178	19	.107	1.5	A	25 ft
NB Approach								2.8	A	
RT	12/1	.049	.729	1034	1041	39	.037	1.5	A	25 ft
LT+TH	12/1	.434	.729	1173	1175	655	.557	2.8	*A	149 ft
WB Approach								13.0	B	
RT	12/1	.081	.204	231	287	73	.254	13.1	B	49 ft
LT+TH	12/1	.073	.204	265	324	74	.228	13.0	B	50 ft
EB Approach								13.6	B	
RT	12/1	.121	.204	231	287	121	.422	14.1	*B	81 ft
LT+TH	12/1	.060	.204	317	379	70	.185	12.8	B	47 ft

KULAMALU
EXISTING 1996 CONDITIONS
PM PEAK HOUR

10/22/96
10:07:45

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - BYPASS/KULA HWY & HALEAKALA HY

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	SB	WB	NB	EB
GRADES	3.0	.0	-3.0	.0
PEDLEVELS	MODER	MODER	MODER	MODER
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	41	14	96

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	1	361	58	54	29	19	21	234	137	176	40	0
WIDTHS	12.0	12.0	12.0	12.0	12.0	.0	12.0	12.0	.0	12.0	12.0	.0
LANES	1	1	1	1	1	0	1	1	0	1	1	0
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1385	1835	672	1406	1766	0	1427	1164	0	1406	1863	0

Phasing Parameters

SEQUENCES	11	ALL		
PERMISSIVES	YES	YES	YES	YES
OVERLAPS	NO	NO	NO	NO
CYCLES	60	120	10	
GREENTIMES	40.76	11.24		
YELLOWTIMES	4.00	4.00		
CRITICALS	8	5		
EXCESS	0			

LEADLAGS	NONE	NONE
OFFSET	.00	1
PEDTIME	.0	0

KULAMALU
EXISTING 1996 CONDITIONS
PM PEAK HOUR

10/22/96
10:07:49

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - BYPASS/KULA HWY & HALEAKALA HY
Degree of Saturation (v/c) .33 Vehicle Delay 4.2 Level of Service A

```
         --------------------------
Sq 11  ¦  Phase 1   ¦  Phase 2   ¦
**/**  --------------------------
       ¦ + + +      ¦            ¦
   .   ¦ + + +      ¦       ++++¦
  /¦\  ¦<+ + +>     ¦      <****¦
   ¦   ¦   v        ¦       ****¦
   ¦   ¦            ¦        v   ¦
North  ¦     <* * +>¦++++>       ¦
   ¦   ¦      * * + ¦++++        ¦
       ¦      * * + ¦  v         ¦
       --------------------------
       ¦ G/C= .679  ¦ G/C= .187  ¦
       ¦ G=  40.8"  ¦ G=  11.2"  ¦
       ¦ Y+R= 4.0"  ¦ Y+R= 4.0"  ¦
       ¦ OFF=  .0%  ¦ OFF=74.6%  ¦
       --------------------------
```

C= 60 sec G= 52.0 sec = 86.7% Y= 8.0 sec = 13.3% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
SB Approach								2.0	A	
RT	12/1	.003	.713	976	987	1	.001	1.6	A	25 ft
TH	12/1	.241	.713	1308	1308	380	.291	2.1	A	92 ft
LT	12/1	.000	.713	453	479	61	.127	1.8	A	25 ft
NB Approach								2.7	A	
RT	12/1	.013	.713	1007	1017	7	.007	1.6	A	25 ft
LT+TH	12/1	.377	.713	814	830	390	.470	2.7	*A	95 ft
WB Approach								12.1	B	
RT	12/1	.022	.221	254	310	14	.045	11.9	B	25 ft
LT+TH	12/1	.049	.221	329	390	51	.131	12.1	*B	34 ft
EB Approach								12.4	B	
RT	12/1	.091	.221	254	310	84	.271	12.6	B	55 ft
TH	12/1	.040	.221	349	411	42	.102	12.0	B	28 ft

KULAMALU
EXISTING 1996 CONDITIONS
AM PEAK HOUR

10/22/96
10:54:46

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & PUKALANI ST

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	EB ~~SB~~	SB ~~WB~~	WB ~~NB~~	NB ~~EB~~
GRADES	8.0	.0	-8.0	2.0
PEDLEVELS	MODER	MODER	MODER	MODER
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	141	0	0	135

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	141	180	0	0	0	0	0	202	193	151	0	608
WIDTHS	12.0	12.0	.0	.0	.0	.0	.0	12.0	12.0	12.0	.0	12.0
LANES	1	1	0	0	0	0	0	1	1	1	0	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1350	1788	0	0	0	0	0	1919	1823	1392	0	1392

Phasing Parameters

SEQUENCES	31			
PERMISSIVES	YES	YES	YES	YES
OVERLAPS	NO	NO	NO	NO
CYCLES	60	180	10	
GREENTIMES	5.00	15.00	30.00	
YELLOWTIMES	4.00	4.00	.00	
CRITICALS	9	12	12	
EXCESS	0			

LEADLAGS	NONE	NONE
OFFSET	.00	1
PEDTIME	.0	0

KULAMALU
EXISTING 1996 CONDITIONS
AM PEAK HOUR

10/22/96
10:54:51

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - HALEAKALA HWY & PUKALANI ST
Degree of Saturation (v/c) .65 Vehicle Delay 17.3 Level of Service C+

```
Sq 31 | Phase 1  | Phase 2  | Phase 3  |
**/** ----------------------------------
      |          | + +      |          |
  .   |          | + +      |          |
 /|\  |          |<+ +      |          |
  |   |          |   v      |          |
West  |          |          |****      |
North |   <* +   |   <+ +   |          |
  |   |    * +   |    + +   |++++      |
      |    * +   |    + +   |   v      |
      ----------------------------------
      | G/C= .086 | G/C= .259 | G/C= .517 |
      | G=   5.0" | G=  15.0" | G=  30.0" |
      | Y+R= 4.0" | Y+R= 4.0" | Y+R=  .0" |
      | OFF=  .0% | OFF=15.5% | OFF=48.3% |
      -------------------------------------
```

C= 58 sec G= 50.0 sec = 86.2% Y= 8.0 sec = 13.8% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								10.7	B	
RT	12/1	.003	.293	343	396	1	.003	9.4	B+	25 ft
TH	12/1	.137	.293	468	524	189	.361	10.7	B	109 ft
WB ~~NB~~ Approach								6.7	B+	
TH	12/1	.142	.448	821	860	213	.248	6.4	B+	96 ft
LT	12/1	.000	.121	448	487	203	.417	6.9	*B+	91 ft
NB ~~EB~~ Approach								26.0	D+	
RT	12/1	.026	.483	634	672	17	.025	5.1	B+	25 ft
LT	12/1	.487	.483	634	672	640	.952	26.6	*D+	270 ft

KULAMALU
EXISTING 1996 CONDITIONS
PM PEAK HOUR

10/22/96
10:56:24

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & PUKALANI ST

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	EB ~~SB~~	SB ~~WB~~	WB ~~NB~~	NB ~~EB~~
GRADES	8.0	.0	-8.0	2.0
PEDLEVELS	MODER	MODER	MODER	MODER
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	134	0	0	196

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	497	179	0	0	0	0	0	107	280	315	0	191
WIDTHS	12.0	12.0	.0	.0	.0	.0	.0	12.0	12.0	12.0	.0	12.0
LANES	1	1	0	0	0	0	0	1	1	1	0	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1350	1788	0	0	0	0	0	1919	1823	1392	0	1392

Phasing Parameters

SEQUENCES	31			
PERMISSIVES	YES	YES	YES	YES
OVERLAPS	NO	NO	NO	NO
CYCLES	60	180	10	
GREENTIMES	5.00	15.00	30.00	
YELLOWTIMES	4.00	4.00	.00	
CRITICALS	9	12	12	
EXCESS	0			

LEADLAGS	NONE	NONE
OFFSET	.00	1
PEDTIME	.0	0

KULAMALU
EXISTING 1996 CONDITIONS
PM PEAK HOUR

10/22/96
10:56:29

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - HALEAKALA HWY & PUKALANI ST
Degree of Saturation (v/c) .55 Vehicle Delay 17.0 Level of Service C+

```
        ---------------------------------------------
Sq 31 ¦  Phase 1     ¦  Phase 2     ¦  Phase 3     ¦
**/** ---------------------------------------------
      ¦              ¦ + +          ¦              ¦
      ¦              ¦ + +          ¦              ¦
 /|\  ¦              ¦<+ +          ¦              ¦
  |   ¦              ¦   v          ¦              ¦
West  ¦              ¦              ¦****          ¦
~~North~~ ¦   <* +       ¦     <+ +     ¦              ¦
  |   ¦    * +       ¦      + +     ¦++++          ¦
      ¦    * +       ¦      + +     ¦   v          ¦
      ---------------------------------------------
      ¦ G/C= .086    ¦ G/C= .259    ¦ G/C= .517    ¦
      ¦ G=    5.0"   ¦ G=   15.0"   ¦ G=   30.0"   ¦
      ¦ Y+R=  4.0"   ¦ Y+R=  4.0"   ¦ Y+R=   .0"   ¦
      ¦ OFF=   .0%   ¦ OFF=15.5%    ¦ OFF=48.3%    ¦
      ---------------------------------------------
      C= 58 sec   G= 50.0 sec = 86.2%  Y= 8.0 sec = 13.8%  Ped= .0 sec = .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								30.1	D+	
RT	12/1	.321	.293	343	396	382	.965	39.6	D	220 ft
TH	12/1	.137	.293	468	524	188	.359	10.7	B	108 ft
WB ~~NB~~ Approach								7.8	B+	
TH	12/1	.084	.448	821	860	113	.131	6.1	B+	51 ft
LT	12/1	.041	.121	449	488	295	.605	8.5	*B+	133 ft
NB ~~EB~~ Approach								5.8	B+	
RT	12/1	.124	.483	634	672	125	.186	5.5	B+	53 ft
LT	12/1	.183	.483	634	672	201	.299	5.9	*B+	85 ft

KULAMALU
EXISTING 1996 CONDITIONS
AM PEAK HOUR

10/22/96
10:53:1c

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & MAKAWAO AV

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

	EB	SB	WB	NB
APPLABELS	~~SB~~	~~WB~~	~~NB~~	~~EB~~
GRADES	8.0	.0	-8.0	.0
PEDLEVELS	MODER	MODER	MODER	MODER
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	101	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	6	197	144	190	52	22	29	151	25	45	67	26
WIDTHS	.0	12.0	12.0	12.0	12.0	.0	.0	12.0	.0	.0	12.0	.0
LANES	0	1	1	1	1	0	0	1	0	0	1	0
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	0	1776	931	1406	1720	0	0	1663	0	0	1482	0

Phasing Parameters

SEQUENCES	31						
PERMISSIVES	YES	YES	YES	YES	LEADLAGS	NONE	NONE
OVERLAPS	NO	NO	NO	NO	OFFSET	.00	1
CYCLES	60	180	10		PEDTIME	.0	0
GREENTIMES	15.00	15.00	25.00				
YELLOWTIMES	.00	.00	.00				
CRITICALS	0	0	0				
EXCESS	0						

KULAMALU
EXISTING 1996 CONDITIONS
AM PEAK HOUR

10/22/96
10:53:20

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - HALEAKALA HWY & MAKAWAO AV
Degree of Saturation (v/c) .36 Vehicle Delay 9.6 Level of Service B+

```
        -----------------------------------
Sq 31  | Phase 1  |  Phase 2  |  Phase 3  |
**/**  -----------------------------------
       |          | + + +     |           |
  .    |          | + + +     |      ++++ |
 /|\   |          |<+ + +>    |     <++++ |
  |    |          |   v       |      ++++ |
West   |          |           |++++   v   |
~~North~~  |   <+ + +>|   <+ + +> |++++>      |
  |    |    + + + |     + + + |++++       |
       |    + + + |     + + + |  v        |
        -----------------------------------
       | G/C= .273 | G/C= .273 | G/C= .455 |
       | G=  15.0" | G=  15.0" | G=  25.0" |
       | Y+R=  .0" | Y+R=  .0" | Y+R=  .0" |
       | OFF=  .0% | OFF=27.3% | OFF=54.5% |
        -----------------------------------
```

C= 55 sec G= 55.0 sec =100.0% Y= .0 sec = .0% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
~~SB~~ EB Approach								15.0	C+	
TH+RT	12/1	.151	.236	365	420	213	.507	12.6	B	126 ft
LT	12/1	.210	.236	176	220	152	.691	18.4	C+	90 ft
~~NB~~ WB Approach								5.0	A	
LT+TH+RT	12/1	.162	.509	817	847	216	.255	5.0	A	82 ft
~~WB~~ SB Approach								6.4	B+	
RT	12/1	.096	.418	546	588	94	.160	6.5	B+	42 ft
LT+TH	12/1	.068	.418	678	719	78	.108	6.3	B+	35 ft
~~EB~~ NB Approach								6.7	B+	
LT+TH+RT	12/1	.131	.418	578	620	145	.234	6.7	B+	65 ft

KULAMALU
EXISTING 1996 CONDITIONS
PM PEAK HOUR

10/22/96
10:54:16

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & MAKAWAO AV

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	~~SB~~ EB	~~WB~~ SB	~~NB~~ WB	~~EB~~ NB
GRADES	8.0	.0	-8.0	.0
PEDLEVELS	MODER	MODER	MODER	MODER
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	188	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	33	169	268	251	66	46	27	125	26	31	57	19
WIDTHS	.0	12.0	12.0	12.0	12.0	.0	.0	12.0	.0	.0	12.0	.0
LANES	0	1	1	1	1	0	0	1	0	0	1	0
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	0	1716	1021	1406	1628	0	0	1661	0	0	1485	0

Phasing Parameters

SEQUENCES	31						
PERMISSIVES	YES	YES	YES	YES	LEADLAGS	NONE	NONE
OVERLAPS	NO	NO	NO	NO	OFFSET	.00	1
CYCLES	60	180	10		PEDTIME	.0	0
GREENTIMES	15.00	15.00	30.00				
YELLOWTIMES	.00	.00	.00				
CRITICALS	0	0	0				
EXCESS	0						

KULAMALU
EXISTING 1996 CONDITIONS
PM PEAK HOUR

10/22/96
10:54:20

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - HALEAKALA HWY & MAKAWAO AV
Degree of Saturation (v/c) .58 Vehicle Delay 29.1@ Level of Service D+
@ expect more delay due to extreme v/c's (see EVALUATE)

```
         -----------------------------------------
Sq 31  |    Phase 1    |    Phase 2    |    Phase 3    |
**/**  -----------------------------------------
       |               | +  +  +       |          ^    |
   .   |               | +  +  +       |        ++++   |
  /|\  |               |<+  +  +>      |       <++++   |
   |   |               |    v          |    ^   ++++   |
West   |         ^     |          ^    |++++    v      |
~~North~~  |      <+  +  +>|      <+  +  +>|++++>          |
   |   |       +  +  + |       +  +  + |++++           |
       |       +  +  + |       +  +  + |    v          |
       -----------------------------------------
       | G/C= .250     | G/C=  .250    | G/C= .500     |
       | G=  15.0"     | G=  15.0"     | G=  30.0"     |
       | Y+R=  .0"     | Y+R=  .0"     | Y+R=  .0"     |
       | OFF=  .0%     | OFF=25.0%     | OFF=50.0%     |
       -----------------------------------------
```

C= 60 sec G= 60.0 sec =100.0% Y= .0 sec = .0% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								51.6@	E	
TH+RT	12/1	.159	.217	311	372	213	.573	15.2	C+	141 ft
LT	12/1	.325	.217	172	220	282	1.276	79.1@	F	186 ft
WB ~~NB~~ Approach								6.2	B+	
LT+TH+RT	12/1	.147	.467	735	775	187	.241	6.2	B+	84 ft
SB ~~WB~~ Approach								5.9	B+	
RT	12/1	.075	.467	615	656	66	.101	5.8	B+	30 ft
LT+TH	12/1	.103	.467	720	760	117	.154	5.9	B+	53 ft
NB ~~SB~~ Approach								6.0	B+	
LT+TH+RT	12/1	.109	.467	652	693	113	.163	6.0	B+	51 ft

```
Major Street:  PUKALANI ST                                   Print Date:   25-Jul-96
Minor Street:  IOLANI ST                                        Analyst:   BC
   Scenario:  EXISTING 1996                                   File Name:    PUKIOL-A
  Peak Hour:      AM                                    Intesection #:
-----------------------------------------------------------------------------------
                               |            V12      V11      V10
    Peak Hour Factor:     1.00 |
                               |            118       16        2         <--- NORTH
---------MAJOR STREET--------- |             |        |         |
     Num of Lanes - V2:      1 |             |        |         |
    Excl LT - V1 (Y/N):      Y |            /         |          \
    Excl RT - V3 (Y/N):      Y |           <          v           >
  Stop/Yield - V3 (Y/N):     N |
      Grade - V1,V2,V3:      0 |       ^                                ^
                               |      /                                  \
     Num of Lanes - V5:      1 | V1   33 -----                            ----     5 V6
    Excl LT - V4 (Y/N):      N |
    Excl RT - V6 (Y/N):      N | V2   54 ------->                        <----   212 V5
  Stop/Yield - V6 (Y/N):     N |
      Grade - V4,V5,V6:      0 | V3   36 -----                            ----     1 V4
                               |            \                            /
---------MINOR STREET--------- |             v                          v    MAJOR STREET
     Num of Lanes - V8:      1 |                                              PUKALANI ST
      Grade - V7,V8,V9:      0 |           <          ^           >
   Shared Lane-V7,8,9:       3 |            \         |          /
(0=N,1=LT,2=TR,3=LTR)          |             |        |         |
                               |             |        |         |
    Num of Lanes - V11:      1 |            223       17        1
   Grade - V10,V11,V12:      0 |
Shared Lane-V10,11,12:       1 |            V7        V8        V9
(0=N,1=LT,2=TR,3=LTR)          |
                               |          MINOR STREET - IOLANI ST
-----------------------------------------------------------------------------------
```

VOLUME ADJUSTMENTS												
MOVEMENT NO.	1	2	3	4	5	6	7	8	9	10	11	12
HOURLY FLOW RATE, V(vph)	33	54	86	1	212	5	223	17	1	2	16	118
VOLUME, v (pcph)	36	54	86	1	212	5	245	19	1	2	18	130

STEP 1: RT FROM MINOR STREET				
Conflicting Flows:	Vc9 = 1/2 V3 + V2 =	54 vhp	Vc12 = 1/2 V6 + V5 =	215 vhp
Potential Capacity:	Cp,9 =	1300 pcph	Cp,12 =	1078 pcph
Movement Capacity:	Cm,9=Cp,9=	1300 pcph	Cm,12=Cp,12=	1078 pcph
Prb. of Queu-free State:	po,9=1-v9/Cm,9=	1.00	po,12=1-v12/Cm,12=	0.88

STEP 2: LT FROM MAJOR STREET				
Conflicting Flows:	Vc,4 = V2 + V3 =	140 vhp	Vc,1 = V5 + V6 =	217 vhp
Potential Capacity:	Cp,4 =	1470 pcph	Cp,1 =	1351 pcph
Movement Capacity:	Cm,4=Cp,4=	1470 pcph	Cm,1=Cp,1=	1351 pcph
Prb. of Queu-free State:	po,4=1-v4/Cm4=	1.00	po,1=1-v1/Cm1=	0.97
Major Left Shared Lane				
Prob. of Queue-free State	p"o,4=	1.00	p"o,1=	NA

----continued ----

Major Street:	PUKALANI ST	DATE:	25-Jul-96
Minor Street:	IOLANI ST	Analyst:	BC
Scenario:	EXISTING 1996	File Name:	PUKIOL-A
Peak Hour:	AM	Intesection	Intesection #:

STEP 3: TH FROM MINOR STREET

Conflicting Flows:	Vc.,9 = 1/2V3+V2+V1+V6+V5+V4 =	305 vph	Vc.,11 = 1/2V6+V5+V4+V3+V2+V1 =	300 vph
Potential Capacity:	Cp,8 =	755 pcph	Cp,11 =	759 pcph
Capacity Adj Factor:	f8 = po,4*po,1 =	0.97	f11 = po,4*po,1 =	0.97
Movement Capacity:	Cm,8 = Cp,8*f8 =	734 pcph	Cm,11 = Cp,11*f11 =	738 pcph
Prob. of Queue-free State:	po,8 = 1-v8/Cm,8 =	0.97	po,11 = 1-v11/Cm,11 =	0.98

STEP 4: LT FROM MINOR STREET

Conflicting Flows:	Vc,7 = 1/2V3+V2+V1+1/2V6+V5+V4+ 1/2(V11+V12) =	370 vph	Vc,10 = 1/2V6+V5+V4+1/2V3+V2+V1+ 1/2(V8+V9) =	312 vph
Potential Capacity:	Cp7 =	647 pcph	Cp10 =	699 pcph
Major Left, Minor Through Impedance Factor:	P''7=po,11*f11 =	0.95	P''10=po,8*f8 =	0.95
Major Left, Minor Through Adjusted Impedance Factor:	p'7 =	0.96	p'10 =	0.96
Capacity Adjustment Factor:	f7 = p'7*po,12 =	0.85	f10 = p'10*po,9 =	0.96
Movement Capacity:	Cm,7 = f7*Cp,7 =	547 pcph	Cm,10 = f10*Cp,10 =	670 pcph

DELAY AND LEVEL OF SERVICE SUMMARY

MOVEMENT	v(pcph)	cm(pcph)	csh(pcph)	AVG TOTAL DELAY	LOS
MINOR LEFT TURN (7)	245	547	SHRD	SHRD	--
MINOR THROUGH (8)	19	734	558	12.1	C
MINOR RIGHT TURN (9)	1	1300	SHRD	SHRD	----
MINOR LEFT TURN (10)	2	670	SHRD	SHRD	--
MINOR THROUGH (11)	16	738	731	5.1	B
MINOR RIGHT TURN (12)	130	1078	--NA--	3.8	A
MAJOR LEFT (1)	36	1351	--NA--	2.7	A
MAJOR LEFT (4)	1	1470	--NA--	2.5	A
MINOR APPROACH (7)(8)(9)	-	-	-	12.1	C
MINOR APPROACH (10)(11)(12)	-	-	-	4.0	A
MAJOR APPROACH (1)(2)(3)	-	-	-	0.6	A
MAJOR APPROACH (4)(5)(6)	-	-	-	0.0	A
TOTAL INTERSECTION (1-12)	-	-	-	5.1	B

LEVEL OF SERVICE CRITERIA

LEVEL OF SERVICE	AVG TOTAL DELAY (SEC/VEH)
A	<=5
B	>5&<=10
C	>10&<=20
D	>20&<=30
E	>30&<=45
F	>45

```
ATA Inc.        TWO-WAY STOP CONTROLLED INTERSECTION LEVEL OF SERVICE ANALYSIS             1994 HCM
****************************************************************************************************
Major Street:   PUKALANI ST
Minor Street:   IOLANI ST                                                  Print Date:    25-Jul-96
    Scenario:   EXISTING 1996                                                 Analyst:    BC
   Peak Hour:   PM                                                          File Name:    PUKIOL-P
                                                                         Intesection #:
----------------------------------------------------------------------------------------------------
                                     |          V12        V11        V10
      Peak Hour Factor:       1.00   |
                                     |          53         10          7          <--- NORTH
 ---------MAJOR STREET---------      |           |          |          |
      Num of Lanes - V2:         1   |           |          |          |
     Excl LT - V1 (Y/N):         Y   |          /           |           \
     Excl RT - V3 (Y/N):         Y   |         <            v            >
   Stop/Yield - V3 (Y/N):        N   |
        Grade - V1,V2,V3:        0   |      ^                                  ^
                                     |     /                                    \
      Num of Lanes - V5:         1   | V1  137 -----                            ----     0 V6
     Excl LT - V4 (Y/N):         N   |
     Excl RT - V6 (Y/N):         N   | V2  182 ------->                        <----   102 V5
   Stop/Yield - V6 (Y/N):        N   |
        Grade - V4,V5,V6:        0   | V3  264 -----                            ----     7 V4
                                     |          \                            /
 ---------MINOR STREET---------      |           v                          v    MAJOR STREET
      Num of Lanes - V8:         1   |                                           PUKALANI ST
      Grade - V7,V8,V9:          0   |          <          ^          >
      Shared Lane-V7,8,9:        3   |           \         |         /
      (0=N,1=LT,2=TR,3=LTR)          |            |        |        |
                                     |            |        |        |
      Num of Lanes - V11:        1   |           125       25       5
      Grade - V10,V11,V12:       0   |
      Shared Lane-V10,11,12:     1   |           V7        V8       V9
      (0=N,1=LT,2=TR,3=LTR)          |
                                     |          MINOR STREET - IOLANI ST
----------------------------------------------------------------------------------------------------
```

VOLUME ADJUSTMENTS

MOVEMENT NO.	1	2	3	4	5	6	7	8	9	10	11	12
HOURLY FLOW RATE, V(vph)	137	182	264	7	102	0	125	25	5	7	10	53
VOLUME, v (pcph)	151	182	264	8	102	0	133	28	6	8	11	58

```
----------------------------------------------------------------------------------------------------
STEP 1: RT FROM MINOR STREET  |                                 |
  Conflicting Flows:          |Vc9 = 1/2 V3 + V2 =     182 vhp  |  Vc12 = 1/2 V6 + V5 =     102 vhp
  Potential Capacity:         |Cp,9 =                 1120 pcph |  Cp,12 =                  1229 pcph
  Movement Capacity:          |Cm,9=Cp,9=             1120 pcph |  Cm,12=Cp,12=             1229 pcph
  Prb. of Queu-free State:    |po,9=1-v9/Cm,9=        0.99      |  po,12=1-v12/Cm,12=       0.95
----------------------------------------------------------------------------------------------------
STEP 2: LT FROM MAJOR STREET  |                                 |
  Conflicting Flows:          |Vc,4 = V2 + V3 =        446 vhp  |  Vc,1 = V5 + V6 =          102 vhp
  Potential Capacity:         |Cp,4 =                 1051 pcph |  Cp,1 =                   1533 pcph
  Movement Capacity:          |Cm,4=Cp,4=             1051 pcph |  Cm,1=Cp,1=               1533 pcph
  Prb. of Queu-free State:    |po,4=1-v4/Cm4=         0.99      |  po,1=1-v1/Cm1=           0.90
  Major Left Shared Lane      |                                 |
   Prob. of Queue-free State  |p'o,4=                 0.99      |  p'o,1=                   NA
----------------------------------------------------------------------------------------------------
```


----continued ----

Major Street:	PUKALANI ST	DATE:	25-Jul-96
Minor Street:	IOLANI ST	Analyst:	BC
Scenario:	EXISTING 1996	File Name:	PUKIOL-P
Peak Hour:	PM	Intesection Intesection #:	

STEP 3: TH FROM MINOR STREET

Conflicting Flows:	Vc.,8 = 1/2V3+V2+V1+V6+V5+V4 =	428 vph	Vc.,11 = 1/2V6+V5+V4+V3+V2+V1 =	428 vph
Potential Capacity:	Cp,8 =	650 pcph	Cp,11 =	650 pcph
Capacity Adj Factor:	f8 = po,4*po,1 =	0.89	f11 = po,4*po,1 =	0.89
Movement Capacity:	Cm,8 = Cp,8*f8 =	582 pcph	Cm,11 = Cp,11*f11 =	582 pcph
Prob. of Queue-free State:	po,8 = 1-v8/Cm,8 =	0.95	po,11 = 1-v11/Cm,11 =	0.98

STEP 4: LT FROM MINOR STREET

Conflicting Flows:	Vc,7 = 1/2V3+V2+V1+1/2V6+V5+V4+ 1/2(V11+V12) =	460 vph	Vc,10 = 1/2V6+V5+V4+1/2V3+V2+V1+ 1/2(V8+V9) =	443 vph
Potential Capacity:	Cp7 =	574 pcph	Cp10 =	587 pcph
Major Left, Minor Through Impedance Factor:	P''7=po,11*f11 =	0.88	P''10=po,8*f8 =	0.85
Major Left, Minor Through Adjusted Impedance Factor:	p'7 =	0.91	p'10 =	0.89
Capacity Adjustment Factor:	f7 = p'7*po,12 =	0.86	f10 = p'10*po,9 =	0.88
Movement Capacity:	Cm,7 = f7*Cp,7 =	495 pcph	Cm,10 = f10*Cp,10 =	517 pcph

DELAY AND LEVEL OF SERVICE SUMMARY

MOVEMENT	v(pcph)	cm(pcph)	csh(pcph)	AVG TOTAL DELAY	LOS
MINOR LEFT TURN (7)	138	495	SHRD	SHRD	--
MINOR THROUGH (8)	28	582	518	10.4	C
MINOR RIGHT TURN (9)	6	1120	SHRD	SHRD	----
MINOR LEFT TURN (10)	8	517	SHRD	SHRD	--
MINOR THROUGH (11)	11	582	552	6.7	B
MINOR RIGHT TURN (12)	58	1229	--NA--	3.1	A
MAJOR LEFT (1)	151	1533	--NA--	2.6	A
MAJOR LEFT (4)	8	1051	--NA--	3.5	A
MINOR APPROACH (7)(8)(9)	-	-	-	10.4	C
MINOR APPROACH (10)(11)(12)	-	-	-	4.0	A
MAJOR APPROACH (1)(2)(3)	-	-	-	0.7	A
MAJOR APPROACH (4)(5)(6)	-	-	-	0.3	A
TOTAL INTERSECTION (1-12)	-	-	-	2.7	A

LEVEL OF SERVICE CRITERIA

LEVEL OF SERVICE	AVG TOTAL DELAY (SEC/VEH)
A	<=5
B	>5&<=10
C	>10&<=20
D	>20&<=30
E	>30&<=45
F	>45

ATA Inc. STOP CONTROLLED T-INTERSECTION LEVEL OF SERVICE ANALYSIS 1994 HCM

Major Street: KULA HWY
Minor Street: OHANA ST
Peak Hour: AM
Scenario: EXISTING 1996

Print Date: 27-Mar
Analyst: BC
File Name: KULOHA-A
Intersection:

```
Peak Hour Factor:        1.00  :
---------MAJOR STREET--------- | V2      590 ----------->               <---- -----  322     V5
    Num of Lanes - V2:      1  |
   Excl RT - V3 (Y/N):      N  | V3        4 -----                           -----    9     V4
Stop/Yield - V3 (Y/N):      N  |                  \                      /
       % Grade - V2,V3:     3  |                   v                    v      MAJOR STREET:
                               |                                               KULA HWY
    Num of Lanes - V5:      1  |                           <         >
   Excl LT - V4 (Y/N):      N  |                            \       /
       % Grade - V4,V5:    -3  |                             |      |
                               |                             |      |
---------MINOR STREET--------- |                             3     17                   NORTH--->
  Num of Lanes - V7,V9:     1  |
     Shared Lane (Y/N):     Y  |                            V7     V9
       % Grade - V7&V9:     0  |                  MINOR STREET: OHANA ST
```

VOLUME ADJUSTMENTS

MOVEMENT NO.	2	3	4	5	7	9
VOLUME, V (vph)	590	4	9	322	3	17
VOLUME, v (pcph)	590	4	8	322	3	19

STEP 1: RT FROM MINOR STREET - V9

Conflicting Flows:	Vc,9 = 1/2*V3+V2 = 2 + 590 =	592	vph
Potential Capacity:	Cp,9 =	694	pcph
Movement Capacity:	Cm,9 = Cp,9 =	694	pcph

STEP 2: LT FROM MAJOR STREET - V4

Conflicting Flows:	Vc,4 = V3+V2 = 4 + 590 =	594	vph
Potential Capacity:	Cp,4 =	893	pcph
Movement Capacity:	Cm,4 = Cp,4 =	893	pcph
Prob. of Queue-free State:	po,4 = 1-v4/Cm,4 =	0.99	
Major Left Shared Lane			
Prob. of Queue-free State:	p*o,4 =	0.99	

STEP 3: LT FROM MINOR STREET - V7

Conflicting Flows:	Vc,7 = 1/2V3+V2+V5+V4 =	923	vph
Potential Capacity:	Cp,7 =	309	pcph
Capacity Adjustment Factor			
Due To Impeding Movements:	f7=po,4=	0.99	
Movement Capacity:	Cm,7 = Cp,7 =	306	pcph

DELAY AND LEVEL OF SERVICE SUMMARY

Movement	v(pcph)	cm(pcph)	csh (pcph)	AVG TOTAL DELAY	LOS
MINOR LEFT TURN (7)	3	306	SHRD	SHRD	SHRD
MINOR RIGHT TURN (9)	19	694	583	6.4	B
MAJOR LEFT TURN (4)	5	893	------	4.1	A

AVERAGE MINOR APPROACH DELAY = 6.4 sec/veh | AVERAGE TOTAL INTERSECTION DELAY = 0.2 sec/veh
LEVEL OF SERVICE = B | LEVEL OF SERVICE = A

```
ATA Inc.            STOP CONTROLLED T-INTERSECTION LEVEL OF SERVICE ANALYSIS                    1994 HCM
==========================================================================================================
Major Street: KULA HWY                                                          Print Date:    27-Mar
Minor Street: OHANA ST                                                             Analyst:        EC
   Peak Hour:       PM                                                          File Name:    KULOHA-P
   Scenario: EXISTING 1996                                                   Intersection:
----------------------------------------------------------------------------------------------------------
Peak Hour Factor:       1.00 :
--------MAJOR STREET-------- : V2       343 ----------->               <---- -----  513      V5
    Num of Lanes - V2:     1 :
   Excl RT - V3 (Y/N):     N : V3        1 -----                             -----   17      V4
Stop/Yield - V3 (Y/N):     N :                 \                         /
       % Grade - V2,V3:    3 :                  v                       v      MAJOR STREET:
                             :                                                 KULA HWY
    Num of Lanes - V5:     1 :                          <           >
   Excl LT - V4 (Y/N):     N :                          \          /
       % Grade - V4,V5:   -3 :                           :         :
                             :                           :         :
--------MINOR STREET-------- :                            2         17                  NORTH--->
 Num of Lanes - V7,V9:     1 :
    Shared Lane (Y/N):     Y :                          V7         V9
      % Grade - V7&V9:     0 :                 MINOR STREET: OHANA ST
----------------------------------------------------------------------------------------------------------
VOLUME ADJUSTMENTS
 MOVEMENT NO.                       2          3            4            5          7         9
 VOLUME, V (vph)                  343          1           17          513          2        17
 VOLUME, v (pcph)                 343          1           15          513          2        19
----------------------------------------------------------------------------------------------------------
STEP 1: RT FROM MINOR STREET - V9
  Conflicting Flows:      : Vc,9 = 1/2*V3+V2 =            1   +   343         =          344   vph
  Potential Capacity:     : Cp,9 =                                                       927  pcph
  Movement Capacity:      : Cm,p = Cp,9 =                                                927  pcph
----------------------------------------------------------------------------------------------------------
STEP 2: LT FROM MAJOR STREET - V4
  Conflicting Flows:            :  Vc,4 = V3+V2 =              1   +    343   =          344   vph
  Potential Capacity:           :  Cp,4 =                                               1175  pcph
  Movement Capacity:            :  Cm,4 = Cp,4 =                                        1175  pcph
  Prob. of Queue-free State:    :  po,4 = 1-v4/Cm,4 =                                   0.99
  Major Left Shared Lane        :
   Prob. of Queue-free State:   :  p*o,4 =                                              0.98
----------------------------------------------------------------------------------------------------------
STEP 3: LT FROM MINOR STREET - V7
  Conflicting Flows:            :  Vc,7 = 1/2V3+V2+V5+V4 =                               874   vph
  Potential Capacity:           :  Cp,7 =                                                330  pcph
  Capacity Adjustment Factor    :
   Due To Impeding Movements:   :  f7=po,4=                                             0.98
  Movement Capacity:            :  Cm,7 = Cp,7 =                                         324  pcph
----------------------------------------------------------------------------------------------------------
DELAY AND LEVEL OF SERVICE SUMMARY                       csh    AVG TOTAL
   Movement                 v(vcph)        cm(pcph)    (pcph)     DELAY      LOS
 ------------            -------------     --------    ------    -------    ------
 MINOR LEFT TURN  (7)          2             324        SHRD      SHRD       SHRD
 MINOR RIGHT TURN (9)         19             927        775        4.8        A
 MAJOR LEFT TURN  (4)         15            1175       ------      3.1        A
----------------------------------------------------------------------------------------------------------
    AVERAGE MINOR APPROACH DELAY =    4.8 sec/veh   :   AVERAGE TOTAL INTERSECTION DELAY =    0.2 sec/veh
              LEVEL OF SERVICE =      A             :                 LEVEL OF SERVICE =      A
==========================================================================================================
```

KULAMALU 03/27/97
FUTURE BASE 17:31:17
AM PEAK HOUR

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & HANA HWY

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	EB ~~SB~~	SB ~~WB~~	WB ~~NB~~	NB ~~EB~~
GRADES	.0	.0	.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	0	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	5	21	17	49	746	53	30	142	2392	512	266	41
WIDTHS	12.0	12.0	.0	12.0	24.0	12.0	12.0	12.0	12.0	12.0	24.0	12.0
LANES	1	1	0	1	2	1	1	1	1	1	2	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	FFLW	NORM	DOPT	FFLW	NORM	NORM
SATURATIONFLOWS	1539	1822	0	1539	3725	1770	0	1783	1770	0	3725	1770

Phasing Parameters

SEQUENCES	76							
PERMISSIVES	NO	NO	NO	NO		LEADLAGS	NONE	NONE
OVERLAPS	NO	NO	NO	NO		OFFSET	.00	1
CYCLES	60	180	10			PEDTIME	.0	0
GREENTIMES	19.00	25.00	5.00	3.00	22.00			
YELLOWTIMES	4.00	4.00	4.00	4.00	.00			
CRITICALS	2	9	5	0	5			
EXCESS	0							

KULAMALU
FUTURE BASE
AM PEAK HOUR

03/27/97
17:31:49

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - HALEAKALA HWY & HANA HWY
Degree of Saturation (v/c) 1.92 Vehicle Delay 54.4@ Level of Service E
@ expect more delay due to extreme v/c's (see EVALUATE)

```
---------------------------------------------------------------------------
Sq 76 |  Phase 1    |  Phase 2    |  Phase 3    |  Phase 4    |  Phase 5    |
**/** ---------------------------------------------------------------------
      | + * *       |             |             |             |        ^    |
      | + * *       |             |             |             |     ++++    |
  .   |<+ * *>      |             |             |             |    <****    |
 /|\  |   v         |             |  ^    ++++  |  ^          |             |
  |   |             |       ^     |++++   v     |++++         |             |
West  |             |   <*  +     |             |++++>        |++++>        |
~~North~~|          |    *  +     |             |             |             |
  |   |             |    *  +     |             |             |             |
      ---------------------------------------------------------------------
      | G/C= .211   | G/C= .278   | G/C= .056   | G/C= .033   | G/C= .244   |
      | G=  19.0"   | G=  25.0"   | G=   5.0"   | G=   3.0"   | G=  22.0"   |
      | Y+R=  4.0"  | Y+R=  4.0"  | Y+R=  4.0"  | Y+R=  4.0"  | Y+R=   .0"  |
      | OFF=   .0%  | OFF=25.6%   | OFF=57.8%   | OFF=67.8%   | OFF=75.6%   |
      ---------------------------------------------------------------------
      C= 90 sec   G= 74.0 sec = 82.2%   Y=16.0 sec = 17.8%   Ped=  .0 sec =   .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
~~SB~~ EB Approach								17.4	C+	
RT	12/1	.074	.233	257	359	5	.014	17.1	C+	25 ft
LT+TH	12/1	.086	.233	312	425	40	.094	17.5	*C+	39 ft
~~NB~~ WB Approach								66.0@	F	
TH	12/1-	.769	.300	433	535	1368	2.557	65.9@	F	1211 ft
LT	12/1+	.739	.300	429	531	1299	2.446	66.0@	*F	1150 ft
~~WB~~ SB Approach								35.4	D	
RT	12/1	.098	.222	239	342	52	.152	18.2	C+	51 ft
TH	24/2	.254	.222	656	828	787	.950	37.1	*D	387 ft
LT	12/1	.095	.078	18	125	56	.406	26.6	D+	65 ft
~~EB~~ NB Approach								16.2	C+	
TH	24/2	.131	.300	979	1118	280	.250	15.4	C+	124 ft
LT	12/1	.088	.156	160	269	43	.156	21.3	C	46 ft

KULAMALU
FUTURE BASE
PM PEAK HOUR

03/27/97
17:32:50

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & HANA HWY

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	~~SB~~ EB	~~WB~~ SB	~~NB~~ WB	~~EB~~ NB
GRADES	.0	.0	.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	0	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	25	257	161	40	506	56	34	37	804	1552	607	[illegible]
WIDTHS	12.0	12.0	.0	12.0	24.0	12.0	12.0	12.0	12.0	12.0	24.0	12.0
LANES	1	1	0	1	2	1	1	1	1	1	2	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	FFLW	NORM	DOPT	FFLW	NORM	NORM
SATURATIONFLOWS	1539	1828	0	1539	3725	1770	0	1781	1770	0	3725	1770

Phasing Parameters

SEQUENCES	76							
PERMISSIVES	NO	NO	NO	NO		LEADLAGS	NONE	NONE
OVERLAPS	NO	NO	NO	NO		OFFSET	.00	1
CYCLES	60	180	10			PEDTIME	.0	0
GREENTIMES	19.00	25.00	5.00	3.00	22.00			
YELLOWTIMES	4.00	4.00	4.00	4.00	.00			
CRITICALS	2	8	12	0	11			
EXCESS	0							

KULAMALU
FUTURE BASE
PM PEAK HOUR

03/27/97
17:33:24

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - HALEAKALA HWY & HANA HWY
Degree of Saturation (v/c) .74 Vehicle Delay 29.7 Level of Service D+

```
          -------------------------------------------------------------------------------------
Sq 76   | Phase 1    | Phase 2    | Phase 3    | Phase 4    | Phase 5    |
**/**   -------------------------------------------------------------------------------------
        | +  *  *    |            |            |            |        ^   |
        | +  *  *    |            |            |            |     ++++   |
  /|\   |<+  *  *>   |            |            |            |    <++++   |
   |    |    v       |            |     ^  ++++|     ^      |            |
 West   |            |      ^     |****    v   |++++        |            |
~~North~~ |            |   <+  *    |            |++++>       |****>       |
   |    |            |    +  *    |            |            |            |
        |            |    +  *    |            |            |            |
          -------------------------------------------------------------------------------------
        | G/C= .211  | G/C= .278  | G/C= .056  | G/C= .033  | G/C= .244  |
        | G=  19.0"  | G=  25.0"  | G=   5.0"  | G=   3.0"  | G=  22.0"  |
        | Y+R= 4.0"  | Y+R= 4.0"  | Y+R= 4.0"  | Y+R= 4.0"  | Y+R=  .0"  |
        | OFF=  .0%  | OFF=25.6%  | OFF=57.8%  | OFF=67.8%  | OFF=75.6%  |
          -------------------------------------------------------------------------------------
        C= 90 sec   G= 74.0 sec = 82.2%   Y=16.0 sec = 17.8%   Ped=  .0 sec =  .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
~~SB~~ EB Approach								62.5	F	
RT	12/1	.083	.233	257	359	26	.072	17.4	C+	25 ft
LT+TH	12/1	.298	.233	313	426	440	1.033	65.2	*F	427 ft
~~NB~~ WB Approach								26.5	D+	
TH	12/1-	.311	.300	432	534	454	.850	27.8	*D+	402 ft
LT	12/1+	.301	.300	429	531	431	.812	25.3	D+	382 ft
~~WB~~ SB Approach								22.0	C	
RT	12/1	.092	.222	239	342	42	.123	18.1	C+	41 ft
TH	24/2	.193	.222	656	828	533	.644	21.7	C	262 ft
LT	12/1	.097	.078	18	125	59	.428	26.9	D+	69 ft
~~EB~~ NB Approach								17.7	C+	
TH	24/2	.218	.300	979	1118	639	.572	17.7	*C+	283 ft
LT	12/1	.073	.156	160	269	2	.007	20.8	*C	25 ft

```
ATA Inc.              STOP CONTROLLED T-INTERSECTION LEVEL OF SERVICE ANALYSIS                  1994 HCM
=========================================================================================================
Major Street: PUKALANI BYPASS                                                   Print Date:   27-Mar
Minor Street: HALEAKALA HWY                                                        Analyst:       BC
  Peak Hour:       PM                                                            File Name:   HALBYP-P
   Scenario: FUTURE BASE                                                      Intersection:
---------------------------------------------------------------------------------------------------------
Peak Hour Factor:       1.00 :
--------MAJOR STREET-------- : V2     1012 ----------->              <---- -----  541      V5
    Num of Lanes - V2:     2 :
   Excl RT - V3 (Y/N):     Y : V3      702 -----                           -----    0      V4
Stop/Yield - V3 (Y/N):     N :               \                            /
      % Grade - V2,V3:     3 :                v                         v      MAJOR STREET:
                             :                                                 PUKALANI BYPASS
    Num of Lanes - V5:     1 :                          <          >
   Excl LT - V4 (Y/N):     N :                          \          /
      % Grade - V4,V5:    -3 :                           :     .   :
                             :                           :         :                    ^
--------MINOR STREET-------- :                          313        0                      NORTH
 Num of Lanes - V7,V9:     1 :
    Shared Lane (Y/N):     N :                          V7        V9
     % Grade - V7&V9:      0 :                  MINOR STREET: HALEAKALA HWY
---------------------------------------------------------------------------------------------------------
VOLUME ADJUSTMENTS
  MOVEMENT NO.                 2          3            4             5         7          9
  VOLUME, V (vph)           1012        702            0           541       313          0
  VOLUME, v (pcph)          1012        702            0           541       344          0
---------------------------------------------------------------------------------------------------------
STEP 1: RT FROM MINOR STREET - V9
  Conflicting Flows:      : Vc,9 = 1/2*V3+V2 =          0   +   1012        =         1012  vph
  Potential Capacity:     : Cp,9 =                                                     425  pcph
  Movement Capacity:      : Cm,p = Cp,9 =                                              425  pcph
---------------------------------------------------------------------------------------------------------
STEP 2: LT FROM MAJOR STREET - V4
  Conflicting Flows:           :  Vc,4 = V3+V2 =          0   +   1012   =         1012  vph
  Potential Capacity:          :  Cp,4 =                                             491  pcph
  Movement Capacity:           :  Cm,4 = Cp,4 =                                      491  pcph
  Prob. of Queue-free State:   :  po,4 = 1-v4/Cm,4 =                                1.00
  Major Left Shared Lane       :
   Prob. of Queue-free State:  :  p*o,4 =                                           1.00
---------------------------------------------------------------------------------------------------------
STEP 3: LT FROM MINOR STREET - V7
  Conflicting Flows:           :  Vc,7 = 1/2V3+V2+V5+V4 =                          1553  vph
  Potential Capacity:          :  Cp,7 =                                             134  pcph
  Capacity Adjustment Factor   :
   Due To Impeding Movements:  :  f7=po,4=                                          1.00
  Movement Capacity:           :  Cm,7 = Cp,7 =                                      134  pcph
---------------------------------------------------------------------------------------------------------
DELAY AND LEVEL OF SERVICE SUMMARY                       csh    AVG TOTAL
   Movement                v(pcph)        cm(pcph)     (pcph)    DELAY      LOS
  ------------           ------------     --------     ------    ------    ------
  MINOR LEFT TURN   (7)      344            134        --NA--    779.0       F
  MINOR RIGHT TURN  (9)        0            425        --NA--      8.5       B
  MAJOR LEFT TURN   (4)        0            491        ------      7.3       B
---------------------------------------------------------------------------------------------------------
    AVERAGE MINOR APPROACH DELAY =  779.0 sec/veh   :   AVERAGE TOTAL INTERSECTION DELAY =  103.2 sec/veh
              LEVEL OF SERVICE =     F              :                   LEVEL OF SERVICE =     F
=========================================================================================================
```

```
ATA Inc.        TWO-WAY STOP CONTROLLED INTERSECTION LEVEL OF SERVICE ANALYSIS              1994 HCM
*************************************************************************************************
Major Street:   PUKALANI BYPASS                                          Print Date:    25-Jul-96
Minor Street:   MAKANI ST                                                   Analyst:    BC
    Scenario:   FUTURE BASE WITHOUT MIT                                   File Name:    PUKMAK-A
   Peak Hour:       AM                                                 Intesection #:
-------------------------------------------------------------------------------------------------
                                |            V12      V11      V10                 ^
     Peak Hour Factor:    1.00  |                                                  |
                                |            275       58       13               NORTH
---------MAJOR STREET---------  |             |        |        |
     Num of Lanes - V2:      2  |             |        |        |
     Excl LT - V1 (Y/N):     Y  |            /         |         \
     Excl RT - V3 (Y/N):     N  |           <          v          >
  Stop/Yield - V3 (Y/N):     N  |
       Grade - V1,V2,V3:     2  |        ^                            ^
                                |       /                              \
     Num of Lanes - V5:      1  | V1   0 -----                          ----    12 V6
     Excl LT - V4 (Y/N):     Y  |
     Excl RT - V6 (Y/N):     N  | V2   5 ------->                      <----  1094 V5
  Stop/Yield - V6 (Y/N):     N  |
       Grade - V4,V5,V6:    -2  | V3   0 -----                          ----     9 V4
                                |            \                         /
---------MINOR STREET---------  |             v                       v    MAJOR STREET
     Num of Lanes - V8:      1  |                                          PUKALANI BYPASS
       Grade - V7,V8,V9:     0  |           <          ^          >
     Shared Lane-V7,8,9:     3  |            \         |         /
 (0=N,1=LT,2=TR,3=LTR)          |             |        |        |
                                |             |        |        |
     Num of Lanes - V11:     1  |             14       76       51
   Grade - V10,V11,V12:      0  |
 Shared Lane-V10,11,12:      3  |            V7       V8       V9
 (0=N,1=LT,2=TR,3=LTR)          |
                                |           MINOR STREET - MAKANI ST
-------------------------------------------------------------------------------------------------
VOLUME ADJUSTMENTS              |
   MOVEMENT NO.                 |    1    2    3    4    5     6     7    8    9    10    11    12
   HOURLY FLOW RATE, V(vph)     |    0    5    0    9 1094    12    14   76   51    13    58   275
   VOLUME, v (pcph)             |    0    5    0    9 1094    12    15   84   56    14    64   303
-------------------------------------------------------------------------------------------------
STEP 1: RT FROM MINOR STREET    |                                |
   Conflicting Flows:           |Vc9 = 1/2 V3 + V2 =      3  vhp |  Vc12 = 1/2 V6 + V5 =   1090 vhp
   Potential Capacity:          |Cp,9 =                1381 pcph |  Cp,12 =                 388 pcph
   Movement Capacity:           |Cm,9=Cp,9=            1381 pcph |  Cm,12=Cp,12=            388 pcph
   Prb. of Queu-free State:     |po,9=1-v9/Cm,9=       0.96      |  po,12=1-v12/Cm,12=     0.22
-------------------------------------------------------------------------------------------------
STEP 2: LT FROM MAJOR STREET    |                                |
   Conflicting Flows:           |Vc,4 = V2 + V3 =         5  vhp |  Vc,1 = V5 + V6 =       1096 vbp
   Potential Capacity:          |Cp,4 =                1704 pcph |  Cp,1 =                  442 pcph
   Movement Capacity:           |Cm,4=Cp,4=            1704 pcph |  Cm,1=Cp,1=              442 pcph
   Prb. of Queu-free State:     |po,4=1-v4/Cm4=        0.99      |  po,1=1-v1/Cm1=         1.00
   Major Left Shared Lane       |                                |
    Prob. of Queue-free State   |p*o,4=                  NA      |  p*o,1=                  NA
-------------------------------------------------------------------------------------------------
```


----continued ----

ATA Inc. TWO-WAY STOP CONTROLLED INTERSECTION LEVEL OF SERVICE ANALYSIS 1994 HCM

```
******************************************************************************************
Major Street:  FUKALANI BYPASS                                       DATE:     25-Jul-96
Minor Street:  MAKANI ST                                             Analyst:  BC
   Scenario:   FUTURE BASE WITHOUT MIT                               File Name: PUKMAK-A
  Peak Hour:   AM                                  Intesection  Intesection #:
------------------------------------------------------------------------------------------
STEP 3: TH FROM MINOR STREET   |                                |
  Conflicting Flows:           |Vc.,9 = 1/2V3+V2+V1+V6+V5+V4    |  Vc.,11 = 1/2V6+V5+V4+V3+V2+V1
                               |      =              1120 vph   |        =              1104 vph
  Potential Capacity:          |Cp,8 =                245 pcph  |  Cp,11 =                247 pcph
  Capacity Adj Factor:         |f8 = po,4*po,1 =      0.99      |  f11 = po,4*po,1 =      0.99
  Movement Capacity:           |Cm,8 = Cp,8*f8 =      243 pcph  |  Cm,11 = Cp,11*f11 =    245 pcph
  Prob. of Queue-free State:   |po,8 = 1-v8/Cm,8 =    0.65      |  po,11 = 1-v11/Cm,11 =  0.74
------------------------------------------------------------------------------------------
STEP 4: LT FROM MINOR STREET   |                                |
  Conflicting Flows:           |Vc,7 = 1/2V3+V2+V1+1/2V6+V5+V4+ |  Vc,10 = 1/2V6+V5+V4+1/2V3+V2+V1+
                               |      1/2(V11+V12) =  1271 vph  |         1/2(V8+V9) =   1142 vph
  Potential Capacity:          |Cp7 =                 153 pcph  |  Cp10 =                 197 pcph
  Major Left, Minor Through    |                                |
   Impedance Factor:           |P''7=po,11*f11 =      0.74      |  P''10=po,8*f8 =        0.65
  Major Left, Minor Through    |                                |
   Adjusted Impedance Factor:  |p'7 =                 0.80      |  p'10 =                 0.73
  Capacity Adjustment Factor:  |f7 = p'7*po,12 =      0.17      |  f10 = p'10*po,9 =      0.70
  Movement Capacity:           |Cm,7 = f7*Cp,7 =       28 pcph  |  Cm,10 = f10*Cp,10 =    138 pcph
------------------------------------------------------------------------------------------
```

DELAY AND LEVEL OF SERVICE SUMMARY

MOVEMENT	v(pcph)	cm(pcph)	csh(pcph)	AVG TOTAL DELAY	LOS
MINOR LEFT TURN (7)	15	28	SHRD	SHRD	--
MINOR THROUGH (8)	84	243	170	96.9	F
MINOR RIGHT TURN (9)	56	1381	SHRD	SHRD	----
MINOR LEFT TURN (10)	14	138	SHRD	SHRD	--
MINOR THROUGH (11)	64	245	333	124.2	F
MINOR RIGHT TURN (12)	303	388	SHRD	SHRD	--
MAJOR LEFT (1)	0	442	--NA--	8.1	B
MAJOR LEFT (4)	9	1704	--NA--	2.1	A
MINOR APPROACH (7)(8)(9)	-	-	-	96.9	F
MINOR APPROACH (10)(11)(12)	-	-	-	124.2	F
MAJOR APPROACH (1)(2)(3)	-	-	-	0.0	----
MAJOR APPROACH (4)(5)(6)	-	-	-	0.0	A
TOTAL INTERSECTION (1-12)	-	-	-	39.0	E

LEVEL OF SERVICE CRITERIA

LEVEL OF SERVICE	AVG TOTAL DELAY (SEC/VEH)
A	<=5
B	>5&<=10
C	>10&<=20
D	>20&<=30
E	>30&<=45
F	>45

ATA Inc.   TWO-WAY STOP CONTROLLED INTERSECTION LEVEL OF SERVICE ANALYSIS   1994 HCM

Major Street: PUKALANI BYPASS   Print Date: 29-Jul-96
Minor Street: MAKANI ST   Analyst: BC
Scenario: FUTURE BASE ~~WITH &~~ WITHOUT KIT   File Name: PUKMAK-P
Peak Hour: PM   Intesection #:

```
                              |           V12       V11       V10             ^
    Peak Hour Factor:    1.00 |                                               |
                              |            39        37         4           NORTH
---------MAJOR STREET-------- |             |         |         |
   Num of Lanes - V2:       2 |             |         |         |
   Excl LT - V1 (Y/N):      Y |             /         |         \
   Excl RT - V3 (Y/N):      N |            (          v          )
 Stop/Yield - V3 (Y/N):     N |
   Grade - V1,V2,V3:        2 |         ^                            ^
                              |        /                              \
   Num of Lanes - V5:       1 | V1  196 -----                          ----    25 V6
   Excl LT - V4 (Y/N):      Y |
   Excl RT - V6 (Y/N):      N | V2  770 -------)                      (----   467 V5
 Stop/Yield - V6 (Y/N):     N |
   Grade - V4,V5,V6:       -2 | V3   25 -----                          ----    18 V4
                              |          \                            /
---------MINOR STREET-------- |           v                          v   MAJOR STREET
   Num of Lanes - V8:       1 |                                          PUKALANI BYPASS
   Grade - V7,V8,V9:        0 |            (          ^          )
   Shared Lane-V7,8,9:      3 |             \         |         /
(0=N,1=LT,2=TR,3=LTR)         |              |        |        |
                              |              |        |        |
   Num of Lanes - V11:      1 |              2       60       26
   Grade - V10,V11,V12:     0 |
 Shared Lane-V10,11,12:     3 |             V7       V8       V9
(0=N,1=LT,2=TR,3=LTR)         |
                              |           MINOR STREET - MAKANI ST
```

```
VOLUME ADJUSTMENTS          |
  MOVEMENT NO.              |    1    2   3    4    5    6     7    8    9   10   11   12
  HOURLY FLOW RATE, V(vph)  |  196  770  25   18  467   25     2   60   26    4   37   39
  VOLUME, v (pcph)          |  274  770  25   18  467   25     2   66   29    4   41   43
-------------------------------------------------------------------------------------------
STEP 1: RT FROM MINOR STREET  |                                |
  Conflicting Flows:          |Vc9 = 1/2 V3 + V2 =   398 vhp   | Vc12 = 1/2 V6 + V5 =   480 vhp
  Potential Capacity:         |Cp,9 =                871 pcph  | Cp,12 =                791 pcph
  Movement Capacity:          |Cm,9=Cp,9=            871 pcph  | Cm,12=Cp,12=           791 pcph
  Prb. of Queu-free State:    |po,9=1-v9/Cm,9=      0.97       | po,12=1-v12/Cm,12=    0.95
-------------------------------------------------------------------------------------------
STEP 2: LT FROM MAJOR STREET  |                                |
  Conflicting Flows:          |Vc,4 = V2 + V3 =      795 vhp   | Vc,1 = V5 + V6 =       492 vhp
  Potential Capacity:         |Cp,4 =                642 pcph  | Cp,1 =                 933 pcph
  Movement Capacity:          |Cm,4=Cp,4=            642 pcph  | Cm,1=Cp,1=             933 pcph
  Prb. of Queu-free State:    |po,4=1-v4/Cm4=       0.97       | po,1=1-v1/Cm1=        0.71
  Major Left Shared Lane      |                                |
   Prob. of Queue-free State  |p'o,4=                NA        | p'o,1=                 NA
-------------------------------------------------------------------------------------------
```


----continued ----

Major Street:	PUKALANI BYPASS	DATE:	29-Jul-96
Minor Street:	MAKANI ST	Analyst:	BC
Scenario:	FUTURE BASE ~~WITH~~ WITHOUT MIT	File Name:	PUKMAK-P
Peak Hour:	PM	Intesection Intesection #:	

STEP 3: TH FROM MINOR STREET		
Conflicting Flows:	Vc.,8 = 1/2V3+V2+V1+V6+V5+V4 = 1489 vph	Vc.,11 = 1/2V6+V5+V4+V3+V2+V1 = 1489 vph
Potential Capacity:	Cp,8 = 147 pcph	Cp,11 = 147 pcph
Capacity Adj Factor:	f8 = po,4*po,1 = 0.69	f11 = po,4*po,1 = 0.69
Movement Capacity:	Cm,8 = Cp,8*f8 = 101 pcph	Cm,11 = Cp,11*f11 = 101 pcph
Prob. of Queue-free State:	po,8 = 1-v8/Cm,8 = 0.35	po,11 = 1-v11/Cm,11 = 0.59

STEP 4: LT FROM MINOR STREET		
Conflicting Flows:	Vc,7 = 1/2V3+V2+V1+1/2V6+V5+V4+ 1/2(V11+V12) = 1514 vph	Vc,10 = 1/2V6+V5+V4+1/2V3+V2+V1+ 1/2(V8+V9) = 1494 vph
Potential Capacity:	Cp7 = 114 pcph	Cp10 = 117 pcph
Major Left, Minor Through Impedance Factor:	P''7=po,11*f11 = 0.41	P''10=po,8*f8 = 0.24
Major Left, Minor Through Adjusted Impedance Factor:	p'7 = 0.53	p'10 = 0.37
Capacity Adjustment Factor:	f7 = p'7*po,12 = 0.50	f10 = p'10*po,9 = 0.36
Movement Capacity:	Cm,7 = f7*Cp,7 = 57 pcph	Cm,10 = f10*Cp,10 = 42 pcph

DELAY AND LEVEL OF SERVICE SUMMARY

MOVEMENT	v(pcph)	cm(pcph)	csh(pcph)	AVG TOTAL DELAY	LOS
MINOR LEFT TURN (7)	2	57	SHRD	SHRD	--
MINOR THROUGH (8)	66	101	134	76.8	F
MINOR RIGHT TURN (9)	29	871	SHRD	SHRD	----
MINOR LEFT TURN (10)	4	42	SHRD	SHRD	--
MINOR THROUGH (11)	41	101	158	47.9	F
MINOR RIGHT TURN (12)	43	791	SHRD	SHRD	--
MAJOR LEFT (1)	274	933	--NA--	5.5	B
MAJOR LEFT (4)	18	642	--NA--	5.8	B
MINOR APPROACH (7)(8)(9)	-	-	-	76.8	F
MINOR APPROACH (10)(11)(12)	-	-	-	47.9	F
MAJOR APPROACH (1)(2)(3)	-	-	-	1.4	A
MAJOR APPROACH (4)(5)(6)	-	-	-	0.2	A
TOTAL INTERSECTION (1-12)	-	-	-	8.0	B

LEVEL OF SERVICE CRITERIA

LEVEL OF SERVICE	AVG TOTAL DELAY (SEC/VEH)
A	(=5
B	)5&(=10
C	)10&(=20
D	)20&(=30
E	)30&(=45
F	)45

KULAMALU
FUTURE BASE
AM PEAK HOUR

03/27/97
17:34:15

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - PUKALANI BYPASS & MAKAWAO AV

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	EB ~~SB~~	SB ~~WB~~	WB ~~NB~~	NB ~~EB~~
GRADES	6.0	.0	-6.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	12	35	219	1

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	L
VOLUMES	12	33	50	376	286	335	219	638	2	21	229	2
WIDTHS	12.0	24.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.
LANES	1	2	1	1	1	1	1	1	1	1	1	
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.9
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YE
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	190
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NOR
SATURATIONFLOWS	1493	3614	1717	1539	1863	753	1585	1919	1823	1539	1863	56

Phasing Parameters

SEQUENCES	41						
PERMISSIVES	NO	YES	NO	YES	LEADLAGS	NONE	NON
OVERLAPS	NO	NO	NO	NO	OFFSET	.00	
CYCLES	60	180	10		PEDTIME	.0	
GREENTIMES	8.00	25.00	25.00				
YELLOWTIMES	.00	.00	.00				
CRITICALS	3	8	6				
EXCESS	0						

KULAMALU
FUTURE BASE
AM PEAK HOUR

03/27/97
17:34:46

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - PUKALANI BYPASS & MAKAWAO AV
Degree of Saturation (v/c) .70 Vehicle Delay 22.4@ Level of Service C
@ expect more delay due to extreme v/c's (see EVALUATE)

```
         -----------------------------------------------
Sq 41   |  Phase 1  |   Phase 2    |   Phase 3    |
**/**    -----------------------------------------------
        |     *     | + +          |         ^    |
  .     |     *     | + +          |      ++++    |
 /|\    |     *>    |<+ +          |     <++++    |
  |     |           |   v          |  ^   ****    |
West    |           |         ^    |++++   v      |
~~North~~ |   <+      |       * +>   |++++>         |
  |     |     +     |         * +  |++++          |
        |     +     |         * +  |   v          |
         -----------------------------------------------
        | G/C= .138 | G/C= .431    | G/C= .431    |
        | G=   8.0" | G=  25.0"    | G=  25.0"    |
        | Y+R=  .0" | Y+R=  .0"    | Y+R=  .0"    |
        | OFF=  .0% | OFF=13.8%    | OFF=56.9%    |
         -----------------------------------------------
C= 58 sec   G= 58.0 sec =100.0%   Y= .0 sec =  .0%   Ped= .0 sec =  .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								12.2	B	
RT	12/1	.002	.397	546	592	1	.002	6.8	B+	25 ft
TH	24/2	.018	.397	1401	1433	35	.024	6.9	B+	25 ft
LT	12/1	.051	.103	128	173	53	.298	15.8	*C+	39 ft
WB ~~NB~~ Approach								18.9	C+	
RT	12/1	.002	.397	583	629	1	.002	6.8	B+	25 ft
TH	12/1	.376	.397	715	761	672	.883	18.9	*C+	331 ft
LT	12/1	.004	.103	138	185	2	.011	15.1	C+	25 ft
SB ~~WB~~ Approach								29.7@	D+	
RT	12/1	.269	.397	564	610	359	.589	10.0	B+	177 ft
TH	12/1	.194	.397	693	739	301	.407	8.3	B+	148 ft
LT	12/1	.519	.397	257	299	353	1.181	68.0@	*F	174 ft
NB ~~EB~~ Approach								7.8	B+	
RT	12/1	.028	.397	564	610	21	.034	6.9	B+	25 ft
TH	12/1	.161	.397	693	739	241	.326	7.9	B+	119 ft
LT	12/1	.000	.397	188	226	23	.102	7.1	B+	25 ft

KULAMALU
FUTURE BASE
PM PEAK HOUR

03/27/97
17:35:27

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - PUKALANI BYPASS & MAKAWAO AV

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	~~SB~~ EB	~~WB~~ SB	~~NB~~ WB	~~EB~~ NB
GRADES	6.0	.0	-6.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	14	103	122	1

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	44	458	278	103	291	174	252	356	2	9	294	2
WIDTHS	12.0	24.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.
LANES	1	2	1	1	1	1	1	1	1	1	1	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.9
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YE
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	190
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NOR
SATURATIONFLOWS	1493	3614	1717	1539	1863	504	1585	1919	1823	1539	1863	51

Phasing Parameters

SEQUENCES	41						
PERMISSIVES	NO	YES	NO	YES	LEADLAGS	NONE	NON
OVERLAPS	NO	NO	NO	NO	OFFSET	.00	1
CYCLES	60	180	10		PEDTIME	.0	
GREENTIMES	15.00	25.00	25.00				
YELLOWTIMES	.00	.00	.00				
CRITICALS	3	8	6				
EXCESS	0						

KULAMALU
FUTURE BASE
PM PEAK HOUR

03/27/97
17:36:08

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - PUKALANI BYPASS & MAKAWAO AV
Degree of Saturation (v/c) .54 Vehicle Delay 18.6 Level of Service C+

```
         ----------------------------------------------
Sq 41  |  Phase 1    |  Phase 2    |  Phase 3    |
**/**  ----------------------------------------------
       |      *      | + +         |          ^  |
       |      *      | + +         |      ++++   |
  /|\  |      *>     |<+ +         |   ^ <++++   |
   |   |             |  v          |      ****   |
 West  |             |         ^   |++++    v    |
~~North~~|   <+        |         * +>|++++>        |
   |   |      +      |         * + |++++         |
       |      +      |         * + |  v          |
       ----------------------------------------------
       | G/C= .231   | G/C= .385   | G/C= .385   |
       | G=  15.0"   | G=  25.0"   | G=  25.0"   |
       | Y+R=   .0"  | Y+R=   .0"  | Y+R=   .0"  |
       | OFF=   .0%  | OFF=23.1%   | OFF=61.5%   |
       ----------------------------------------------
       C= 65 sec   G= 65.0 sec =100.0%  Y=  .0 sec =  .0%  Ped=  .0 sec =  .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								17.0	C+	
RT	12/1	.042	.354	471	528	32	.061	9.0	B+	25 ft
TH	24/2	.158	.354	1224	1279	482	.377	10.2	B	142 ft
LT	12/1	.209	.200	277	343	293	.854	29.0	*D+	214 ft
WB ~~NB~~ Approach								11.1	B	
RT	12/1	.123	.354	504	561	137	.244	9.6	B+	81 ft
TH	12/1	.232	.354	620	679	375	.552	11.6	*B	221 ft
LT	12/1	.004	.200	297	365	2	.005	13.5	B	25 ft
SB ~~WB~~ Approach								34.6	D	
RT	12/1	.003	.354	488	545	1	.002	8.8	B+	25 ft
TH	12/1	.202	.354	601	659	306	.464	10.9	B	181 ft
LT	12/1	.440	.354	139	175	183	1.028	74.5	*F	108 ft
NB ~~EB~~ Approach								10.8	B	
RT	12/1	.014	.354	488	545	8	.015	8.8	B+	25 ft
TH	12/1	.203	.354	601	659	309	.469	10.9	B	182 ft
LT	12/1	.000	.354	142	178	21	.116	9.2	B+	25 ft

KULAMALU
FUTURE BASE
AM PEAK HOUR

03/27/97
17:38:29

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - BYPASS/KULA HWY & HALEAKALA HY

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	SB	WB	NB	EB
GRADES	6.0	.0	-6.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	1	37	39	127

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	1	350	53	109	32	55	85	769	182	356	79	1
WIDTHS	12.0	12.0	12.0	12.0	12.0	.0	12.0	12.0	12.0	12.0	12.0	.0
LANES	1	1	1	1	1	0	1	1	1	1	1	0
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1493	1807	240	1539	1481	0	1585	1919	1823	1539	1858	0

Phasing Parameters

SEQUENCES	31	ALL		
PERMISSIVES	YES	YES	YES	YES
OVERLAPS	YES	YES	YES	YES
CYCLES	60	120	10	
GREENTIMES	9.96	28.07	9.96	
YELLOWTIMES	4.00	4.00	4.00	
CRITICALS	9	8	5	
EXCESS	0			

LEADLAGS	NONE	NONE
OFFSET	.00	1
PEDTIME	.0	0

KULAMALU
FUTURE BASE
AM PEAK HOUR

03/27/97
17:39:01

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - BYPASS/KULA HWY & HALEAKALA HY
Degree of Saturation (v/c) .44 Vehicle Delay 5.4 Level of Service B+

```
------------------------------------------------
Sq 31 | Phase 1    | Phase 2     | Phase 3     |
**/** ------------------------------------------
      |            | + + +       |         ^   |
      |            | + + +       |       ++++  |
  /|\ |            |<+ + +>      |      <****  |
   |  |            |  v          |   ^   ****  |
   |  |       ^    |        ^    |++++   v     |
North |    <* + +> |   <+ * +>   |++++>        |
   |  |++++  * + + |    + * +    |++++         |
      |     v * + +|    + * +    |  v          |
------------------------------------------------
      | G/C= .166  | G/C= .468   | G/C= .166   |
      | G=  10.0"  | G=  28.1"   | G=  10.0"   |
      | Y+R= 4.0"  | Y+R= 4.0"   | Y+R= 4.0"   |
      | OFF= -.0%  | OFF=23.3%   | OFF=76.7%   |
------------------------------------------------
C= 60 sec   G= 48.0 sec = 80.0%  Y=12.0 sec = 20.0%  Ped=  .0 sec =   .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
SB Approach								6.5	B+	
RT	12/1	.002	.501	711	748	1	.001	4.8	A	25 ft
TH	12/1	.238	.501	872	906	368	.406	6.2	B+	155 ft
LT	12/1	.000	.501	93	116	56	.467	8.4	B+	25 ft
NB Approach								2.6	A	
RT	12/1	.052	.734	1161	1163	48	.041	1.4	A	25 ft
TH	12/1	.443	.734	1408	1408	809	.575	2.8	*A	182 ft
LT	12/1	.000	.199	592	618	192	.311	2.1	*A	43 ft
WB Approach								13.3	B	
RT	12/1	.077	.199	249	307	76	.248	13.2	B	51 ft
LT+TH	12/1	.093	.199	238	295	92	.312	13.5	*B	62 ft
EB Approach								9.0	B+	
RT	12/1	.195	.432	620	665	241	.362	7.6	B+	115 ft
LT+TH	12/1	.069	.199	308	370	84	.227	13.1	B	57 ft

KULAMALU
FUTURE BASE
PM PEAK HOUR

03/27/97
17:39:42

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - BYPASS/KULA HWY & HALEAKALA HY

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	SB	WB	NB	EB
GRADES	6.0	.0	-6.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	1	52	21	153

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	1	680	74	87	36	31	33	485	200	218	46	0
WIDTHS	12.0	12.0	12.0	12.0	12.0	.0	12.0	12.0	12.0	12.0	12.0	.0
LANES	1	1	1	1	1	0	1	1	1	1	1	0
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1493	1807	300	1539	1676	0	1585	1919	1823	1539	1863	0

Phasing Parameters

SEQUENCES	31	ALL		
PERMISSIVES	YES	YES	YES	YES
OVERLAPS	YES	YES	YES	YES
CYCLES	60	120	10	
GREENTIMES	7.62	32.76	7.62	
YELLOWTIMES	4.00	4.00	4.00	
CRITICALS	9	2	5	
EXCESS	0			

LEADLAGS	NONE	NONE
OFFSET	.00	1
PEDTIME	.0	0

KULAMALU
FUTURE BASE
PM PEAK HOUR

03/27/97
17:40:13

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - BYPASS/KULA HWY & HALEAKALA HY
Degree of Saturation (v/c) .48 Vehicle Delay 5.8 Level of Service B+

```
        -------------------------------------------
Sq 31  |  Phase 1   |  Phase 2   |  Phase 3   |
**/**  -------------------------------------------
       |            | +  *  +    |        ^   |
  .    |            | +  *  +    |      ++++  |
 /|\   |            |<+  *  +>   |    <****   |
  |    |            |    v       |      ****  |
  |    |        ^   |        ^   |      v     |
North  |   <*  +  +>|  <+  +  +> |++++>       |
  |    |++++ *  +  +|    +  +  + |++++        |
       |   v  *  +  +|    +  +  + |   v        |
        -------------------------------------------
       | G/C= .127  | G/C= .546  | G/C= .127  |
       | G=   7.6"  | G=  32.8"  | G=   7.6"  |
       | Y+R= 4.0"  | Y+R= 4.0"  | Y+R= 4.0"  |
       | OFF=  .0%  | OFF=19.4%  | OFF=80.6%  |
        -------------------------------------------
       C= 60 sec   G= 48.0 sec = 80.0%   Y=12.0 sec = 20.0%   Ped= .0 sec = .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
SB Approach								6.9	B+	
RT	12/1	.002	.579	838	865	1	.001	3.4	A	25 ft
TH	12/1	.421	.579	1025	1047	716	.684	7.0	*B+	254 ft
LT	12/1	.086	.579	145	174	78	.448	5.9	B+	28 ft
NB Approach								2.5	A	
RT	12/1	.019	.773	1225	1225	13	.011	1.0	A	25 ft
TH	12/1	.297	.773	1483	1483	511	.345	1.4	A	98 ft
LT	12/1	.062	.160	378	420	211	.502	5.4	*B+	49 ft
WB Approach								14.3	B	
RT	12/1	.043	.160	191	247	37	.150	14.0	B	26 ft
LT+TH	12/1	.067	.160	211	269	71	.264	14.4	*B	50 ft
EB Approach								10.8	B	
RT	12/1	.071	.354	493	545	68	.125	8.5	B+	37 ft
TH	12/1	.044	.160	238	299	48	.161	14.0	B	34 ft

KULAMALU
FUTURE BASE
AM PEAK HOUR

03/27/97
17:42:09

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & PUKALANI ST

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	~~SB~~ EB	~~WB~~ SB	~~NB~~ WB	~~EB~~ NB
GRADES	8.0	.0	-8.0	2.0
PEDLEVELS	MODER	MODER	MODER	MODER
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	141	0	0	135

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	141	342	0	0	0	0	0	249	193	151	0	608
WIDTHS	12.0	12.0	.0	.0	.0	.0	.0	12.0	12.0	12.0	.0	12.0
LANES	1	1	0	0	0	0	0	1	1	1	0	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1350	1788	0	0	0	0	0	1919	1823	1392	0	1392

Phasing Parameters

SEQUENCES	31			
PERMISSIVES	YES	YES	YES	YES
OVERLAPS	NO	NO	NO	NO
CYCLES	60	180	10	
GREENTIMES	5.00	15.00	30.00	
YELLOWTIMES	4.00	4.00	.00	
CRITICALS	9	2	12	
EXCESS	0			

LEADLAGS	NONE	NONE
OFFSET	.00	1
PEDTIME	.0	0

KULAMALU
FUTURE BASE
AM PEAK HOUR

03/27/97
17:42:44

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - HALEAKALA HWY & PUKALANI ST
Degree of Saturation (v/c) .71 Vehicle Delay 17.4 Level of Service C+

```
------------------------------------------------
Sq 31 | Phase 1   | Phase 2   | Phase 3   |
**/** ------------------------------------------
      |           | + *       |           |
      |           | + *       |           |
 /|\  |           |<+ *       |           |
  |   |           |  v        |    ^      |
West  |       ^   |       ^   |****       |
North |    <* +   |    <+ +   |           |
  |   |     * +   |     + +   |++++       |
      |     * +   |     + +   |    v      |
------------------------------------------------
| G/C= .086   | G/C= .259   | G/C= .517   |
| G=    5.0"  | G=   15.0"  | G=   30.0"  |
| Y+R= 4.0"   | Y+R= 4.0"   | Y+R=   .0"  |
| OFF=   .0%  | OFF=15.5%   | OFF=48.3%   |
------------------------------------------------
C= 58 sec   G= 50.0 sec = 86.2%   Y= 8.0 sec = 13.8%   Ped= .0 sec = .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								14.3	B	
RT	12/1	.003	.293	343	396	1	.003	9.4	B+	25 ft
TH	12/1	.235	.293	468	524	360	.687	14.3	*B	207 ft
WB ~~NB~~ Approach								7.6	B+	
TH	12/1	.168	.448	821	860	262	.305	6.7	B+	118 ft
LT	12/1	.060	.121	316	352	203	.577	8.9	*B+	91 ft
NB ~~EB~~ Approach								26.0	D+	
RT	12/1	.026	.483	634	672	17	.025	5.1	B+	25 ft
LT	12/1	.487	.483	634	672	640	.952	26.6	*D+	270 ft

KULAMALU
FUTURE BASE
PM PEAK HOUR

03/27/97
17:43:24

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & PUKALANI ST

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	~~SB~~ EB	~~WB~~ SB	~~NB~~ WB	~~EB~~ NB
GRADES	8.0	.0	-8.0	2.0
PEDLEVELS	MODER	MODER	MODER	MODER
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	134	0	0	196

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	497	220	0	0	0	0	0	168	280	315	0	191
WIDTHS	12.0	12.0	.0	.0	.0	.0	.0	12.0	12.0	12.0	.0	12.0
LANES	1	1	0	0	0	0	0	1	1	1	0	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1350	1788	0	0	0	0	0	1919	1823	1392	0	1392

Phasing Parameters

SEQUENCES	31			
PERMISSIVES	YES	YES	YES	YES
OVERLAPS	NO	NO	NO	NO
CYCLES	60	180	10	
GREENTIMES	5.00	15.00	30.00	
YELLOWTIMES	4.00	4.00	.00	
CRITICALS	9	12	10	
EXCESS	0			

LEADLAGS	NONE	NONE
OFFSET	.00	1
PEDTIME	.0	0

CORRECTION

THE PRECEDING DOCUMENT(S) HAS BEEN REPHOTOGRAPHED TO ASSURE LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

KULAMALU
FUTURE BASE
PM PEAK HOUR

03/27/97
17:43:24

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & PUKALANI ST

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	~~SB~~ EB	~~WB~~ SB	~~NB~~ WB	~~EB~~ NB
GRADES	8.0	.0	-8.0	2.0
PEDLEVELS	MODER	MODER	MODER	MODER
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	134	0	0	196

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	497	220	0	0	0	0	0	168	280	315	0	191
WIDTHS	12.0	12.0	.0	.0	.0	.0	.0	12.0	12.0	12.0	.0	12.0
LANES	1	1	0	0	0	0	0	1	1	1	0	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1350	1788	0	0	0	0	0	1919	1823	1392	0	1392

Phasing Parameters

SEQUENCES	31						
PERMISSIVES	YES	YES	YES	YES	LEADLAGS	NONE	NONE
OVERLAPS	NO	NO	NO	NO	OFFSET	.00	1
CYCLES	60	180	10		PEDTIME	.0	0
GREENTIMES	5.00	15.00	30.00				
YELLOWTIMES	4.00	4.00	.00				
CRITICALS	9	12	10				
EXCESS	0						

KULAMALU
FUTURE BASE
PM PEAK HOUR

03/27/97
17:43:55

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - HALEAKALA HWY & PUKALANI ST
Degree of Saturation (v/c) .56 Vehicle Delay 16.8 Level of Service C+

```
        ----------------------------------------------
Sq 31 |  Phase 1   |   Phase 2   |   Phase 3    |
**/** ----------------------------------------------
      |            | + +         |              |
  .   |            | + +         |              |
 /|\  |            |<+ +         |              |
  |   |            |   v         |      ^       |
West  |       ^    |       ^     |++++          |
North |    <* +    |     <+ +    |              |
  |   |     * +    |       + +   |****          |
      |     * +    |       + +   |      v       |
        ----------------------------------------------
      | G/C= .086 | G/C= .259 | G/C= .517 |
      | G=   5.0" | G=  15.0" | G=  30.0" |
      | Y+R= 4.0" | Y+R= 4.0" | Y+R=   .0" |
      | OFF=  .0% | OFF=15.5% | OFF=48.3% |
        ----------------------------------------------
      C= 58 sec   G= 50.0 sec = 86.2%  Y= 8.0 sec = 13.8%  Ped=  .0 sec =   .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
~~SB~~ EB Approach								28.9	D+	
RT	12/1	.321	.293	343	396	382	.965	39.6	D	220 ft
TH	12/1	.162	.293	468	524	232	.443	11.2	B	134 ft
~~NB~~ WB Approach								8.8	B+	
TH	12/1	.122	.448	821	860	177	.206	6.3	B+	80 ft
LT	12/1	.070	.121	392	430	295	.686	10.2	*B	133 ft
~~EB~~ NB Approach								5.8	B+	
RT	12/1	.124	.483	634	672	125	.186	5.5	*B+	53 ft
LT	12/1	.183	.483	634	672	201	.299	5.9	*B+	85 ft

KULAMALU
FUTURE BASE
AM PEAK HOUR

03/27/97
17:45:14

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & MAKAWAO AV

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	EB ~~SB~~	SB ~~WB~~	WB ~~NB~~	NB ~~EB~~
GRADES	8.0	.0	-8.0	.0
PEDLEVELS	MODER	MODER	MODER	MODER
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	118	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	6	345	169	203	52	24	31	195	25	45	67	26
WIDTHS	.0	12.0	12.0	12.0	12.0	.0	.0	12.0	.0	.0	12.0	.0
LANES	0	1	1	1	1	0	0	1	0	0	1	0
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	0	1781	784	1406	1706	0	0	1672	0	0	1481	0

Phasing Parameters

SEQUENCES	31			
PERMISSIVES	YES	YES	YES	YES
OVERLAPS	NO	NO	NO	NO
CYCLES	60	180	10	
GREENTIMES	15.00	15.00	25.00	
YELLOWTIMES	.00	.00	.00	
CRITICALS	3	11	0	
EXCESS	0			

LEADLAGS	NONE	NONE
OFFSET	.00	1
PEDTIME	.0	0

KULAMALU
FUTURE BASE
AM PEAK HOUR

03/27/97
17:45:45

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

```
Intersection Averages for Int #   0 - HALEAKALA HWY & MAKAWAO AV
     Degree of Saturation (v/c)  .56   Vehicle Delay  20.1   Level of Service C

          ------------------------------------------------
Sq 31   |  Phase 1   |  Phase 2   |  Phase 3   |
**/**   ------------------------------------------------
        |            | + + +      |        ^   |
   .    |            | + + +      |        ++++|
  /|\   |            |<+ + +>     |       <++++|
   |    |            |    v       |        ++++|
West    |        ^   |        ^   |++++    v   |
~~North~~ |    <+ + +>|     <+ + +>|++++>       |
   |    |     + + +  |     + + +  |++++        |
        |     + + +  |     + + +  |  v         |
          ------------------------------------------------
        | G/C= .273  | G/C= .273  | G/C= .455  |
        | G=  15.0"  | G=  15.0"  | G=  25.0"  |
        | Y+R=   .0" | Y+R=   .0" | Y+R=   .0" |
        | OFF=   .0% | OFF=27.3%  | OFF=54.5%  |
          ------------------------------------------------
        C= 55 sec   G= 55.0 sec =100.0%   Y=  .0 sec =   .0%   Ped=  .0 sec =   .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								35.1	D	
TH+RT	12/1	.238	.236	366	421	369	.876	25.9	D+	218 ft
LT	12/1	.281	.236	144	183	178	.962	53.9	*E	105 ft
WB ~~NB~~ Approach								5.2	B+	
LT+TH+RT	12/1	.191	.509	821	851	264	.310	5.2	B+	100 ft
SB ~~WB~~ Approach								6.4	B+	
RT	12/1	.092	.418	546	588	89	.151	6.4	B+	40 ft
LT+TH	12/1	.070	.418	672	713	80	.112	6.3	B+	36 ft
NB ~~EB~~ Approach								6.7	B+	
LT+TH+RT	12/1	.131	.418	577	619	145	.234	6.7	*B+	65 ft

KULAMALU
FUTURE BASE
PM PEAK HOUR

03/27/97
17:46:23

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & MAKAWAO AV

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	EB ~~SB~~	SB ~~WB~~	WB ~~NB~~	NB ~~EB~~
GRADES	8.0	.0	-8.0	.0
PEDLEVELS	MODER	MODER	MODER	MODER
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	201	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	33	209	287	269	66	49	29	187	26	31	57	19
WIDTHS	.0	12.0	12.0	12.0	12.0	.0	.0	12.0	.0	.0	12.0	.0
LANES	0	1	1	1	1	0	0	1	0	0	1	0
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	0	1728	808	1406	1609	0	0	1673	0	0	1483	0

Phasing Parameters

SEQUENCES	31						
PERMISSIVES	YES	YES	YES	YES	LEADLAGS	NONE	NONE
OVERLAPS	NO	NO	NO	NO	OFFSET	.00	1
CYCLES	60	180	10		PEDTIME	.0	0
GREENTIMES	15.00	15.00	30.00				
YELLOWTIMES	.00	.00	.00				
CRITICALS	3	8	5				
EXCESS	0						

KULAMALU
FUTURE BASE
PM PEAK HOUR

03/27/97
17:46:53

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - HALEAKALA HWY & MAKAWAO AV
Degree of Saturation (v/c) .74 Vehicle Delay 30.2@ Level of Service D+
@ expect more delay due to extreme v/c's (see EVALUATE)

```
         ----------------------------------------------
Sq 31  |  Phase 1  |  Phase 2  |  Phase 3  |
**/**  ----------------------------------------------
       |           | + + +     |        ^  |
  .    |           | + + +     |     ++++|
 /|\   |           |<+ + +>    |    <****|
  |    |           |   v       |   ^  ****|
West   |      ^    |      ^    |++++   v  |
North  |   <+ + +> |  <+ * *>  |++++>     |
  |    |    + + +  |   + * *   |++++      |
       |    + + +  |   + * *   |  v       |
       ----------------------------------------------
       | G/C= .250  | G/C= .250  | G/C= .500  |
       | G=  15.0"  | G=  15.0"  | G=  30.0"  |
       | Y+R=   .0" | Y+R=   .0" | Y+R=   .0" |
       | OFF=   .0% | OFF=25.0%  | OFF=50.0%  |
       ----------------------------------------------
```

C= 60 sec G= 60.0 sec =100.0% Y= .0 sec = .0% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								54.4@	E	
TH+RT	12/1	.183	.217	313	374	255	.682	17.4	C+	168 ft
LT	12/1	.427	.217	132	171	302	1.726	85.6@	*F	200 ft
WB ~~NB~~ Approach								6.6	B+	
LT+TH+RT	12/1	.189	.467	741	781	255	.327	6.6	*B+	115 ft
SB ~~WB~~ Approach								5.9	B+	
RT	12/1	.080	.467	615	656	72	.110	5.8	B+	32 ft
LT+TH	12/1	.107	.467	711	751	121	.161	6.0	*B+	54 ft
NB ~~EB~~ Approach								6.0	B+	
LT+TH+RT	12/1	.109	.467	651	692	113	.163	6.0	B+	51 ft

```
ATA Inc.        TWO-WAY STOP CONTROLLED INTERSECTION LEVEL OF SERVICE ANALYSIS                1994 HCM
****************************************************************************************************
Major Street:  PUKALANI ST                                                   Print Date:   27-Jul-96
Minor Street:  IOLANI ST                                                        Analyst:   BC
    Scenario:  FUTURE BASE WITH & WITHOUT MIT                                 File Name:   PUKIOL-A
   Peak Hour:     AM                                                      Intesection #:
----------------------------------------------------------------------------------------------------
                               |               V12        V11        V10
     Peak Hour Factor:    1.00 |
                               |               118        16          2          <--- NORTH
---------MAJOR STREET--------- |                |          |          |
     Num of Lanes - V2:      1 |                |          |          |
    Excl LT - V1 (Y/N):      Y |               /           |           \
    Excl RT - V3 (Y/N):      Y |              <            v            >
  Stop/Yield - V3 (Y/N):     N |
     Grade - V1,V2,V3:       0 |        ^                                    ^
                               |       /                                      \
     Num of Lanes - V5:      1 | V1   33 -----                                 ----     5 V6
    Excl LT - V4 (Y/N):      N |
    Excl RT - V6 (Y/N):      N | V2   54 ------->                              <----  212 V5
  Stop/Yield - V6 (Y/N):     N |
     Grade - V4,V5,V6:       0 | V3   86 -----                                 ----     1 V4
                               |             \                                /
---------MINOR STREET--------- |              v                              v   MAJOR STREET
     Num of Lanes - V8:      1 |                                                 PUKALANI ST
     Grade - V7,V8,V9:       0 |              <            ^            >
    Shared Lane-V7,8,9:      3 |               \           |           /
 (0=N,1=LT,2=TR,3=LTR)         |                |          |          |
                               |                |          |          |
     Num of Lanes - V11:     1 |               223         17          1
   Grade - V10,V11,V12:      0 |
  Shared Lane-V10,11,12:     1 |               V7         V8         V9
 (0=N,1=LT,2=TR,3=LTR)         |
                               |          MINOR STREET - IOLANI ST
----------------------------------------------------------------------------------------------------
VOLUME ADJUSTMENTS             |
  MOVEMENT NO.                 |     1    2    3    4    5    6    7    8    9   10   11   12
  HOURLY FLOW RATE, V(vph)     |    33   54   86    1  212    5  223   17    1    2   16  118
  VOLUME, v (pcph)             |    36   54   86    1  212    5  245   19    1    2   18  130
----------------------------------------------------------------------------------------------------
STEP 1: RT FROM MINOR STREET   |                                |
  Conflicting Flows:           |Vc9 = 1/2 V3 + V2 =     54 vhp  |  Vc12 = 1/2 V6 + V5 =    215 vhp
  Potential Capacity:          |Cp,9 =                1300 pcph |  Cp,12 =                1078 pcph
  Movement Capacity:           |Cm,9=Cp,9=            1300 pcph |  Cm,12=Cp,12=           1078 pcph
  Prb. of Queu-free State:     |po,9=1-v9/Cm,9=       1.00      |  po,12=1-v12/Cm,12=     0.88
----------------------------------------------------------------------------------------------------
STEP 2: LT FROM MAJOR STREET   |                                |
  Conflicting Flows:           |Vc,4 = V2 + V3 =       140 vhp  |  Vc,1 = V5 + V6 =        217 vhp
  Potential Capacity:          |Cp,4 =                1470 pcph |  Cp,1 =                 1351 pcph
  Movement Capacity:           |Cm,4=Cp,4=            1470 pcph |  Cm,1=Cp,1=             1351 pcph
  Prb. of Queu-free State:     |po,4=1-v4/Cm4=        1.00      |  po,1=1-v1/Cm1=         0.97
  Major Left Shared Lane       |                                |
   Prob. of Queue-free State   |p"o,4=                1.00      |  p"o,1=                 NA
----------------------------------------------------------------------------------------------------
```


----continued ----

Major Street:	PUKALANI ST	DATE:	27-Jul-96
Minor Street:	IOLANI ST	Analyst:	BC
Scenario:	FUTURE BASE WITH & WITHOUT MIT	File Name:	PUKIOL-A
Peak Hour:	AM	Intesection Intesection #:	

STEP 3: TH FROM MINOR STREET

Conflicting Flows:	Vc.,8 = 1/2V3+V2+V1+V6+V5+V4 = 305 vph	Vc.,11 = 1/2V6+V5+V4+V3+V2+V1 = 300 vph
Potential Capacity:	Cp,8 = 755 pcph	Cp,11 = 759 pcph
Capacity Adj Factor:	f8 = po,4*po,1 = 0.97	f11 = po,4*po,1 = 0.97
Movement Capacity:	Cm,8 = Cp,8*f8 = 734 pcph	Cm,11 = Cp,11*f11 = 738 pcph
Prob. of Queue-free State:	po,8 = 1-v8/Cm,8 = 0.97	po,11 = 1-v11/Cm,11 = 0.98

STEP 4: LT FROM MINOR STREET

Conflicting Flows:	Vc,7 = 1/2V3+V2+V1+1/2V6+V5+V4+ 1/2(V11+V12) = 370 vph	Vc,10 = 1/2V6+V5+V4+1/2V3+V2+V1+ 1/2(V8+V9) = 312 vph
Potential Capacity:	Cp7 = 647 pcph	Cp10 = 699 pcph
Major Left, Minor Through Impedance Factor:	P''7=po,11*f11 = 0.95	P''10=po,8*f8 = 0.95
Major Left, Minor Through Adjusted Impedance Factor:	p'7 = 0.96	p'10 = 0.96
Capacity Adjustment Factor:	f7 = p'7*po,12 = 0.85	f10 = p'10*po,9 = 0.96
Movement Capacity:	Cm,7 = f7*Cp,7 = 547 pcph	Cm,10 = f10*Cp,10 = 670 pcph

DELAY AND LEVEL OF SERVICE SUMMARY

MOVEMENT	v(pcph)	cm(pcph)	csh(pcph)	AVG TOTAL DELAY	LOS
MINOR LEFT TURN (7)	245	547	SHRD	SHRD	--
MINOR THROUGH (8)	19	734	558	12.1	C
MINOR RIGHT TURN (9)	1	1300	SHRD	SHRD	----
MINOR LEFT TURN (10)	2	670	SHRD	SHRD	--
MINOR THROUGH (11)	18	738	731	5.1	B
MINOR RIGHT TURN (12)	130	1078	--NA--	3.8	A
MAJOR LEFT (1)	36	1351	--NA--	2.7	A
MAJOR LEFT (4)	1	1470	--NA--	2.5	A
MINOR APPROACH (7)(8)(9)	-	-	-	12.1	C
MINOR APPROACH (10)(11)(12)	-	-	-	4.0	A
MAJOR APPROACH (1)(2)(3)	-	-	-	0.6	A
MAJOR APPROACH (4)(5)(6)	-	-	-	0.0	A
TOTAL INTERSECTION (1-12)	-	-	-	5.1	B

LEVEL OF SERVICE CRITERIA

LEVEL OF SERVICE	AVG TOTAL DELAY (SEC/VEH)
A	<=5
B	>5&<=10
C	>10&<=20
D	>20&<=30
E	>30&<=45
F	>45

Major Street:	PUKALANI ST		
Minor Street:	IOLANI ST	Print Date:	28-Mar-97
Scenario:	FUTURE BASE WITH & WITHOUT MIT	Analyst:	BC
Peak Hour:	PM	File Name:	PUKIOL-P
		Intesection #:	

```
                                   |        V12       V11       V10
   Peak Hour Factor:          1.00 |
                                   |        53        10         7          <--- NORTH
   ---------MAJOR STREET---------  |         |         |         |
   Num of Lanes - V2:            1 |         |         |         |
   Excl LT - V1 (Y/N):           Y |        /          |          \
   Excl RT - V3 (Y/N):           Y |       <           v           >
   Stop/Yield - V3 (Y/N):        N |
   Grade - V1,V2,V3:             0 |     ^                             ^
                                   |    /                               \
   Num of Lanes - V5:            1 | V1  137 -----                       ----     0 V6
   Excl LT - V4 (Y/N):           N |
   Excl RT - V6 (Y/N):           N | V2  182 ------->                  <----    102 V5
   Stop/Yield - V6 (Y/N):        N |
   Grade - V4,V5,V6:             0 | V3  264 -----                       ----     7 V4
                                   |          \                         /
   ---------MINOR STREET---------  |           v                       v    MAJOR STREET
   Num of Lanes - V8:            1 |                                        PUKALANI ST
   Grade - V7,V8,V9:             0 |       <           ^           >
   Shared Lane-V7,8,9:           3 |        \          |          /
   (0=N,1=LT,2=TR,3=LTR)           |         |         |         |
                                   |         |         |         |
   Num of Lanes - V11:           1 |        125        25         5
   Grade - V10,V11,V12:          0 |
   Shared Lane-V10,11,12:        1 |        V7        V8        V9
   (0=N,1=LT,2=TR,3=LTR)           |
                                   |           MINOR STREET - IOLANI ST
```

VOLUME ADJUSTMENTS												
MOVEMENT NO.	1	2	3	4	5	6	7	8	9	10	11	12
HOURLY FLOW RATE, V(vph)	137	182	264	7	102	0	125	25	5	7	10	53
VOLUME, v (pcph)	151	182	264	8	102	0	138	28	6	8	11	58

STEP 1: RT FROM MINOR STREET				
Conflicting Flows:	Vc9 = 1/2 V3 + V2 =	182 vhp	Vc12 = 1/2 V6 + V5 =	102 vhp
Potential Capacity:	Cp,9 =	1120 pcph	Cp,12 =	1229 pcph
Movement Capacity:	Cm,9=Cp,9=	1120 pcph	Cm,12=Cp,12=	1229 pcph
Prb. of Queu-free State:	po,9=1-v9/Cm,9=	0.99	po,12=1-v12/Cm,12=	0.95

STEP 2: LT FROM MAJOR STREET				
Conflicting Flows:	Vc,4 = V2 + V3 =	446 vhp	Vc,1 = V5 + V6 =	102 vhp
Potential Capacity:	Cp,4 =	1051 pcph	Cp,1 =	1533 pcph
Movement Capacity:	Cm,4=Cp,4=	1051 pcph	Cm,1=Cp,1=	1533 pcph
Prb. of Queu-free State:	po,4=1-v4/Cm4=	0.99	po,1=1-v1/Cm1=	0.90
Major Left Shared Lane				
Prob. of Queue-free State	p*o,4=	0.99	p*o,1=	NA

----continued ----

Major Street: PUKALANI ST	DATE: 28-Mar-97
Minor Street: IOLANI ST	Analyst: BC
Scenario: FUTURE BASE WITH & WITHOUT MIT	File Name: PUKIOL-P
Peak Hour: PM	Intesection Intesection #:

STEP 3: TH FROM MINOR STREET

Conflicting Flows:	Vc.,8 = 1/2V3+V2+V1+V6+V5+V4 = 428 vph	Vc.,11 = 1/2V6+V5+V4+V3+V2+V1 = 428 vph
Potential Capacity:	Cp,8 = 650 pcph	Cp,11 = 650 pcph
Capacity Adj Factor:	f8 = po,4*po,1 = 0.89	f11 = po,4*po,1 = 0.89
Movement Capacity:	Cm,8 = Cp,8*f8 = 582 pcph	Cm,11 = Cp,11*f11 = 582 pcph
Prob. of Queue-free State:	po,8 = 1-v8/Cm,8 = 0.95	po,11 = 1-v11/Cm,11 = 0.98

STEP 4: LT FROM MINOR STREET

Conflicting Flows:	Vc,7 = 1/2V3+V2+V1+1/2V6+V5+V4+ 1/2(V11+V12) = 460 vph	Vc,10 = 1/2V6+V5+V4+1/2V3+V2+V1+ 1/2(V8+V9) = 443 vph
Potential Capacity:	Cp7 = 574 pcph	Cp10 = 587 pcph
Major Left, Minor Through Impedance Factor:	P''7=po,11*f11 = 0.88	P''10=po,8*f8 = 0.85
Major Left, Minor Through Adjusted Impedance Factor:	p'7 = 0.91	p'10 = 0.89
Capacity Adjustment Factor:	f7 = p'7*po,12 = 0.86	f10 = p'10*po,9 = 0.88
Movement Capacity:	Cm,7 = f7*Cp,7 = 495 pcph	Cm,10 = f10*Cp,10 = 517 pcph

DELAY AND LEVEL OF SERVICE SUMMARY

MOVEMENT	v(pcph)	cm(pcph)	csh(pcph)	AVG TOTAL DELAY	LOS
MINOR LEFT TURN (7)	138	495	SHRD	SHRD	--
MINOR THROUGH (8)	28	582	518	10.4	C
MINOR RIGHT TURN (9)	6	1120	SHRD	SHRD	----
MINOR LEFT TURN (10)	8	517	SHRD	SHRD	--
MINOR THROUGH (11)	11	582	552	6.7	B
MINOR RIGHT TURN (12)	58	1229	--NA--	3.1	A
MAJOR LEFT (1)	151	1533	--NA--	2.6	A
MAJOR LEFT (4)	8	1051	--NA--	3.5	A
MINOR APPROACH (7)(8)(9)	-	-	-	10.4	C
MINOR APPROACH (10)(11)(12)	-	-	-	4.0	A
MAJOR APPROACH (1)(2)(3)	-	-	-	0.7	A
MAJOR APPROACH (4)(5)(6)	-	-	-	0.3	A
TOTAL INTERSECTION (1-12)	-	-	-	2.7	A

LEVEL OF SERVICE CRITERIA

LEVEL OF SERVICE	AVG TOTAL DELAY (SEC/VEH)
A	<=5
B	>5&<=10
C	>10&<=20
D	>20&<=30
E	>30&<=45
F	>45

```
ATA Inc.              STOP CONTROLLED T-INTERSECTION LEVEL OF SERVICE ANALYSIS                       1994 HCM
==========================================================================================================
Major Street: KULA HWY                                                            Print Date:    27-Mar
Minor Street: OHANA ST                                                              Analyst:         BC
   Peak Hour:        AM                                                           File Name:   KULOHA-A
     Scenario: FUTURE BASE WITHOUT MIT                                          Intersection:
----------------------------------------------------------------------------------------------------------
Peak Hour Factor:       1.00  :
--------MAJOR STREET-------- : V2        899 -----------\                  <---- -----  436      V5
     Num of Lanes - V2:      1 :
    Excl RT - V3 (Y/N):      N : V3        4 -----                               -----    9      V4
Stop/Yield - V3 (Y/N):      N :                         \                      /
        % Grade - V2,V3:     3 :                          v                  v      MAJOR STREET:
                                :                                                    KULA HWY
     Num of Lanes - V5:      1 :                               <            >
    Excl LT - V4 (Y/N):      N :                                \          /
        % Grade - V4,V5:    -3 :                                 :        :
                                :                                 :        :
--------MINOR STREET-------- :                                   3       17                 NORTH--->
   Num of Lanes - V7,V9:     1 :
      Shared Lane (Y/N):     Y :                              V7        V9
       % Grade - V7&V9:      0 :                       MINOR STREET: OHANA ST
----------------------------------------------------------------------------------------------------------
VOLUME ADJUSTMENTS
  MOVEMENT NO.                      2         3           4                5        7         9
  VOLUME, V (vph)                 899         4           9              436        3        17
  VOLUME, v (pcph)                899         4           8              436        3        19
----------------------------------------------------------------------------------------------------------
STEP 1: RT FROM MINOR STREET - V9
  Conflicting Flows:      : Vc,9 = 1/2*V3+V2 =           2   +    899          =        901   vph
  Potential Capacity:     : Cp,9 =                                                      484   pcph
  Movement Capacity:      : Cm,9 = Cp,9 =                                               484   pcph
----------------------------------------------------------------------------------------------------------
STEP 2: LT FROM MAJOR STREET - V4
  Conflicting Flows:               : Vc,4 = V3+V2 =             4   +   899   =         903   vph
  Potential Capacity:                Cp,4 =                                             636   pcph
  Movement Capacity:                 Cm,4 = Cp,4 =                                      636   pcph
  Prob. of Queue-free State:       : po,4 = 1-v4/Cm,4 =                                0.99
  Major Left Shared Lane
   Prob. of Queue-free State:        p*o,4 =                                           0.98
----------------------------------------------------------------------------------------------------------
STEP 3: LT FROM MINOR STREET - V7
  Conflicting Flows:               : Vc,7 = 1/2V3+V2+V5+V4 =                           1346   vph
  Potential Capacity:                Cp,7 =                                             176   pcph
  Capacity Adjustment Factor
   Due To Impeding Movements:        f7=po,4=                                          0.98
  Movement Capacity:                 Cm,7 = Cp,7 =                                      173   pcph
----------------------------------------------------------------------------------------------------------
DELAY AND LEVEL OF SERVICE SUMMARY
                                                             csh     AVG TOTAL
     Movement                    v(pcph)        cm(pcph)    (pcph)     DELAY      LOS
   ------------                ------------     --------    ------    -------    ------
  MINOR LEFT TURN    (7)             3             173       SHRD      SHRD       SHRD
  MINOR RIGHT TURN   (9)            19             484        381      10.0         C
  MAJOR LEFT TURN    (4)             8             636      ------      5.7         B
----------------------------------------------------------------------------------------------------------
     AVERAGE MINOR APPROACH DELAY =     10.0 sec/veh       AVERAGE TOTAL INTERSECTION DELAY =     0.2 sec/veh
                 LEVEL OF SERVICE =     C                                 LEVEL OF SERVICE =     A
==========================================================================================================
```

```
ATA Inc.              STOP CONTROLLED T-INTERSECTION LEVEL OF SERVICE ANALYSIS                    1994 HCM
=========================================================================================================
Major Street: KULA HWY
Minor Street: OHANA ST                                                          Print Date:    27-Mar
  Peak Hour:        PM                                                             Analyst:        BC
   Scenario: FUTURE BASE WITHOUT MIT                                             File Name:    KULOHA-F
                                                                              Intersection:
---------------------------------------------------------------------------------------------------------
Peak Hour Factor:      1.00  :
--------MAJOR STREET-------- : V2        600 ----------->                  <---- -----  660      V5
   Num of Lanes - V2:     1  :
   Excl RT - V3 (Y/N):    N  : V3         1 -----                              -----   17       V4
Stop/Yield - V3 (Y/N):    N                     \                             /
      % Grade - V2,V3:    3  :                   v                           v      MAJOR STREET:
                             :                                                      KULA HWY
   Num of Lanes - V5:     1  :                         <            >
   Excl LT - V4 (Y/N):    N  :                          \          /
      % Grade - V4,V5:   -3  :                           :         :
                             :                           :         :
--------MINOR STREET-------- :                           2         17                     NORTH--->
 Num of Lanes - V7,V9:    1  :
   Shared Lane (Y/N):     Y  :
     % Grade - V7&V9:     0                             V7         V9
                                                  MINOR STREET: OHANA ST
---------------------------------------------------------------------------------------------------------
VOLUME ADJUSTMENTS
 MOVEMENT NO.                  2          3          4          5          7          9
 VOLUME, V (vph)             600          1         17        660          2         17
 VOLUME, v (pcph)            600          1         15        660          2         19
---------------------------------------------------------------------------------------------------------
STEP 1: RT FROM MINOR STREET - V9
  Conflicting Flows:      : Vc,9 = 1/2*V3+V2 =          1   +   600      =          601   vph
  Potential Capacity:     : Cp,9 =                                                  687   pcph
  Movement Capacity:      : Cm,p = Cp,9 =                                           687   pcph
---------------------------------------------------------------------------------------------------------
STEP 2: LT FROM MAJOR STREET - V4
  Conflicting Flows:            :  Vc,4 = V3+V2 =          1   +   600   =          601   vph
  Potential Capacity:           :  Cp,4 =                                           887   pcph
  Movement Capacity:            :  Cm,4 = Cp,4 =                                    887   pcph
  Prob. of Queue-free State:    :  po,4 = 1-v4/Cm,4 =                              0.98
  Major Left Shared Lane        :
   Prob. of Queue-free State:   :  p*o,4 =                                         0.97
---------------------------------------------------------------------------------------------------------
STEP 3: LT FROM MINOR STREET - V7
  Conflicting Flows:            :  Vc,7 = 1/2V3+V2+V5+V4 =                         1278   vph
  Potential Capacity:           :  Cp,7 =                                           193   pcph
  Capacity Adjustment Factor    :
   Due To Impeding Movements:   :  f7=po,4=                                        0.97
  Movement Capacity:            :  Cm,7 = Cp,7 =                                    187   pcph
---------------------------------------------------------------------------------------------------------
DELAY AND LEVEL OF SERVICE SUMMARY
   Movement                  v(vcph)       cm(pcph)     csh      AVG TOTAL
 ------------                                          (pcph)     DELAY       LOS
                           -------------   --------    ------    -------     ------
 MINOR LEFT TURN   (7)          2             187       SHRD      SHRD        SHRD
 MINOR RIGHT TURN  (9)         19             687       536        7.0          B
 MAJOR LEFT TURN   (4)         15             887      ------      4.1          A
---------------------------------------------------------------------------------------------------------
   AVERAGE MINOR APPROACH DELAY =      7.0 sec/veh   :   AVERAGE TOTAL INTERSECTION DELAY =    0.2 sec/veh
               LEVEL OF SERVICE =      B             :                   LEVEL OF SERVICE =    A
=========================================================================================================
```

KULAMALU
FUTURE BASE W/MIT
AM PEAK HOUR

03/27/97
18:55:29

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & HANA HWY

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	EB ~~SB~~	SB ~~WB~~	WB ~~NB~~	NB ~~EB~~
GRADES	.0	.0	.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	0	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	5	21	17	49	748	53	30	142	2392	512	266	41
WIDTHS	12.0	12.0	.0	12.0	24.0	12.0	12.0	12.0	12.0	12.0	24.0	12.0
LANES	1	1	0	1	2	1	1	1	1	1	2	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	FFLW	NORM	DOPT	FFLW	NORM	NORM
SATURATIONFLOWS	1539	1822	0	1539	3725	832	0	1783	1770	0	3725	486

Phasing Parameters

SEQUENCES	71	ALL					
PERMISSIVES	NO	NO	NO	NO	LEADLAGS	NONE	NONE
OVERLAPS	NO	NO	NO	NO	OFFSET	.00	1
CYCLES	60	90	10		PEDTIME	.0	0
GREENTIMES	9.09	25.59	13.32				
YELLOWTIMES	4.00	4.00	4.00				
CRITICALS	2	9	5				
EXCESS	0						

KULAMALU
FUTURE BASE W/MIT
AM PEAK HOUR

03/27/97
18:56:04

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - HALEAKALA HWY & HANA HWY
Degree of Saturation (v/c) 1.31 Vehicle Delay 38.9@ Level of Service D
@ expect more delay due to extreme v/c's (see EVALUATE)

```
        --------------------------------------------
Sq 71  | Phase 1   | Phase 2    | Phase 3    |
**/**  --------------------------------------------
       | +  *  *   |            |        ^   |
       | +  *  *   |            |       ++++ |
 /|\   |<+  *  *>  |            |     <****|
  |    |    v      |            |   ^   ++++ |
West   |           |       ^    |++++   v    |
~~North~~ |        |    <*  +   |++++>       |
  |    |           |      *  +  |            |
       |           |      *  +  |            |
        --------------------------------------------
       | G/C= .152  | G/C= .426  | G/C= .222  |
       | G=   9.1"  | G=  25.6"  | G=  13.3"  |
       | Y+R= 4.0"  | Y+R= 4.0"  | Y+R= 4.0"  |
       | OFF=  .0%  | OFF=21.8%  | OFF=71.1%  |
        --------------------------------------------
```

C= 60 sec G= 48.0 sec = 80.0% Y=12.0 sec = 20.0% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								13.1	B	
RT	12/1	.009	.185	227	284	5	.018	12.9	B	25 ft
LT+TH	12/1	.039	.185	275	337	40	.119	13.2	*B	27 ft
WB ~~NB~~ Approach								49.9@	E+	
TH	12/1-	.762	.460	780	820	1368	1.668	49.8@	E+	623 ft
LT	12/1+	.732	.460	774	814	1299	1.596	49.9@	*E+	592 ft
SB ~~WB~~ Approach								17.2	C+	
RT	12/1	.057	.255	335	393	52	.132	11.1	B	33 ft
TH	24/2	.230	.255	884	951	787	.828	17.9	*C+	247 ft
LT	12/1	.000	.255	167	212	56	.263	11.7	B	35 ft
NB ~~EB~~ Approach								11.8	B	
TH	24/2	.095	.255	884	951	280	.294	11.7	B	88 ft
LT	12/1	.000	.255	90	118	43	.347	12.5	B	27 ft

KULAMALU
FUTURE BASE W/MIT
PM PEAK HOUR

03/27/97
18:58:47

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & HANA HWY

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	EB ~~SB~~	SB ~~WB~~	WB ~~NB~~	NB ~~EB~~
GRADES	.0	.0	.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	0	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	25	257	161	40	506	56	34	37	804	1552	607	2
WIDTHS	12.0	12.0	.0	12.0	24.0	12.0	12.0	12.0	12.0	12.0	24.0	12.0
LANES	1	1	0	1	2	1	1	1	1	1	2	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	FFLW	NORM	DOPT	FFLW	NORM	NORM
SATURATIONFLOWS	1539	1828	0	1539	3725	541	0	1781	1770	0	3725	541

Phasing Parameters

SEQUENCES	71	ALL		
PERMISSIVES	NO	NO	NO	NO
OVERLAPS	NO	NO	NO	NO
CYCLES	60	120	10	
GREENTIMES	17.62	18.62	11.76	
YELLOWTIMES	4.00	4.00	4.00	
CRITICALS	2	8	11	
EXCESS	0			

LEADLAGS	NONE	NONE
OFFSET	.00	1
PEDTIME	.0	0

KULAMALU
FUTURE BASE W/MIT
PM PEAK HOUR

03/27/97
18:59:19

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - HALEAKALA HWY & HANA HWY
Degree of Saturation (v/c) .69 Vehicle Delay 14.8 Level of Service B

```
Sq 71 |  Phase 1   |  Phase 2   |  Phase 3   |
**/** ----------------------------------------
      | +  *  *    |            |       ^    |
  .   | +  *  *    |            |       ++++ |
 /|\  |<+  *  *>   |            |      <++++ |
  |   |    v       |            |   ^   ++++ |
We|st |            |       ^    |++++   v    |
North |            |    <+ *    |****>       |
  |   |            |     + *    |            |
      |            |     + *    |            |
      ----------------------------------------
      | G/C= .294  | G/C= .310  | G/C= .196  |
      | G=  17.6"  | G=  18.6"  | G=  11.8"  |
      | Y+R= 4.0"  | Y+R= 4.0"  | Y+R= 4.0"  |
      | OFF=  .0%  | OFF=36.0%  | OFF=73.7%  |
      ----------------------------------------
```

C= 60 sec G= 48.0 sec = 80.0% Y=12.0 sec = 20.0% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								14.5	B	
RT	12/1	.033	.327	449	503	26	.052	8.9	B+	25 ft
LT+TH	12/1	.274	.327	543	598	440	.736	14.8	*B	250 ft
WB ~~NB~~ Approach								14.1	B	
TH	12/1-	.288	.344	558	612	454	.742	14.6	*B	251 ft
LT	12/1+	.277	.344	554	608	431	.709	13.7	B	239 ft
SB ~~WB~~ Approach								14.3	B	
RT	12/1	.048	.229	295	353	42	.119	11.8	B	27 ft
TH	24/2	.164	.229	783	854	533	.624	14.5	B	173 ft
LT	12/1	.000	.229	89	117	59	.476	15.1	C+	38 ft
NB ~~EB~~ Approach								16.4	C+	
TH	24/2	.192	.229	783	854	639	.748	16.5	*C+	208 ft
LT	12/1	.000	.229	89	117	2	.016	11.6	B	25 ft

KULAMALU
FUTURE BASE W/MIT
AM PEAK HOUR

07/03/96
10:26:02

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - BYPASS & HALEAKALA HY

METROAREA	NONCBD	
LOSTTIME		2.0
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	~~SB~~ EB	~~NB~~ SB	~~WB~~ WB	~~EB~~ NB
GRADES	6.0	.0	-6.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	0	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	179	302	0	0	0	0	0	1432	0	0	0	1012
WIDTHS	12.0	24.0	.0	.0	.0	.0	.0	24.0	.0	.0	.0	24.0
LANES	1	2	0	0	0	0	0	2	0	0	0	2
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	FFLW	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	0	1807	0	0	0	0	0	3237	0	0	0	3078

Phasing Parameters

SEQUENCES	11	AL					
PERMISSIVES	YES	YES	YES	YES	LEADLAGS	NONE	NONE
OVERLAPS	YES	YES	YES	YES	OFFSET	.00	1
CYCLES	60	120	10		PEDTIME	0	0
GREENTIMES	27.45	24.55					
YELLOWTIMES	4.00	4.00					
CRITICALS	8	12					
EXCESS	0						

KULAMALU
FUTURE BASE W/MIT
AM PEAK HOUR

07/03/96
10:26:1[illegible]

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - BYPASS & HALEAKALA HY
Degree of Saturation (v/c) .73 Vehicle Delay 10.0 Level of Service B

```
        -------------------------
Sq 11  |   Phase 1   |  Phase 2  |
**/**  -------------------------
       |     +       |           |
   .   |     +       |           |
  /|\  |     +       |           |
   |   |     v       |     .     |
 West  |          .  |****       |
 North |          x  |           |
   |   |          x  |           |
       |          x  |           |
       -------------------------
       | G/C= .457   | G/C= .409 |
       | G=  27.4"   | G=  24.6" |
       | Y+R= 4.0"   | Y+R= 4.0" |
       | OFF=   .0%  | OFF=52.4% |
       -------------------------
```

C= 60 sec G= 52.0 sec = 86.7% Y= 8.0 sec = 13.3% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								5.5	B-	
TH	24/2	.109	.491	1764	1774	318	.179	5.5	B+	68 ft
WB ~~NB~~ Approach								10.1	B	
TH	24/2	.401	.491	1876	1883	1507	.800	10.1	B	324 ft
NB ~~EB~~ Approach								11.3	B	
LT	24/2	.362	.443	1332	1362	1065	.782	11.3	B	250 ft

KULAMALU
FUTURE BASE W/MIT
PM PEAK HOUR

07/03/9[illegible]
10:27:0[illegible]

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int = 0 - BYPASS & HALEAKALA HY

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	EB	SB	WB	NB
GRADES	6.0	.0	-6.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	0	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	702	1012	0	0	0	0	0	541	0	0	0	317
WIDTHS	12.0	24.0	.0	.0	.0	.0	.0	24.0	0	0	.0	24.0
LANES	1	2	0	0	0	0	0	2	0	0	0	2
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.[illegible]
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	FFLW	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	0	1807	0	0	0	0	0	3537	0	0	0	[illegible]

Phasing Parameters

SEQUENCES	11	ALL					
PERMISSIVES	YES	YES	YES	YES	LEADLAGS	NONE	NONE
OVERLAPS	YES	YES	YES	YES	OFFSET	.00	[illegible]
CYCLES	60	120	10		PERTIME	0	[illegible]
GREENTIMES	43.97	8.03					
YELLOWTIMES	4.00	4.00					
CRITICALS	2	12					
EXCESS	0						

```
KULAMALU                                                          07/03/94
FUTURE BASE W/MIT                                                 10:27:14
PM PEAK HOUR


SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int #    0 - BYPASS & HALEAKALA HY
     Degree of Saturation (v/c)  .37  Vehicle Delay   4.5   Level of Service A

        --------------------------
Sq 11 |   Phase 1   |   Phase 2  |
**/** --------------------------
      |    *        |            |
  .   |    *        |            |
 /|\  |    *        |       .    |
  |   |    v        |            |
  |   |        .    |****        |
North |        +    |            |
  |   |        +    |            |
      |        +    |            |
        --------------------------
      | G/C= .623   | G/C= .243  |
      | G=  37.4"   | G=  14.6"  |
      | Y+R= 4.0"   | Y+R= 4.0"  |
      | OFF=   .0%  | OFF=69.0%  |
        --------------------------
        C= 60 sec   G= 52.0 sec = 86.7%  Y= 8.0 sec = 13.3%  Ped=  .0 sec =   .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB Approach								3.3	A	
TH	24/2	.310	.657	2373	2373	1065	.449	3.3	*A	154 ft
WB Approach								2.7	A	
TH	24/2	.169	.657	2520	2520	569	.226	2.7	A	82 ft
NB Approach								11.5	B	
LT	24/2	.131	.277	789	852	329	.386	11.5	*B	100 ft

KULAMALU
FUTURE BASE W/MIT
AM PEAK HOUR

03/27/97
17:50:24

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - PUKALANI BYP & MAKANI ST

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	EB ~~SB~~	SB ~~WB~~	WB ~~NB~~	NB ~~EB~~
GRADES	2.0	.0	-2.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	0	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	0	307	1	275	58	13	12	1084	9	51	76	14
WIDTHS	.0	24.0	12.0	12.0	12.0	12.0	.0	24.0	12.0	12.0	12.0	12.0
LANES	0	2	1	1	1	1	0	2	1	1	1	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	0	3688	224	1539	1863	1422	0	3755	936	1539	1863	1492

Phasing Parameters

SEQUENCES	11	ALL		
PERMISSIVES	YES	YES	YES	YES
OVERLAPS	YES	YES	YES	YES
CYCLES	60	120	10	
GREENTIMES	30.90	21.10		
YELLOWTIMES	4.00	4.00		
CRITICALS	8	4		
EXCESS	0			

LEADLAGS	NONE	NONE
OFFSET	.00	1
PEDTIME	.0	0

KULAMALU
FUTURE BASE W/MIT
AM PEAK HOUR

03/27/97
17:50:53

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - PUKALANI BYP & MAKANI ST
Degree of Saturation (v/c) .43 Vehicle Delay 6.4 Level of Service B+

```
         ---------------------------------
Sq 11  |   Phase 1     |   Phase 2      |
**/**  ---------------------------------
       |     + +       |          ^     |
   .   |     + +       |         ****   |
  /|\  |     + +>      |        <++++   |
   |   |     v         |     ^   ++++   |
We|st  |          ^    |++++    v       |
North  |    <+  *  *>  |++++>           |
   |   |     +  *  *   |++++            |
       |     +  *  *   |    v           |
       ---------------------------------
       | G/C= .515     | G/C= .352      |
       | G=   30.9"    | G=   21.1"     |
       | Y+R= 4.0"     | Y+R= 4.0"      |
       | OFF=  .0%     | OFF=58.2%      |
       ---------------------------------
       C= 60 sec   G= 52.0 sec = 86.7%   Y= 8.0 sec = 13.3%   Ped=  .0 sec =   .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								4.3	A	
TH	24/2	.108	.548	2022	2022	323	.160	4.3	A	62 ft
LT	12/1	.000	.548	97	119	1	.008	4.0	A	25 ft
WB ~~NB~~ Approach								6.0	B+	
TH+RT	24/2	.322	.548	2059	2059	1154	.560	6.0	*B+	220 ft
LT	12/1	.000	.548	477	513	9	.018	4.0	A	25 ft
SB ~~WB~~ Approach								9.1	B+	
RT	12/1	.226	.385	544	593	289	.487	9.5	*B+	150 ft
TH	12/1	.054	.385	668	717	61	.085	7.6	B+	32 ft
LT	12/1	.000	.385	498	547	14	.026	7.4	B+	25 ft
NB ~~EB~~ Approach								7.6	B+	
RT	12/1	.059	.385	544	593	54	.091	7.6	B+	28 ft
TH	12/1	.067	.385	668	717	80	.112	7.7	B+	41 ft
LT	12/1	.000	.385	526	575	15	.026	7.4	B+	25 ft

KULAMALU
FUTURE BASE W/MIT
PM PEAK HOUR

03/27/97
17:51:39

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - PUKALANI BYP & MAKANI ST

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	EB ~~SB~~	SB ~~WB~~	WB ~~NB~~	NB ~~EB~~
GRADES	2.0	.0	-2.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	0	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	25	770	196	39	37	4	25	467	18	26	60	2
WIDTHS	.0	24.0	12.0	12.0	12.0	12.0	.0	24.0	12.0	12.0	12.0	12.0
LANES	0	2	1	1	1	1	0	2	1	1	1	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	0	3668	1752	1539	1863	1448	0	3730	343	1539	1863	1557

Phasing Parameters

SEQUENCES	21	ALL		
PERMISSIVES	YES	YES	YES	YES
OVERLAPS	YES	YES	YES	YES
CYCLES	60	120	10	
GREENTIMES	14.02	19.96	14.02	
YELLOWTIMES	4.00	4.00	4.00	
CRITICALS	3	8	5	
EXCESS	0			

LEADLAGS	NONE	NONE
OFFSET	.00	1
PEDTIME	.0	0

KULAMALU
FUTURE BASE W/MIT
PM PEAK HOUR

03/27/97
17:52:09

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - PUKALANI BYP & MAKANI ST
Degree of Saturation (v/c) .32 Vehicle Delay 5.4 Level of Service B+

```
        --------------------------------------------
Sq 21  | Phase 1     | Phase 2     | Phase 3     |
**/**   --------------------------------------------
       | + + * ^     | + + +       |        ^    |
  .    | + + * ++++  | + + +       |        ++++ |
 /|\   |<+ + *>      |<+ + +>      |       <**** |
  |    |   v         |   v         |   ^    ++++ |
West   |             |       ^     |++++    v    |
~~North~~ |          |   <+ * *>   |++++>        |
  |    |             |    + * *    |++++         |
       |             |    + * *    |  v          |
        --------------------------------------------
       | G/C= .234   | G/C= .333   | G/C= .234   |
       | G=  14.0"   | G=  20.0"   | G=  14.0"   |
       | Y+R= 4.0"   | Y+R= 4.0"   | Y+R= 4.0"   |
       | OFF=  .0%   | OFF=30.0%   | OFF=70.0%   |
        --------------------------------------------
       C= 60 sec   G= 48.0 sec = 80.0%  Y=12.0 sec = 20.0%  Ped= .0 sec =  .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								2.8	A	
TH+RT	24/2	.247	.666	2444	2444	837	.342	2.8	A	118 ft
LT	12/1	.040	.267	612	642	206	.321	2.9	*A	58 ft
WB ~~NB~~ Approach								9.1	B+	
TH+RT	24/2	.160	.366	1323	1365	518	.379	9.1	*B+	138 ft
LT	12/1	.000	.366	94	120	19	.152	8.3	B+	25 ft
SB ~~WB~~ Approach								7.3	B+	
RT	12/1	.047	.567	845	873	41	.047	3.7	A	25 ft
TH	12/1	.038	.267	437	497	39	.078	10.6	*B	25 ft
LT	12/1	.000	.267	331	387	4	.010	10.4	B	25 ft
NB ~~EB~~ Approach								10.7	B	
RT	12/1	.034	.267	354	411	27	.066	10.6	B	25 ft
TH	12/1	.055	.267	437	497	63	.127	10.8	B	39 ft
LT	12/1	.000	.267	358	416	2	.005	10.4	B	25 ft

KULAMALU
FUTURE BASE W/MIT
AM PEAK HOUR

07/03/96
10:38:54

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - PUKALANI BYPASS & MAKAWAO AV

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	EB ~~SB~~	SB ~~WB~~	WB ~~NB~~	NB ~~EB~~
GRADES	6.0	.0	-6.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	12	94	235	1

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	12	251	134	376	286	335	219	638	2	21	145	22
WIDTHS	12.0	24.0	12.0	12.0	12.0	12.0	12.0	24.0	12.0	12.0	12.0	12.0
LANES	1	2	1	1	1	1	1	2	1	1	1	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1493	3614	1717	1539	1863	1770	1585	3637	1823	1539	1863	728

Phasing Parameters

SEQUENCES	42	ALL		
PERMISSIVES	YES	YES	YES	YES
OVERLAPS	YES	YES	YES	YES
CYCLES	60	180	10	
GREENTIMES	8.73	15.94	10.60	8.73
YELLOWTIMES	4.00	4.00	4.00	4.00
CRITICALS	3	8	6	11
EXCESS	0			

LEADLAGS	NONE	NONE
OFFSET	.00	0
PEDTIME	0	0

KULAMALU
FUTURE BASE W/MIT
AM PEAK HOUR

07/03/96
10:42:20

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - PUKALANI BYPASS & MAKAWAO AV
Degree of Saturation (v/c) .46 Vehicle Delay 9.7 Level of Service B+

```
       -----------------------------------------------------------
Sq 42 | Phase 1        | Phase 2         | Phase 3      | Phase 4     |
**/** -----------------------------------------------------------
      |        *       | + + +           |              |             |
  .   |        * ++++  | + + +           |          ++++|         ++++|
 /|\  |        *>      |<+ + +>          |         <++++|        <++++|
  |   |                |   v             |          ****|         ++++|
West  |                |                 |          v   |++++    v    |
~~North~~ |     <+         |        <+ * +>  |           +> |****>        |
  |   |++++ +          |          + * +  |           +  |++++         |
      |   v +          |          + * +  |           +  |   v         |
      -----------------------------------------------------------
      | G/C= .145      | G/C= .266       | G/C= .177    | G/C= .145   |
      | G=    8.7"     | G=   15.9"      | G=   10.6"   | G=    8.7"  |
      | Y+R= 4.0"      | Y+R= 4.0"       | Y+R= 4.0"    | Y+R= 4.0"   |
      | OFF=  .0%      | OFF=21.2%       | OFF=54.4%    | OFF=78.8%   |
      -----------------------------------------------------------
```

C= 60 sec G= 44.0 sec = 73.3% Y=16.0 sec = 26.7% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								8.8	B+	
RT	12/1	.002	.299	390	446	1	.002	9.5	B+	25 ft
TH	24/2	.093	.299	1022	1080	264	.244	10.2	B	78 ft
LT	12/1	.034	.179	391	427	141	.330	8.8	*B+	55 ft
WB ~~NB~~ Approach								12.1	B	
RT	12/1	.002	.542	829	860	1	.001	4.1	A	25 ft
TH	24/2	.195	.299	1089	1147	672	.586	12.1	*B	198 ft
LT	12/1	.000	.179	570	602	2	.003	4.7	A	25 ft
SB ~~WB~~ Approach								7.4	B-	
RT	12/1	.231	.634	958	976	297	.304	3.3	A	92 ft
TH	12/1	.195	.422	742	786	301	.383	7.9	B+	147 ft
LT	12/1	.139	.210	488	528	353	.669	10.5	*B	172 ft
NB ~~EB~~ Approach								14.0	B	
RT	12/1	.025	.391	553	602	21	.035	7.3	B+	25 ft
TH	12/1	.112	.179	271	333	153	.459	15.0	*B	106 ft
LT	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

KULAMALU
FUTURE BASE W/MIT
PM PEAK HOUR

07/03/96
10:34:55

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - PUKALANI BYPASS & MAKAWAO AV

METROAREA	NONCBD	
LOSTTIME		2.0
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	EB ~~SB~~	SB ~~WB~~	WB ~~NB~~	NB ~~EB~~
GRADES	6.0	.0	-6.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	14	103	122	1

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	44	458	278	103	291	174	252	356	2	9	294	20
WIDTHS	12.0	24.0	12.0	12.0	12.0	12.0	12.0	24.0	12.0	12.0	12.0	12.0
LANES	1	2	1	1	1	1	1	2	1	1	1	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1493	1807	1717	1559	1663	1770	1585	3837	588	1559	1663	1770

Phasing Parameters

SEQUENCES	24	ALL		
PERMISSIVES	YES	YES	YES	YES
OVERLAPS	YES	YES	YES	YES
CYCLES	60	180	10	
GREENTIMES	8.70	11.05	8.43	15.82
YELLOWTIMES	4.00	4.00	4.00	4.00
CRITICALS	3	2	6	11
EXCESS	0			

LEADLAGS	NONE	NONE
OFFSET	.00	[illegible]
PEDTIME	0	[illegible]

KULAMALU
FUTURE BASE W/MIT
PM PEAK HOUR

07/03/96
10:38:16

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - PUKALANI BYPASS & MAKAWAO AV
Degree of Saturation (v/c) .46 Vehicle Delay 10.3 Level of Service B

```
Sq 24 | Phase 1      | Phase 2     | Phase 3      | Phase 4   |
**/** -----------------------------------------------------------
      | + + *        | + + +       | +            |           |
      | + + * ++++   | + + +       | +            |      ++++ |
 /|\  |<+ + *>       |<+ + +>      |<+            |     <++++ |
  |   |   v          |   v         |         **** |      ++++ |
West  |              |             |++++     v    |++++   v   |
~~North~~ |          |     <+ * +> |          +>  |****>      |
  |   |              |      + * +  |          +   |++++       |
      |              |      + * +  |          +   |  v        |
-----------------------------------------------------------------
      | G/C= .162    | G/C= .149   | G/C= .147    | G/C= .275 |
      | G=    9.7"   | G=    9.0"  | G=    8.8"   | G=  16.5" |
      | Y+R= 4.0"    | Y+R= 4.0"   | Y+R= 4.0"    | Y+R= 4.0" |
      | OFF=   .0%   | OFF=22.9%   | OFF=44.5%    | OFF=65.9% |
```

C= 60 sec G= 44.0 sec = 73.3% Y=16.0 sec = 26.7% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
~~SE~~ EB Approach								8.6	B+	
RT	12/1	.040	.625	912	933	32	.034	2.8	A	25 ft
TH	24/2	.155	.412	1456	1488	482	.324	7.8	B+	120 ft
LT	12/1	.127	.196	416	456	293	.643	10.5	*B	145 ft
~~NE~~ WB Approach								13.1	B	
RT	12/1	.120	.396	580	628	137	.218	7 8	B+	70 ft
TH	24/2	.118	.183	624	701	375	.535	15.0	*B	129 ft
LT	12/1	.000	.183	90	121	2	.016	13.0	B	25 ft
~~WB~~ SB Approach								9.6	B+	
RT	12/1	.002	.537	795	827	1	.001	4.2	A	25 ft
TH	12/1	.198	.308	517	574	306	.533	11.9	B	179 ft
LT	12/1	.046	.180	427	460	183	.398	5.8	*B+	74 ft
~~EB~~ NB Approach								11.4	B	
RT	12/1	.013	.308	419	474	8	.017	9.3	B+	25 ft
TH	12/1	.199	.308	517	574	309	.538	11.9	*B	180 ft

KULAMALU
FUTURE BASE W/MIT
AM PEAK HOUR

03/27/97
17:53:20

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - BYPASS/KULA HWY & HALEAKALA HY

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	SB	WB	NB	EB
GRADES	6.0	.0	-6.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	1	65	39	127

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	1	528	93	109	32	55	85	769	182	178	39	1
WIDTHS	12.0	12.0	12.0	12.0	12.0	.0	12.0	12.0	12.0	12.0	12.0	.0
LANES	1	1	1	1	1	0	1	1	1	1	1	0
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1493	1807	1717	1539	1607	0	1585	1919	1823	1539	1851	0

Phasing Parameters

SEQUENCES	41	ALL		
PERMISSIVES	YES	YES	YES	YES
OVERLAPS	YES	YES	YES	YES
CYCLES	60	120	10	
GREENTIMES	7.31	33.38	7.31	
YELLOWTIMES	4.00	4.00	4.00	
CRITICALS	3	8	5	
EXCESS	0			

LEADLAGS	NONE	NONE
OFFSET	.00	1
PEDTIME	.0	0

KULAMALU
FUTURE BASE W/MIT
AM PEAK HOUR

03/27/97
17:53:51

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - BYPASS/KULA HWY & HALEAKALA HY
Degree of Saturation (v/c) .53 Vehicle Delay 6.6 Level of Service B+

```
       ----------------------------------------------
Sq 41 |   Phase 1     |   Phase 2     |   Phase 3     |
**/** ----------------------------------------------
      |      * ^      | + + +         |           ^   |
  .   |      * ++++   | + + +         |         ++++  |
 /|\  |      *>       |<+ + +>        |        <****  |
  |   |               |   v           |     ^   ****  |
  |   |               |        ^      |++++     v     |
North |     <+        |     <+ * +>   |++++>          |
  |   |++++ +         |      + * +    |++++           |
      |   v +         |      + * +    |  v            |
      ----------------------------------------------
      | G/C= .122     | G/C= .556     | G/C= .122     |
      | G=    7.3"    | G=   33.4"    | G=    7.3"    |
      | Y+R= 4.0"     | Y+R= 4.0"     | Y+R= 4.0"     |
      | OFF=   .0%    | OFF=18.9%     | OFF=81.2%     |
      ----------------------------------------------
```

C= 60 sec G= 48.0 sec = 80.0% Y=12.0 sec = 20.0% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
SB Approach								4.9	A	
RT	12/1	.002	.590	855	880	1	.001	3.3	A	25 ft
TH	12/1	.338	.590	1045	1065	556	.522	5.1	B+	192 ft
LT	12/1	.006	.155	343	386	98	.254	3.9	*A	28 ft
NB Approach								6.3	B+	
RT	12/1	.052	.590	911	935	48	.051	3.4	A	25 ft
TH	12/1	.443	.590	1113	1131	809	.715	7.2	*B+	280 ft
LT	12/1	.050	.155	371	411	192	.467	3.6	A	36 ft
WB Approach								12.9	B	
RT	12/1	.052	.344	476	529	46	.087	8.6	B+	25 ft
LT+TH	12/1	.086	.155	192	249	92	.369	15.1	*C+	66 ft
EB Approach								11.1	B	
RT	12/1	.059	.344	476	529	54	.102	8.7	B+	30 ft
LT+TH	12/1	.040	.155	227	287	42	.146	14.2	B	30 ft

KULAMALU
FUTURE BASE W/MIT
PM PEAK HOUR

03/27/97
18:26:31

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - BYPASS/KULA HWY & HALEAKALA HY

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	SB	WB	NB	EB
GRADES	6.0	.0	-6.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	1	52	28	140

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	1	680	74	87	36	31	33	485	200	218	46	0
WIDTHS	12.0	12.0	12.0	12.0	12.0	.0	12.0	12.0	12.0	12.0	12.0	.0
LANES	1	1	1	1	1	0	1	1	1	1	1	0
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1493	1807	300	1539	1676	0	1585	1919	1823	1539	1863	0

Phasing Parameters

SEQUENCES	31	ALL					
PERMISSIVES	YES	YES	YES	YES	LEADLAGS	NONE	NONE
OVERLAPS	YES	YES	YES	YES	OFFSET	.00	1
CYCLES	60	120	10		PEDTIME	.0	0
GREENTIMES	7.62	32.76	7.62				
YELLOWTIMES	4.00	4.00	4.00				
CRITICALS	9	2	5				
EXCESS	0						

KULAMALU
FUTURE BASE W/MIT
PM PEAK HOUR

03/27/97
18:27:01

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - BYPASS/KULA HWY & HALEAKALA HY
Degree of Saturation (v/c) .48 Vehicle Delay 5.8 Level of Service B+

```
          --------------------------------------------
Sq 31    |  Phase 1    |  Phase 2    |  Phase 3    |
**/**    --------------------------------------------
         |             | + * +       |      ^      |
  .      |             | + * +       |      ++++|
 /|\     |             |<+ * +>      |    <****|
  |      |             |   v         |      ****|
  |      |        ^    |        ^    |      v      |
North    |     <* + +> |     <+ + +>|++++>         |
  |      |++++ * + +   |       + + +|++++          |
         |   v * + +   |       + + +|   v          |
          --------------------------------------------
         | G/C= .127   | G/C= .546   | G/C= .127   |
         | G=    7.6"  | G=   32.8"  | G=    7.6"  |
         | Y+R= 4.0"   | Y+R= 4.0"   | Y+R= 4.0"   |
         | OFF=   .0%  | OFF=19.4%   | OFF=80.6%   |
          --------------------------------------------
         C= 60 sec   G= 48.0 sec = 80.0%   Y=12.0 sec = 20.0%   Ped= .0 sec = .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
SB Approach								6.9	B+	
RT	12/1	.002	.579	838	865	1	.001	3.4	A	25 ft
TH	12/1	.421	.579	1025	1047	716	.684	7.0	*B+	254 ft
LT	12/1	.086	.579	145	174	78	.448	5.9	B+	28 ft
NB Approach								2.6	A	
RT	12/1	.009	.773	1225	1225	5	.004	1.0	A	25 ft
TH	12/1	.297	.773	1483	1483	511	.345	1.4	A	98 ft
LT	12/1	.062	.160	378	420	211	.502	5.4	*B+	49 ft
WB Approach								14.3	B	
RT	12/1	.043	.160	191	247	37	.150	14.0	B	26 ft
LT+TH	12/1	.067	.160	211	269	71	.264	14.4	*B	50 ft
EB Approach								10.6	B	
RT	12/1	.082	.354	493	545	82	.150	8.6	B+	45 ft
TH	12/1	.044	.160	238	299	48	.161	14.0	B	34 ft

KULAMALU
FUTURE BASE W/MIT
AM PEAK HOUR

03/27/97
17:59:36

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & PUKALANI ST

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	~~SB~~ EB	~~WB~~ SB	~~NB~~ WB	~~EB~~ NB
GRADES	8.0	.0	-8.0	2.0
PEDLEVELS	MODER	MODER	MODER	MODER
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	141	0	0	135

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	141	40	0	0	0	0	0	249	193	151	0	608
WIDTHS	12.0	12.0	.0	.0	.0	.0	.0	12.0	12.0	12.0	.0	12.0
LANES	1	1	0	0	0	0	0	1	1	1	0	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1350	1788	0	0	0	0	0	1919	1617	1392	0	1392

Phasing Parameters

SEQUENCES	11	ALL					
PERMISSIVES	YES	YES	YES	YES	LEADLAGS	NONE	NONE
OVERLAPS	NO	NO	NO	NO	OFFSET	.00	1
CYCLES	60	120	10		PEDTIME	.0	0
GREENTIMES	12.41	39.59					
YELLOWTIMES	4.00	4.00					
CRITICALS	8	12					
EXCESS	0						

```
KULAMALU                                                      03/27/97
FUTURE BASE W/MIT                                             18:00:07
AM PEAK HOUR
```

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

```
Intersection Averages for Int #   0 - HALEAKALA HWY & PUKALANI ST
     Degree of Saturation (v/c)  .59  Vehicle Delay   8.6  Level of Service B+

        -------------------------
Sq 11  |  Phase 1   |  Phase 2   |
**/**   -------------------------
        | + +        |            |
   .    | + +        |            |
  /|\   |<+ +        |            |
   |    |    v       |      ^     |
 Welst  |        ^   |****        |
 North  |     <+ *   |            |
   |    |      + *   |++++        |
        |      + *   |     v      |
        -------------------------
        | G/C= .207  | G/C= .660  |
        | G=  12.4"  | G=  39.6"  |
        | Y+R= 4.0"  | Y+R= 4.0"  |
        | OFF=   .0% | OFF=27.3%  |
        -------------------------
        C= 60 sec   G= 52.0 sec = 86.7%  Y= 8.0 sec = 13.3%  Ped=  .0 sec =   .0%
```

~~SB~~ EB Approach — HCM Delay 11.5, LOS B

Lane Group	Width/Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
RT	12/1	.003	.240	269	324	1	.003	11.2	B	25 ft
TH	12/1	.042	.240	368	429	42	.098	11.5	B	27 ft

~~NB~~ WB Approach — HCM Delay 14.0, LOS B

Lane Group	Width/Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
TH	12/1	.169	.240	399	461	262	.568	14.2	*B	168 ft
LT	12/1	.161	.240	329	388	203	.523	13.8	B	130 ft

~~EB~~ NB Approach — HCM Delay 4.5, LOS A

Lane Group	Width/Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
RT	12/1	.026	.693	952	965	17	.018	1.8	A	25 ft
LT	12/1	.488	.693	952	965	640	.663	4.6	*A	166 ft

KULAMALU
FUTURE BASE W/MIT
PM PEAK HOUR

03/27/97
18:45:21

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & PUKALANI ST

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	EB ~~SB~~	SB ~~WB~~	WB ~~NB~~	NB ~~EB~~
GRADES	8.0	.0	-8.0	2.0
PEDLEVELS	MODER	MODER	MODER	MODER
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	134	0	0	196

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	497	220	0	0	0	0	0	168	280	315	0	191
WIDTHS	12.0	12.0	.0	.0	.0	.0	.0	12.0	12.0	12.0	.0	12.0
LANES	1	1	0	0	0	0	0	1	1	1	0	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1350	1788	0	0	0	0	0	1919	998	1392	0	1392

Phasing Parameters

SEQUENCES	11	ALL		
PERMISSIVES	YES	YES	YES	YES
OVERLAPS	NO	NO	NO	NO
CYCLES	60	120	10	
GREENTIMES	34.47	17.53		
YELLOWTIMES	4.00	4.00		
CRITICALS	9	12		
EXCESS	0			

LEADLAGS	NONE	NONE
OFFSET	.00	1
PEDTIME	.0	0

KULAMALU
FUTURE BASE W/MIT
PM PEAK HOUR

03/27/97
18:45:52

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - HALEAKALA HWY & PUKALANI ST
Degree of Saturation (v/c) .37 Vehicle Delay 5.6 Level of Service B+

```
           ----------------------------------
Sq 11    |  Phase 1   |   Phase 2   |
**/**    ----------------------------------
         | + +        |             |
         | + +        |             |
  /|\    |<+ +        |             |
   |     |   v        |     ^       |
 we|st   |       ^    |****         |
 ~~North~~ |    <* +    |             |
   |     |      * +   |++++         |
         |      * +   |     v       |
         ----------------------------------
         | G/C= .575  | G/C= .292   |
         | G=  34.5"  | G=  17.5"   |
         | Y+R= 4.0"  | Y+R= 4.0"   |
         | OFF=  .0%  | OFF=64.1%   |
         ----------------------------------
         C= 60 sec   G= 52.0 sec = 86.7%  Y= 8.0 sec = 13.3%  Ped= .0 sec = .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								4.1	A	
RT	12/1	.323	.608	795	820	382	.466	4.5	A	126 ft
TH	12/1	.164	.608	1070	1087	232	.213	3.4	A	77 ft
WB ~~NB~~ Approach								4.2	A	
TH	12/1	.123	.608	1151	1166	177	.152	3.3	A	59 ft
LT	12/1	.344	.608	577	607	295	.486	4.7	*A	98 ft
NB ~~EB~~ Approach								10.4	B	
RT	12/1	.125	.325	400	453	125	.276	9.8	B+	71 ft
LT	12/1	.184	.325	400	453	201	.444	10.8	*B	114 ft

KULAMALU
FUTURE BASE W/MIT
AM PEAK HOUR

03/27/97
18:03:07

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & MAKAWAO AV

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	EB ~~SB~~	SB ~~WB~~	WB ~~NB~~	NB ~~EB~~
GRADES	8.0	.0	-8.0	.0
PEDLEVELS	MODER	MODER	MODER	MODER
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	60	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	6	127	85	203	52	24	31	195	25	45	67	26
WIDTHS	.0	12.0	12.0	12.0	12.0	.0	.0	12.0	.0	.0	12.0	.0
LANES	0	1	1	1	1	0	0	1	0	0	1	0
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	0	1769	888	1406	1683	0	0	1617	0	0	1476	0

Phasing Parameters

SEQUENCES	11	ALL		
PERMISSIVES	YES	YES	YES	YES
OVERLAPS	NO	NO	NO	NO
CYCLES	60	180	10	
GREENTIMES	30.49	21.51		
YELLOWTIMES	4.00	4.00		
CRITICALS	8	4		
EXCESS	0			

LEADLAGS	NONE	NONE
OFFSET	.00	1
PEDTIME	.0	0

KULAMALU
FUTURE BASE W/MIT
AM PEAK HOUR

03/27/97
18:03:37

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - HALEAKALA HWY & MAKAWAO AV
Degree of Saturation (v/c) .23 Vehicle Delay 6.1 Level of Service B+

```
       -------------------------
Sq 11  |  Phase 1  |  Phase 2  |
**/**  -------------------------
       | + + +     |        ^  |
   .   | + + +     |     **** |
  /|\  |(+ + +)    |    (++++|
   |   |   v       |   ^  ++++|
 We|st |        ^  |++++   v  |
 North |   (* * *) |++++)     |
   |   |    * * *  |++++      |
       |    * * *  |   v      |
       -------------------------
       | G/C= .508 | G/C= .359 |
       | G=  30.5" | G=  21.5" |
       | Y+R= 4.0" | Y+R= 4.0" |
       | OFF=  .0% | OFF=57.5% |
       -------------------------
```

C= 60 sec G= 52.0 sec = 86.7% Y= 8.0 sec = 13.3% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								4.5	A	
TH+RT	12/1	.109	.541	930	958	140	.146	4.4	A	54 ft
LT	12/1	.146	.541	444	481	89	.185	4.6	A	34 ft
WB ~~NB~~ Approach								4.9	A	
LT+TH+RT	12/1	..200	.541	846	876	264	.301	4.9	*A	102 ft
SB ~~WB~~ Approach								7.9	B+	
RT	12/1	.145	.392	503	551	151	.274	8.1	*B+	77 ft
LT+TH	12/1	.073	.392	611	660	80	.121	7.5	B+	41 ft
NB ~~EB~~ Approach								8.0	B+	
LT+TH+RT	12/1	.134	.392	529	578	145	.251	8.0	B+	74 ft

KULAMALU
FUTURE BASE W/MIT
PM PEAK HOUR

03/27/97
18:36:59

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & MAKAWAO AV

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	~~SB~~ EB	~~WB~~ SB	~~NB~~ WB	~~EB~~ NB
GRADES	8.0	.0	-8.0	.0
PEDLEVELS	MODER	MODER	MODER	MODER
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	205	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	33	209	287	269	66	49	29	187	26	31	57	19
WIDTHS	.0	12.0	12.0	12.0	12.0	.0	.0	12.0	.0	.0	12.0	.0
LANES	0	1	1	1	1	0	0	1	0	0	1	0
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	0	1728	1699	1406	1578	0	0	1528	0	0	1446	0

Phasing Parameters

SEQUENCES	21	ALL		
PERMISSIVES	YES	YES	YES	YES
OVERLAPS	YES	YES	YES	YES
CYCLES	60	180	10	
GREENTIMES	12.37	23.26	12.37	
YELLOWTIMES	4.00	4.00	4.00	
CRITICALS	3	8	5	
EXCESS	0			

LEADLAGS	NONE	NONE
OFFSET	.00	1
PEDTIME	.0	0

KULAMALU
FUTURE BASE W/MIT
PM PEAK HOUR

03/27/97
18:37:30

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - HALEAKALA HWY & MAKAWAO AV
Degree of Saturation (v/c) .32 Vehicle Delay 6.0 Level of Service B+

```
       ---------------------------------------------
Sq 21 |  Phase 1   |  Phase 2   |  Phase 3   |
**/** ---------------------------------------------
      | + + * ^    | + + +      |        ^   |
  .   | + + *  ++++| + + +      |        ++++|
 /|\  |<+ + *>     |<+ + +>     |       <****|
  |   |   v        |   v        |   ^    ****|
Wcl st|            |        ^   |++++    v   |
North |            |    <* * *> |++++>       |
  |   |            |     * * *  |++++        |
      |            |     * * *  |   v        |
      ---------------------------------------------
      | G/C= .206  | G/C= .388  | G/C= .206  |
      | G=  12.4"  | G=  23.3"  | G=  12.4"  |
      | Y+R= 4.0"  | Y+R= 4.0"  | Y+R= 4.0"  |
      | OFF=  .0%  | OFF=27.3%  | OFF=72.7%  |
      ---------------------------------------------
      C= 60 sec   G= 48.0 sec = 80.0%  Y=12.0 sec = 20.0%  Ped=  .0 sec =  .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	@E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
~~SB~~ EB Approach								2.6	A	
TH+RT	12/1	.183	.694	1195	1199	255	.213	2.1	A	66 ft
LT	12/1	.014	.239	717	733	302	.412	3.0	*A	78 ft
~~NB~~ WB Approach								8.0	B+	
LT+TH+RT	12/1	.205	.421	598	644	255	.396	8.0	*B+	125 ft
~~WB~~ SB Approach								9.7	B+	
RT	12/1	.076	.512	684	720	67	.093	4.8	A	28 ft
LT+TH	12/1	.109	.239	319	378	121	.320	12.3	*B	78 ft
~~EB~~ NB Approach								12.4	B	
LT+TH+RT	12/1	.112	.239	289	346	113	.327	12.4	B	72 ft

KULAMALU 07/26/96
MASTER PLAN W/O MIT 14:27:29
AM PEAK HOUR

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & HANA HWY

METROAREA	NONCBD	
LOSTTIME		2.0
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

	EB	SB	WB	NB
APPLABELS	~~SB~~	~~NB~~	~~NB~~	~~EB~~
GRADES	.0	.0	.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	0	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	5	39	17	49	748	83	54	156	2728	931	266	41
WIDTHS	12.0	12.0	.0	12.0	24.0	12.0	12.0	12.0	12.0	12.0	24.0	12.0
LANES	1	1	0	1	2	1	1	1	1	1	2	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	FFLW	NORM	DOPT	FFLW	NORM	NORM
SATURATIONFLOWS	1539	1835	0	1539	3725	1770	0	1783	1770	0	3725	1770

Phasing Parameters

SEQUENCES	76							
PERMISSIVES	NO	NO	NO	NO		LEADLAGS	NONE	NONE
OVERLAPS	NO	NO	NO	NO		OFFSET	.00	1
CYCLES	60	180	10			PEDTIME	.0	0
GREENTIMES	19.00	25.00	5.00	3.00	22.00			
YELLOWTIMES	4.00	4.00	4.00	4.00	.00			
CRITICALS	2	9	5	5	5			
EXCESS	0							

KULAMALU 07/26/96
MASTER PLAN W/O MIT 14:27:50
AM PEAK HOUR

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - HALEAKALA HWY & HANA HWY
Degree of Saturation (v/c) 2.20 Vehicle Delay 55.1# Level of Service F
expect more delay due to extreme v/c's (see EVALUATE)

```
        ------------------------------------------------------------
Sq 76 |  Phase 1  |  Phase 2  |  Phase 3  |  Phase 4  |  Phase 5  |
**/** ------------------------------------------------------------
      | + * *     |           |           |           |      ^    |
  .   | + * *     |           |           |           |      ++++|
 /|\  |<+ * *>    |           |           |           |     ¿****|
  |   |   v       |           |    ^  ++++|   ^       |           |
West  |           |      ^    |++++    v  |++++       |           |
~~North~~ |       |    <* +   |           |++++>      |++++>      |
  |   |           |     * +   |           |           |           |
      |           |     * +   |           |           |           |
      ------------------------------------------------------------
      | G/C= .211 | G/C= .278 | G/C= .056 | G/C= .033 | G/C= .244 |
      | G=  19.0" | G=  25.0" | G=   5.0" | G=   3.0" | G=  22.0" |
      | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" | Y+R=  .0" |
      | OFF=  .0% | OFF=25.6% | OFF=57.8% | OFF=67.8% | OFF=75.6% |
      ------------------------------------------------------------
      C= 90 sec  G= 74.0 sec = 82.2%  Y=16.0 sec = 17.8%  Ped=  .0 sec =   .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								17.6	C+	
RT	12/1	.074	.233	257	359	5	.014	17.1	C+	25 ft
LT+TH	12/1	.096	.233	314	428	59	.138	17.7	*C+	57 ft
WB ~~NB~~ Approach								66.0#	F	
TH	12/1-	.861	.300	433	535	1557	2.910	65.9#	F	1379 ft
LT	12/1+	.829	.300	429	531	1479	2.785	66.0#	*F	1310 ft
SB ~~WB~~ Approach								35.6	D	
RT	12/1	.098	.222	239	342	52	.152	18.2	C+	51 ft
TH	24/2	.254	.222	656	828	787	.950	37.1	*D	387 ft
LT	12/1	.113	.078	18	125	87	.630	32.1	D+	101 ft
NB ~~EB~~ Approach								16.2	C+	
TH	24/2	.131	.300	979	1118	280	.250	15.4	C+	124 ft
LT	12/1	.088	.156	160	269	43	.156	21.3	C	46 ft

KULAMALU
MASTER PLAN W/O MIT
PM PEAK HOUR

07/27/96
08:24:21

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & HANA HWY

METROAREA	NONCBD	
LOSTTIME		2.0
LEVELOFSERVICE	C	5
NODELOCATION	0	0

Approach Parameters

APPLABELS	~~SB~~ EB	~~WB~~ SB	~~NB~~ WB	~~EB~~ NB
GRADES	.0	.0	.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	0	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	25	274	161	40	506	85	63	54	1213	1956	607	2
WIDTHS	12.0	12.0	.0	12.0	24.0	12.0	12.0	12.0	12.0	12.0	24.0	12.0
LANES	1	1	0	1	2	1	1	1	1	1	2	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	FFLW	NORM	DOPT	FFLW	NORM	NORM
SATURATIONFLOWS	1539	1829	0	1539	3725	1770	0	1781	1770	0	3725	1770

Phasing Parameters

SEQUENCES	76							
PERMISSIVES	NO	NO	NO	NO		LEADLAGS	NONE	NONE
OVERLAPS	NO	NO	NO	NO		OFFSET	.00	1
CYCLES	60	180	10			PEDTIME	.0	0
GREENTIMES	19.00	25.00	5.00	3.00	22.00			
YELLOWTIMES	4.00	4.00	4.00	4.00	.00			
CRITICALS	2	8	11	5	5			
EXCESS	0							

KULANALU
MASTER PLAN W/O MIT
PM PEAK HOUR

07/27/96
08:24:34

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - HALEAKALA HWY & HANA HWY
Degree of Saturation (v/c) .94 Vehicle Delay 47.4@ Level of Service E+
@ expect more delay due to extreme v/c's (see EVALUATE)

```
       ----------------------------------------------------------
Sq 76 | Phase 1  | Phase 2  | Phase 3  | Phase 4  | Phase 5  |
**/** ----------------------------------------------------------
      | + * *    |          |          |          |        ^ |
  .   | + * *    |          |          |          |     ++++ |
 /|\  |(+ * *)   |          |          |          |    (**** |
  |   |   v      |          |    ^ ++++|    ^     |          |
West  |          |        ^ |++++  v   |++++      |          |
North |          |   (+ *   |          |++++)     |++++)     |
  |   |          |    + *   |          |          |          |
      |          |    + *   |          |          |          |
       ----------------------------------------------------------
      | G/C= .211 | G/C= .278 | G/C= .056 | G/C= .033 | G/C= .244 |
      | G= 19.0"  | G= 25.0"  | G= 5.0"   | G= 3.0"   | G= 22.0"  |
      | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" | Y+R= .0"  |
      | OFF= .0%  | OFF=25.6% | OFF=57.8% | OFF=67.8% | OFF=75.6% |
       ----------------------------------------------------------
```

C= 90 sec G= 74.0 sec = 82.2% Y=16.0 sec = 17.8% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								68.8@	F	
RT	12/1	.083	.233	257	359	26	.072	17.4	C+	25 ft
LT+TH	12/1	.306	.233	313	427	457	1.070	71.8@	*F	443 ft
WB ~~NB~~ Approach								66.0@	F	
TH	12/1-	.428	.300	432	534	684	1.281	65.9@	*F	606 ft
LT	12/1+	.413	.300	429	531	650	1.224	66.0@	F	576 ft
SB ~~WB~~ Approach								23.0	C	
RT	12/1	.092	.222	239	342	42	.123	18.1	C+	41 ft
TH	24/2	.193	.222	656	828	533	.644	21.7	*C	262 ft
LT	12/1	.114	.078	18	125	89	.645	32.7	D	104 ft
NB ~~EB~~ Approach								17.7	C+	
TH	24/2	.218	.300	979	1118	639	.572	17.7	*C+	283 ft
LT	12/1	.073	.156	160	269	2	.007	20.8	C	25 ft

ATA Inc. STOP CONTROLLED T-INTERSECTION LEVEL OF SERVICE ANALYSIS 1994 HCM

Major Street: PUKALANI BYPASS
Minor Street: HALEAKALA HWY
Peak Hour: PM
Scenario: MASTER PLAN W/O MIT

Print Date: 27-Jul
Analyst: BC
File Name: HALBYP-P
Intersection:

```
Peak Hour Factor:          1.00 |
--------MAJOR STREET--------    | V2     1236 ----------->          <---- -----  883    V5
    Num of Lanes - V2:        2 |
    Excl RT - V3 (Y/N):       Y | V3      927 -----                      -----   0    V4
 Stop/Yield - V3 (Y/N):       N |               \                   /
      % Grade - V2,V3:        3 |                v                 v          MAJOR STREET:
                                |                                             PUKALANI BYPASS
    Num of Lanes - V5:        1 |                    <        >
    Excl LT - V4 (Y/N):       N |                    \       /
      % Grade - V4,V5:       -3 |                     |      |                     ^
                                |                     |      |                     |
--------MINOR STREET--------    |                    426     0            kan   NORTH
 Num of Lanes - V7,V9:        1 |
    Shared Lane (Y/N):        N |                    V7      V9
      % Grade - V7&V9:        0 |          MINOR STREET: HALEAKALA HWY
```

VOLUME ADJUSTMENTS

MOVEMENT NO.	2	3	4	5	7	9
VOLUME, V (vph)	1236	927	0	883	426	0
VOLUME, v (pcph)	1236	927	0	883	469	0

STEP 1: RT FROM MINOR STREET - V9

Conflicting Flows:	Vc,9 = 1/2*V3+V2 =	0 + 1236 =	1236 vph
Potential Capacity:	Cp,9 =		327 pcph
Movement Capacity:	Cm,p = Cp,9 =		327 pcph

STEP 2: LT FROM MAJOR STREET - V4

Conflicting Flows:	Vc,4 = V3+V2 =	0 + 1236 =	1236 vph
Potential Capacity:	Cp,4 =		372 pcph
Movement Capacity:	Cm,4 = Cp,4 =		372 pcph
Prob. of Queue-free State:	po,4 = 1-v4/Cm,4 =		1.00
Major Left Shared Lane			
Prob. of Queue-free State:	p*o,4 =		1.00

STEP 3: LT FROM MINOR STREET - V7

Conflicting Flows:	Vc,7 = 1/2V3+V2+V5+V4 =	2119 vph
Potential Capacity:	Cp,7 =	63 pcph
Capacity Adjustment Factor Due To Impeding Movements:	f7=po,4=	1.00
Movement Capacity:	Cm,7 = Cp,7 =	63 pcph

DELAY AND LEVEL OF SERVICE SUMMARY

Movement	v(vcph)	cm(pcph)	csh (pcph)	AVG TOTAL DELAY	LOS
MINOR LEFT TURN (7)	469	63	--NA--	3031.2	F
MINOR RIGHT TURN (9)	0	327	--NA--	11.0	C
MAJOR LEFT TURN (4)	0	372	------	9.7	B

AVERAGE MINOR APPROACH DELAY = 3031.2 sec/veh | AVERAGE TOTAL INTERSECTION DELAY = 404.1 sec/veh
LEVEL OF SERVICE = F | LEVEL OF SERVICE = F

```
*********************************************************************************************
Major Street:   PUKALANI BYPASS
Minor Street:   MAKANI ST                                              Print Date:   26-Jul-96
    Scenario:   MASTER PLAN W/O MIT                                       Analyst:   BC
   Peak Hour:       AM                                                  File Name:    PUKMAK-A
                                                                    Intesection #:
---------------------------------------------------------------------------------------------
                                |           V12      V11      V10                ^
     Peak Hour Factor:    1.00  |                                                |
                                |           275      58       13               NORTH
 ---------MAJOR STREET--------- |            |        |        |
     Num of Lanes - V2:      2  |            |        |        |
    Excl LT - V1 (Y/N):      Y  |           /         |        \
    Excl RT - V3 (Y/N):      N  |          <          v         >
  Stop/Yield - V3 (Y/N):     N  |
      Grade - V1,V2,V3:      2  |       ^                               ^
                                |      /                                 \
     Num of Lanes - V5:      1  | V1    0 -----                           ----    12 V6
    Excl LT - V4 (Y/N):      Y  |
    Excl RT - V6 (Y/N):      N  | V2    5 ------->                       <----  1365 V5
  Stop/Yield - V6 (Y/N):     N  |
      Grade - V4,V5,V6:     -2  | V3    0 -----                           ----     9 V4
                                |             \                          /
 ---------MINOR STREET--------- |              v                        v    MAJOR STREET
     Num of Lanes - V8:      1  |                                             PUKALANI BYPASS
      Grade - V7,V8,V9:      0  |          <          ^         >
    Shared Lane-V7,8,9:      3  |           \         |        /
 (0=N,1=LT,2=TR,3=LTR)          |            |        |        |
                                |            |        |        |
     Num of Lanes - V11:     1  |           14       76       51
   Grade - V10,V11,V12:      0  |
  Shared Lane-V10,11,12:     3  |           V7       V8       V9
 (0=N,1=LT,2=TR,3=LTR)          |
                                |            MINOR STREET - MAKANI ST
---------------------------------------------------------------------------------------------
VOLUME ADJUSTMENTS              |
  MOVEMENT NO.                  |    1   2   3    4    5    6    7   8   9   10    11    12
  HOURLY FLOW RATE, V(vph)      |    0   5   0    9 1365   12   14  76  51   13    58   275
  VOLUME, v (pcph)              |    0   5   0    9 1365   12   15  84  56   14    64   303
---------------------------------------------------------------------------------------------
STEP 1: RT FROM MINOR STREET    |                               |
  Conflicting Flows:            |Vc9 = 1/2 V3 + V2 =      3 vhp | Vc12 = 1/2 V6 + V5 =  1371 vhp
  Potential Capacity:           |Cp,9 =                1381 pcph| Cp,12 =                280 pcph
  Movement Capacity:            |Cm,9=Cp,9=            1381 pcph| Cm,12=Cp,12=           280 pcph
  Prb. of Queu-free State:      |po,9=1-v9/Cm,9=       0.96     | po,12=1-v12/Cm,12=   -0.08
---------------------------------------------------------------------------------------------
STEP 2: LT FROM MAJOR STREET    |                               |
  Conflicting Flows:            |Vc,4 = V2 + V3 =         5 vhp | Vc,1 = V5 + V6 =      1377 vhp
  Potential Capacity:           |Cp,4 =                1704 pcph| Cp,1 =                 313 pcph
  Movement Capacity:            |Cm,4=Cp,4=            1704 pcph| Cm,1=Cp,1=             313 pcph
  Prb. of Queu-free State:      |po,4=1-v4/Cm4=        0.99     | po,1=1-v1/Cm1=        1.00
  Major Left Shared Lane        |                               |
   Prob. of Queue-free State    |p'o,4=                NA       | p'o,1=                NA
---------------------------------------------------------------------------------------------
```


----continued ----

Major Street: PUKALANI BYPASS DATE: 26-Jul-96
Minor Street: MAKANI ST Analyst: BC
Scenario: MASTER PLAN W/O MIT File Name: PUKMAK-A
Peak Hour: AM Intesection Intesection #:

STEP 3: TH FROM MINOR STREET		
Conflicting Flows:	Vc.,8 = 1/2V3+V2+V1+V6+V5+V4	Vc.,11 = 1/2V6+V5+V4+V3+V2+V1
	= 1391 vph	= 1385 vph
Potential Capacity:	Cp,8 = 167 pcph	Cp,11 = 169 pcph
Capacity Adj Factor:	f8 = po,4*po,1 = 0.99	f11 = po,4*po,1 = 0.99
Movement Capacity:	Cm,8 = Cp,8*f8 = 167 pcph	Cm,11 = Cp,11*f11 = 168 pcph
Prob. of Queue-free State:	po,8 = 1-v8/Cm,8 = 0.50	po,11 = 1-v11/Cm,11 = 0.62
STEP 4: LT FROM MINOR STREET		
Conflicting Flows:	Vc,7 = 1/2V3+V2+71+1/2V6+V5+V4+	Vc,10 = 1/2V6+V5+V4+1/2V3+V2+V1+
	1/2(V11+V12) = 1552 vph	1/2(V8+V9) = 1423 vph
Potential Capacity:	Cp7 = 108 pcph	Cp10 = 130 pcph
Major Left, Minor Through Impedance Factor:	P''7=po,11*f11 = 0.62	P''10=po,8*f8 = 0.49
Major Left, Minor Through Adjusted Impedance Factor:	p'7 = 0.70	p'10 = 0.60
Capacity Adjustment Factor:	f7 = p'7*po,12 = *****	f10 = p'10*po,9 = 0.58
Movement Capacity:	Cm,7 = f7*Cp,7 = -6 pcph	Cm,10 = f10*Cp,10 = 75 pcph

DELAY AND LEVEL OF SERVICE SUMMARY

MOVEMENT	v(pcph)	cm(pcph)	csh(pcph)	AVG TOTAL DELAY	LOS
MINOR LEFT TURN (7)	15	-6	SHRD	SHRD	--
MINOR THROUGH (8)	84	167	-84	-15.6	A
MINOR RIGHT TURN (9)	56	1381	SHRD	SHRD	----
MINOR LEFT TURN (10)	14	75	SHRD	SHRD	--
MINOR THROUGH (11)	64	168	231	343.8	F
MINOR RIGHT TURN (12)	303	280	SHRD	SHRD	--
MAJOR LEFT (1)	0	313	--NA--	11.5	C
MAJOR LEFT (4)	9	1704	--NA--	2.1	A
MINOR APPROACH (7)(8)(9)	-	-	-	-15.6	A
MINOR APPROACH (10)(11)(12)	-	-	-	343.8	F
MAJOR APPROACH (1)(2)(3)	-	-	-	0.0	----
MAJOR APPROACH (4)(5)(6)	-	-	-	0.0	A
TOTAL INTERSECTION (1-12)	-	-	-	68.5	F

LEVEL OF SERVICE CRITERIA

LEVEL OF SERVICE	AVG TOTAL DELAY (SEC/VEH)
A	<=5
B	>5&<=10
C	>10&<=20
D	>20&<=30
E	>30&<=45
F	>45

```
ATA Inc.        TWO-WAY STOP CONTROLLED INTERSECTION LEVEL OF SERVICE ANALYSIS                1994 HCM
*************************************************************************************************
Major Street:   PUKALANI BYPASS
Minor Street:   MAKANI ST                                                    Print Date:   27-Jul-96
    Scenario:   MASTER PLAN W/O MIT                                             Analyst:   BC
   Peak Hour:       PM                                                        File Name:   PUKMAK-P
                                                                        Intesection #:
-------------------------------------------------------------------------------------------------
                              |
                              |            V12       V11       V10                    ^
   Peak Hour Factor:    1.00  |                                                       |
                              |            39        37         4                   NORTH
 ---------MAJOR STREET--------|             |         |         |
     Num of Lanes - V2:    2  |             |         |         |
    Excl LT - V1 (Y/N):    Y  |            /          |          \
    Excl RT - V3 (Y/N):    N  |           <           v           >
  Stop/Yield - V3 (Y/N):   N  |
    Grade - V1,V2,V3:      2  |                 ^                            ^
                              |                /                              \
     Num of Lanes - V5:    1  | V1   196 -----                                 ----    25 V6
    Excl LT - V4 (Y/N):    Y  |
    Excl RT - V6 (Y/N):    N  | V2   994 ------->                             <----    809 V5
  Stop/Yield - V6 (Y/N):   N  |
    Grade - V4,V5,V6:     -2  | V3    25 -----                                 ----    18 V4
                              |               \                               /
 ---------MINOR STREET--------|                v                             v   MAJOR STREET
     Num of Lanes - V8:    1  |                                                   PUKALANI BYPASS
    Grade - V7,V8,V9:      0  |                <          ^          >
   Shared Lane-V7,8,9:     3  |                 \         |         /
 (0=N,1=LT,2=TR,3=LTR)        |                  |        |        |
                              |                  |        |        |
     Num of Lanes - V11:   1  |                  2       60       26
  Grade - V10,V11,V12:     0  |
  Shared Lane-V10,11,12:   3  |                 V7       V8       V9
 (0=N,1=LT,2=TR,3=LTR)        |
                              |               MINOR STREET - MAKANI ST
-------------------------------------------------------------------------------------------------
VOLUME ADJUSTMENTS            |
  MOVEMENT NO.                |     1    2    3     4    5     6     7    8    9    10    11    12
  HOURLY FLOW RATE, V(vph)    |   196  994   25    18  809    25     2   60   26     4    37    39
  VOLUME, v (pcph)            |   274  994   25    18  809    25     2   66   29     4    41    43
-------------------------------------------------------------------------------------------------
STEP 1: RT FROM MINOR STREET  |                                  |
  Conflicting Flows:          |Vc9 = 1/2 V3 + V2 =      510  vhp |  Vc12 = 1/2 V6 + V5 =     822 vhp
  Potential Capacity:         |Cp,9 =                   764 pcph |  Cp,12 =                  531 pcph
  Movement Capacity:          |Cm,9=Cp,9=               764 pcph |  Cm,12=Cp,12=             531 pcph
  Prb. of Queu-free State:    |po,9=1-v9/Cm,9=         0.96      |  po,12=1-v12/Cm,12=     0.92
-------------------------------------------------------------------------------------------------
STEP 2: LT FROM MAJOR STREET  |                                  |
  Conflicting Flows:          |Vc,4 = V2 + V3 =        1019  vhp |  Vc,1 = V5 + V6 =         834 vhp
  Potential Capacity:         |Cp,4 =                   486 pcph |  Cp,1 =                   611 pcph
  Movement Capacity:          |Cm,4=Cp,4=               486 pcph |  Cm,1=Cp,1=               611 pcph
  Prb. of Queu-free State:    |po,4=1-v4/Cm4=          0.96      |  po,1=1-v1/Cm1=         0.55
  Major Left Shared Lane      |                                  |
  Prob. of Queue-free State   |p"o,4=                   NA       |  p"o,1=                   NA
-------------------------------------------------------------------------------------------------
```


----continued ----

Major Street: PUKALANI BYPASS
Minor Street: MAKANI ST
Scenario: MASTER PLAN W/O MIT
Peak Hour: PM

DATE: 27-Jul-96
Analyst: BC
File Name: PUKMAK-P
Intesection Intesection #:

STEP 3: TH FROM MINOR STREET		
Conflicting Flows:	Vc.,8 = 1/2V3+V2+V1+V6+V5+V4 = 2055 vph	Vc.,11 = 1/2V6+V5+V4+V3+V2+V1 = 2055 vph
Potential Capacity:	Cp,8 = 69 pcph	Cp,11 = 69 pcph
Capacity Adj Factor:	f8 = po,4*po,1 = 0.53	f11 = po,4*po,1 = 0.53
Movement Capacity:	Cm,8 = Cp,8*f8 = 36 pcph	Cm,11 = Cp,11*f11 = 36 pcph
Prob. of Queue-free State:	po,8 = 1-v8/Cm,8 = 0.01	po,11 = 1-v11/Cm,11 = 0.01

STEP 4: LT FROM MINOR STREET		
Conflicting Flows:	Vc,7 = 1/2V3+V2+V1+1/2V6+V5+V4+ 1/2(V11+V12) = 2080 vph	Vc,10 = 1/2V6+V5+V4+1/2V3+V2+V1+ 1/2(V8+V9) = 2060 vph
Potential Capacity:	Cp7 = 50 pcph	Cp10 = 51 pcph
Major Left, Minor Through Impedance Factor:	P''7=po,11*f11 = 0.01	P''10=po,8*f8 = 0.01
Major Left, Minor Through Adjusted Impedance Factor:	p'7 = 0.05	p'10 = 0.05
Capacity Adjustment Factor:	f7 = p'7*po,12 = 0.04	f10 = p'10*po,9 = 0.04
Movement Capacity:	Cm,7 = f7*Cp,7 = 2 pcph	Cm,10 = f10*Cp,10 = 2 pcph

DELAY AND LEVEL OF SERVICE SUMMARY

MOVEMENT	v(pcph)	cm(pcph)	csh(pcph)	AVG TOTAL DELAY	LOS
MINOR LEFT TURN (7)	2	2	SHRD	SHRD	--
MINOR THROUGH (8)	66	36	34	******	F
MINOR RIGHT TURN (9)	29	764	SHRD	SHRD	----
MINOR LEFT TURN (10)	4	2	SHRD	SHRD	--
MINOR THROUGH (11)	41	36	29	******	F
MINOR RIGHT TURN (12)	43	531	SHRD	SHRD	--
MAJOR LEFT (1)	274	611	--NA--	10.6	C
MAJOR LEFT (4)	18	486	--NA--	7.7	B
MINOR APPROACH (7)(8)(9)	-	-	-	******	F
MINOR APPROACH (10)(11)(12)	-	-	-	******	F
MAJOR APPROACH (1)(2)(3)	-	-	-	2.2	A
MAJOR APPROACH (4)(5)(6)	-	-	-	0.2	A
TOTAL INTERSECTION (1-12)	-	-	-	93.9	F

LEVEL OF SERVICE CRITERIA

LEVEL OF SERVICE	AVG TOTAL DELAY (SEC/VEH)
A	<=5
B	>5&<=10
C	>10&<=20
D	>20&<=30
E	>30&<=45
F	>45

KULAMALU
MASTER PLAN W/O MIT
AM PEAK HOUR

07/26/96
14:35:02

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - PUKALANI BYPASS & MAKAWAO AV

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	EB ~~SB~~	SB ~~WB~~	WB ~~NB~~	NB ~~EB~~
GRADES	6.0	.0	-6.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	12	35	247	1

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	12	33	50	376	308	403	237	919	2	21	247	22
WIDTHS	12.0	24.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
LANES	1	2	1	1	1	1	1	1	1	1	1	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1493	3614	1717	1539	1863	687	1585	1919	1823	1539	1863	514

Phasing Parameters

SEQUENCES	41							
PERMISSIVES	NO	YES	NO	YES		LEADLAGS	NONE	NONE
OVERLAPS	NO	NO	NO	NO		OFFSET	.00	1
CYCLES	60	180	10			PEDTIME	.0	0
GREENTIMES	8.00	25.00	25.00					
YELLOWTIMES	.00	.00	.00					
CRITICALS	8	6	11					
EXCESS	0							

KULAMALU
MASTER PLAN W/O MIT
AM PEAK HOUR

07/26/96
14:35:06

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - PUKALANI BYPASS & MAKAWAO AV
Degree of Saturation (v/c) .95 Vehicle Delay 36.2@ Level of Service D
@ expect more delay due to extreme v/c's (see EVALUATE)

```
      --------------------------------------
Sq 41 |  Phase 1  |  Phase 2  |  Phase 3  |
**/** --------------------------------------
      |     +     | + +       |         ^ |
  .   |     +     | + +       |      ++++|
 /|\  |     +>    |<+ +       |     <++++|
  |   |           |   v       |    ^  ++++|
 West |           |        ^  |++++   v   |
      |    <+     |      + +> |****>      |
  |   |     +     |      + +  |++++       |
      |     +     |      + +  |  v        |
      --------------------------------------
      | G/C= .138 | G/C= .431 | G/C= .431 |
      | G=   8.0" | G=  25.0" | G=  25.0" |
      | Y+R=  .0" | Y+R=  .0" | Y+R=  .0" |
      | OFF=  .0% | OFF=13.8% | OFF=56.9% |
      --------------------------------------
```

C= 58 sec G= 58.0 sec =100.0% Y= .0 sec = .0% Ped= .0 sec = .0%

EB ~~SB~~ Approach 12.2 B

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
RT	12/1	.002	.397	546	592	1	.002	6.8	B+	25 ft
TH	24/2	.018	.397	1401	1433	35	.024	6.9	B+	25 ft
LT	12/1	.051	.103	128	173	53	.298	15.8	C+	39 ft

WB ~~NB~~ Approach 51.5@ E

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
RT	12/1	.002	.397	583	629	1	.002	6.8	B+	25 ft
TH	12/1	.519	.397	715	761	967	1.271	51.6@	*E	476 ft
LT	12/1	.004	.103	138	185	2	.011	15.1	C+	25 ft

SB ~~NB~~ Approach 32.6@ D

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
RT	12/1	.269	.397	564	610	359	.589	10.0	B+	177 ft
TH	12/1	.206	.397	693	739	324	.438	8.5	B+	159 ft
LT	12/1	.660	.397	232	273	424	1.553	70.1@	*F	209 ft

NB ~~SB~~ Approach 7.9 B+

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
RT	12/1	.028	.397	564	610	21	.034	6.9	B+	25 ft
TH	12/1	.172	.397	693	739	260	.352	8.1	*B+	128 ft
LT	12/1	.000	.397	167	204	23	.113	7.2	B+	25 ft

KULAMALU 07/27/96
MASTER PLAN W/O MIT 08:30:38
PM PEAK HOUR

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - PUKALANI BYPASS & MAKAWAO AV

METROAREA		NONCBD
LOSTTIME		2.0
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	~~SB~~ EB	~~WB~~ SB	~~NB~~ WB	~~EB~~ NB
GRADES	6.0	.0	-6.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	14	103	138	1

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	44	682	275	103	313	239	317	698	2	9	316	20
WIDTHS	12.0	24.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
LANES	1	2	1	1	1	1	1	1	1	1	1	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1493	3614	1717	1539	1863	448	1585	1919	1623	1539	1863	457

Phasing Parameters

SEQUENCES	41						
PERMISSIVES	NO	YES	NO	YES	LEADLAGS	NONE	NONE
OVERLAPS	NO	NO	NO	NO	OFFSET	.00	1
CYCLES	60	180	10		PEDTIME	.0	0
GREENTIMES	15.00	25.00	25.00				
YELLOWTIMES	.00	.00	.00				
CRITICALS	3	0	8				
EXCESS	0						

KULAMALU
MASTER PLAN W/O MIT
PM PEAK HOUR

07/27/96
08:30:43

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int 0 0 - PUKALANI BYPASS & MAKAWAO AV
Degree of Saturation (v/c) .77 Vehicle Delay 30.6@ Level of Service D+
@ expect more delay due to extreme v/c's (see EVALUATE)

```
        --------------------------------------
Sq 41 | Phase 1  | Phase 2   | Phase 3  |
**/** --------------------------------------
      |    *     | + +       |        ^ |
  .   |    *     | + +       |     ++++|
 /|\  |    *)    |(+ +       |    (++++|
  |   |          |  v        |   ^  ++++|
West  |          |        ^  |++++   v  |
~~North~~ |  (+  |'      + +)|++++)     |
  |   |    +     |       + + |++++      |
      |    +     |       + + |  v       |
       --------------------------------------
      | G/C= .231 | G/C= .385 | G/C= .385 |
      | G=  15.0" | G=  25.0" | G=  25.0" |
      | Y+R=  .0" | Y+R=  .0" | Y+R=  .0" |
      | OFF=  .0% | OFF=23.1% | OFF=61.5% |
       --------------------------------------
```

C= 65 sec G= 65.0 sec =100.0% Y= .0 sec = .0% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								15.1	C+	
RT	12/1	.042	.354	471	528	32	.061	9.0	B+	25 ft
TH	24/2	.222	.354	1224	1279	718	.561	11.4	B	212 ft
LT	12/1	.208	.200	277	343	291	.848	28.4	*D+	213 ft
WB ~~NB~~ Approach								46.2@	E+	
RT	12/1	.158	.354	504	561	188	.335	10.1	B	111 ft
TH	12/1	.410	.354	620	679	735	1.082	55.5@	*E	434 ft
LT	12/1	.004	.200	297	365	2	.005	13.5	B	25 ft
SB ~~WB~~ Approach								44.0@	E+	
RT	12/1	.003	.354	488	545	1	.002	8.8	B+	25 ft
TH	12/1	.214	.354	601	659	329	.499	11.2	B	194 ft
LT	12/1	.635	.354	121	154	252	1.595	87.0@	F	149 ft
NB ~~EB~~ Approach								11.0	B	
RT	12/1	.014	.354	488	545	8	.015	8.8	B+	25 ft
TH	12/1	.216	.354	601	659	333	.505	11.2	B	197 ft
LT	12/1	.000	.354	125	158	21	.130	9.2	B+	25 ft

KULAMALU 03/27/97
MASTER PLAN W/O MIT 17:00:41
AM PEAK HOUR

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - BYPASS/KULA HWY & HALEAKALA HY

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	SB	WB	NB	EB
GRADES	6.0	.0	-6.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	1	37	44	127

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	1	418	53	109	35	64	92	1104	182	707	81	[illegible]
WIDTHS	12.0	12.0	12.0	12.0	12.0	.0	12.0	12.0	12.0	12.0	12.0	.0
LANES	1	1	1	1	1	0	1	1	1	1	1	0
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1493	1807	246	1539	1456	0	1585	1919	1823	1539	1858	0

Phasing Parameters

SEQUENCES	31	ALL					
PERMISSIVES	YES	YES	YES	YES	LEADLAGS	NONE	NONE
OVERLAPS	YES	YES	YES	YES	OFFSET	.00	[illegible]
CYCLES	60	120	10		PEDTIME	.0	[illegible]
GREENTIMES	10.32	27.35	10.32				
YELLOWTIMES	4.00	4.00	4.00				
CRITICALS	10	8	10				
EXCESS	0						

KULAMALU   03/27/97
MASTER PLAN W/O MIT   17:01:59
AM PEAK HOUR

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int #   0 - BYPASS/KULA HWY & HALEAKALA HY
Degree of Saturation (v/c) .69   Vehicle Delay 10.0   Level of Service B

```
       --------------------------------
Sq 31  |  Phase 1 |  Phase 2 |  Phase 3 |
**/**  --------------------------------
       |          | + + +    |       ^  |
   .   |          | + + +    |      ++++|
 /|\   |          |(+ + +)   |     (++++|
  |    |          |   v      |   ^  ++++|
  |    |       ^  |       ^  |++++   v  |
North  |   (+ + +)|   (+ * +)|++++)     |
  |    |**** + + +|     + * +|****      |
       |   v + + +|     + * +|   v      |
       --------------------------------
       | G/C= .172| G/C= .456| G/C= .172|
       | G=  10.3"| G=  27.4"| G=  10.3"|
       | Y+R= 4.0"| Y+R= 4.0"| Y+R= 4.0"|
       | OFF= -.0%| OFF=23.9%| OFF=76.1%|
       --------------------------------
       C= 60 sec   G= 48.0 sec = 80.0%  Y=12.0 sec = 20.0%  Ped=  .0 sec =   .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
SB Approach								7.2	B+	
RT	12/1	.002	.489	692	730	1	.001	5.1	B+	25 ft
TH	12/1	.276	.489	848	884	440	.498	7.1	B+	190 ft
LT	12/1	.000	.489	93	115	56	.467	8.6	B+	25 ft
NB Approach								6.1	B+	
RT	12/1	.055	.728	1151	1154	51	.044	1.5	A	25 ft
TH	12/1	.613	.728	1396	1396	1162	.832	6.8	*B+	267 ft
LT	12/1	.035	.205	498	534	192	.360	2.7	A	44 ft
WB Approach								13.3	B	
RT	12/1	.077	.205	258	316	76	.241	13.0	B	51 ft
LT+TH	12/1	.104	.205	242	299	104	.348	13.5	B	70 ft
EB Approach								19.2	C+	
RT	12/1	.427	.444	640	683	611	.895	20.1	*C	286 ft
LT+TH	12/1	.071	.205	319	381	86	.226	12.9	B	58 ft

KULAMALU
MASTER PLAN W/O MIT
PM PEAK HOUR

03/27/97
17:03:51

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - BYPASS/KULA HWY & HALEAKALA HY

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	SB	WB	NB	EB
GRADES	6.0	.0	-6.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	1	52	28	140

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	1	969	74	87	39	39	42	892	200	332	49	0
WIDTHS	12.0	12.0	12.0	12.0	12.0	.0	12.0	12.0	12.0	12.0	12.0	.0
LANES	1	1	1	1	1	0	1	1	1	1	1	0
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1493	1807	214	1539	1620	0	1585	1919	1823	1539	1863	0

Phasing Parameters

SEQUENCES	31	ALL		
PERMISSIVES	YES	YES	YES	YES
OVERLAPS	YES	YES	YES	YES
CYCLES	60	120	10	
GREENTIMES	5.77	36.45	5.77	
YELLOWTIMES	4.00	4.00	4.00	
CRITICALS	9	2	5	
EXCESS	0			

LEADLAGS	NONE	NONE
OFFSET	.00	[illegible]
PEDTIME	.0	[illegible]

KULAMALU
MASTER PLAN W/O MIT
PM PEAK HOUR

03/27/97
17:04:25

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - BYPASS/KULA HWY & HALEAKALA HY
Degree of Saturation (v/c) .67 Vehicle Delay 8.1 Level of Service B+

```
Sq 31 |  Phase 1   |  Phase 2   |  Phase 3   |
**/** ------------------------------------------
      |            | + * +      |        ^   |
  .   |            | + * +      |     ++++|
 /|\  |            |<+ * +>     |    <****|
  |   |            |   v        |     ****|
  |   |        ^   |        ^   |     v      |
North |   <* + +>  |   <+ + +>  |++++>       |
  |   |++++ * + +  |     + + +  |++++        |
      |   v * + +  |     + + +  |  v         |
      ------------------------------------------
      | G/C= .096  | G/C= .608  | G/C= .096  |
      | G=   5.8"  | G=  36.5"  | G=   5.8"  |
      | Y+R= 4.0"  | Y+R= 4.0"  | Y+R= 4.0"  |
      | OFF= -.0%  | OFF=16.3%  | OFF=83.7%  |
      ------------------------------------------
      C= 60 sec   G= 48.0 sec = 80.0%  Y=12.0 sec = 20.0%  Ped= .0 sec = .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
SB Approach								11.3	B	
RT	12/1	.002	.641	939	957	1	.001	2.5	A	25 ft
TH	12/1	.577	.641	1147	1158	1020	.881	11.5	*B	309 ft
LT	12/1	.086	.641	112	135	78	.569	7.9	B+	25 ft
NB Approach								3.3	A	
RT	12/1	.021	.804	1274	1274	15	.012	.8	A	25 ft
TH	12/1	.506	.804	1542	1542	939	.609	2.0	A	155 ft
LT	12/1	.066	.130	318	364	211	.580	9.5	*B+	84 ft
WB Approach								15.8	C+	
RT	12/1	.043	.130	147	195	37	.186	15.1	C+	27 ft
LT+TH	12/1	.077	.130	156	207	82	.390	16.1	*C+	60 ft
EB Approach								12.4	B	
RT	12/1	.168	.292	394	450	202	.449	11.7	B	121 ft
TH	12/1	.048	.130	183	240	52	.216	15.2	C+	38 ft

KULAMALU 07/26/96
MASTER PLAN W/O MIT 14:30:13
AM PEAK HOUR

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & PUKALANI ST

METROAREA	NONCBD	
LOSTTIME		2.0
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

	EB	SB	WB	NB
APPLABELS	~~SB~~	~~WB~~	~~NB~~	~~EB~~
GRADES	8.0	.0	-8.0	2.0
PEDLEVELS	MODER	MODER	MODER	MODER
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	252	0	0	141

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	257	693	0	0	0	0	0	243	218	171	0	701
WIDTHS	12.0	12.0	.0	.0	.0	.0	.0	12.0	12.0	12.0	.0	12.0
LANES	1	1	0	0	0	0	0	1	1	1	0	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1350	1788	0	0	0	0	0	1919	1823	1392	0	1392

Phasing Parameters

SEQUENCES	31							
PERMISSIVES	YES	YES	YES	YES		LEADLAGS	NONE	NONE
OVERLAPS	NO	NO	NO	NO		OFFSET	.00	1
CYCLES	60	180	10			PEDTIME	.0	0
GREENTIMES	5.00	15.00	30.00					
YELLOWTIMES	4.00	4.00	.00					
CRITICALS	9	2	12					
EXCESS	0							

KULAMALU 07/26/96
MASTER PLAN W/O MIT 14:30:18
AM PEAK HOUR

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - HALEAKALA HWY & PUKALANI ST
Degree of Saturation (v/c) 1.03 Vehicle Delay 43.0# Level of Service E+
expect more delay due to extreme v/c's (see EVALUATE)

```
         -----------------------------------
Sq 31  | Phase 1  | Phase 2  | Phase 3  |
**/**  -----------------------------------
       |          | + *      |          |
   .   |          | + *      |          |
  /|\  |          |<+ *      |          |
   |   |          |   v      |    ^     |
we|st  |     ^    |       ^  |****      |
~~North~~ |   <* +   |   <+ +   |          |
   |   |      * + |     + +  |++++      |
       |      * + |     + +  |    v     |
         -----------------------------------
       | G/C= .086 | G/C= .259 | G/C= .517 |
       | G=   5.0" | G=  15.0" | G=  30.0" |
       | Y+R= 4.0" | Y+R= 4.0" | Y+R=  .0" |
       | OFF=  .0% | OFF=15.5% | OFF=48.3% |
         -----------------------------------
```

C= 58 sec G= 50.0 sec = 86.2% Y= 8.0 sec = 13.8% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								58.8#	E	
RT	12/1	.010	.293	343	396	5	.013	9.4	B+	25 ft
TH	12/1	.431	.293	468	524	729	1.391	59.1#	*E	420 ft
WB ~~NB~~ Approach								8.6	B+	
TH	12/1	.168	.448	821	860	262	.305	6.7	B+	118 ft
LT	12/1	.075	.121	315	352	229	.651	10.9	*B	103 ft
NB ~~EB~~ Approach								49.8#	E+	
RT	12/1	.042	.483	634	672	32	.048	5.1	B+	25 ft
LT	12/1	.552	.483	634	672	738	1.098	51.8#	*E	311 ft

KULAMALU
MASTER PLAN W/O MIT
PM PEAK HOUR

07/27/96
08:26:35

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int 1   0 - HALEAKALA HWY & PUKALANI ST

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	EB ~~SB~~	SB ~~WB~~	WB ~~NB~~	NB ~~EB~~
GRADES	8.0	.0	-8.0	2.0
PEDLEVELS	MODER	MODER	MODER	MODER
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	223	0	0	203

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	609	334	0	0	0	0	0	171	305	340	0	304
WIDTHS	12.0	12.0	.0	.0	.0	.0	.0	12.0	12.0	12.0	.0	12.0
LANES	1	1	0	0	0	0	0	1	1	1	0	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1350	1788	0	0	0	0	0	1919	1823	1392	0	1392

Phasing Parameters

SEQUENCES	31			
PERMISSIVES	YES	YES	YES	YES
OVERLAPS	NO	NO	NO	NO
CYCLES	60	180	10	
GREENTIMES	5.00	15.00	30.00	
YELLOWTIMES	4.00	4.00	.00	
CRITICALS	9	2	12	
EXCESS	0			

LEADLAGS	NONE	NONE
OFFSET	.00	1
PEDTIME	.0	0

KULAMALU
MASTER PLAN W/O MIT
PM PEAK HOUR

07/27/96
08:26:39

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - HALEAKALA HWY & PUKALANI ST
Degree of Saturation (v/c) .68 Vehicle Delay 23.3 Level of Service C

```
      -----------------------------------
Sq 31 |  Phase 1  |  Phase 2  |  Phase 3  |
**/** -----------------------------------
      |           | + *       |           |
  *   |           | + *       |           |
 /|\  |           |(+ *       |           |
  |   |           |   v       |     ^     |
We st |      ^    |       ^   |****       |
North |   (* +    |   (+ +    |           |
  |   |    * +    |    + +    |++++       |
      |    * +    |    + +    |   v       |
      -----------------------------------
      | G/C= .086 | G/C= .259 | G/C= .517 |
      | G=   5.0" | G=  15.0" | G=  30.0" |
      | Y+R= 4.0" | Y+R= 4.0" | Y+R=  .0" |
      | OFF=  .0% | OFF=15.5% | OFF=48.3% |
      -----------------------------------
```

C= 58 sec G= 50.0 sec = 86.2% Y= 8.0 sec = 13.8% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								36.0	D	
RT	12/1	.338	.293	343	396	406	1.025	55.1	E	234 ft
TH	12/1	.230	.293	468	524	352	.672	14.0	*B	203 ft
WB ~~NB~~ Approach								19.6	C+	
TH	12/1	.123	.448	821	860	180	.209	6.3	B+	81 ft
LT	12/1	.124	.121	316	352	321	.912	27.1	*D+	144 ft
NB ~~EB~~ Approach								6.5	B+	
RT	12/1	.139	.483	634	672	144	.214	5.6	B+	61 ft
LT	12/1	.269	.483	634	672	320	.476	6.9	*B+	135 ft

KULAMALU
MASTER PLAN W/O MIT
AM PEAK HOUR

07/26/96
14:29:07

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & MAKAWAO AV

METROAREA	NONCBD	
LOSTTIME		2.0
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	~~SB~~ EB	~~NB~~ SB	~~NB~~ WB	~~EB~~ NB
GRADES	8.0	.0	-8.0	.0
PEDLEVELS	*MODER*	*MODER*	*MODER*	*MODER*
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	123	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	6	698	187	225	52	24	31	198	25	45	67	26
WIDTHS	.0	12.0	12.0	12.0	12.0	.0	.0	12.0	.0	.0	12.0	.0
LANES	0	1	1	1	1	0	0	1	0	0	1	0
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	0	1785	777	1406	1706	0	0	1672	0	0	1481	0

Phasing Parameters

SEQUENCES	31						
PERMISSIVES	YES	YES	YES	YES	LEADLAGS	NONE	NONE
OVERLAPS	NO	NO	NO	NO	OFFSET	.00	1
CYCLES	60	180	10		PEDTIME	.0	0
GREENTIMES	15.00	15.00	25.00				
YELLOWTIMES	.00	.00	.00				
CRITICALS	2	11	0				
EXCESS	0						

KULAMALU
MASTER PLAN W/O MIT
AM PEAK HOUR

07/26/96
14:29:13

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - HALEAKALA HWY & MAKAWAO AV
Degree of Saturation (v/c) 1.08 Vehicle Delay 43.4# Level of Service E+
expect more delay due to extreme v/c's (see EVALUATE)

```
      -------------------------------------
Sq 31 |  Phase 1  |  Phase 2  |  Phase 3  |
**/** -------------------------------------
      |           | + + +     |        ^  |
  .   |           | + + +     |      ++++|
 /|\  |           |<+ + +>    |     <++++|
  |   |           |   v       |   ^  ++++|
West  |     ^     |      ^    |++++   v   |
~~North~~ |  <+ + +>|  <+ + +>|++++>      |
  |   |     + + + |    + + +  |++++       |
      |     + + + |    + + +  |  v        |
      -------------------------------------
      | G/C= .273 | G/C= .273 | G/C= .455 |
      | G=  15.0" | G=  15.0" | G=  25.0" |
      | Y+R=  .0" | Y+R=  .0" | Y+R=  .0" |
      | OFF=  .0% | OFF=27.3% | OFF=54.5% |
      -------------------------------------
      C= 55 sec   G= 55.0 sec =100.0%  Y=  .0 sec =   .0%  Ped=  .2 sec =   .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								67.3#	F	
TH+RT	12/1	.437	.236	366	422	741	1.756	63.3#	*F	437 ft
LT	12/1	.308	.236	143	182	197	1.071	82.5#	F	116 ft
WB ~~NB~~ Approach								5.2	B+	
LT+TH+RT	12/1	.193	.509	821	851	267	.314	5.2	B+	101 ft
SB ~~WB~~ Approach								6.4	B+	
RT	12/1	.107	.418	546	588	107	.182	6.5	B+	48 ft
LT+TH	12/1	.070	.418	672	713	80	.112	6.3	B+	36 ft
NB ~~EB~~ Approach								6.7	B+	
LT+TH+RT	12/1	.131	.418	577	619	145	.234	6.7	*B+	65 ft

KULAMALU 07/27/96
MASTER PLAN W/O MIT 08:25:31
PM PEAK HOUR

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & MAKAWAO AV

METROAREA	NONCBD	
LOSTTIME		2.0
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	~~SB~~ EB	~~WB~~ SB	~~NB~~ WB	~~EB~~ NB
GRADES	8.0	.0	-8.0	.0
PEDLEVELS	MODER	MODER	MODER	MODER
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	205	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	33	326	309	291	66	49	29	190	26	31	57	19
WIDTHS	.0	12.0	12.0	12.0	12.0	.0	.0	12.0	.0	.0	12.0	.0
LANES	0	1	1	1	1	0	0	1	0	0	1	0
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	0	1748	800	1406	1609	0	0	1674	0	0	1483	0

Phasing Parameters

SEQUENCES.	31						
PERMISSIVES	YES	YES	YES	YES	LEADLAGS	NONE	NONE
OVERLAPS	NO	NO	NO	NO	OFFSET	.00	1
CYCLES	60	180	10		PEDTIME	.0	0
GREENTIMES	15.00	15.00	30.00				
YELLOWTIMES	.00	.00	.00				
CRITICALS	2	5	0				
EXCESS	0						

```
KULANALU                                                     07/27/96
MASTER PLAN W/O KIT                                          08:25:38
PM PEAK HOUR

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int #   0 - HALEAKALA HWY & MAKAWAO AV
      Degree of Saturation (v/c)  .87  Vehicle Delay  39.3@  Level of Service D
         @ expect more delay due to extreme v/c's (see EVALUATE)
      ------------------------------------
Sq 31 |  Phase 1  |  Phase 2  |  Phase 3  |
**/** ------------------------------------
      |           | + + +     |        ^  |
  .   |           | + + +     |      ++++|
 /|\  |           |(+ + +)    |     (++++|
  |   |           |   v       |   ^  ++++|
West  |     ^     |       ^   |++++   v   |
North |  (+ + +)  |  (+ + +)  |++++)      |
  |   |    + + +  |    + + +  |++++       |
      |    + + +  |    + + +  |  v        |
      ------------------------------------
      | G/C= .250 | G/C= .250 | G/C= .500 |
      | G=  15.0" | G=  15.0" | G=  30.0" |
      | Y+R=  .0" | Y+R=  .0" | Y+R=  .0" |
      | OFF=  .0% | OFF=25.0% | OFF=50.0% |
      ------------------------------------
      C= 60 sec   G= 60.0 sec =100.0%  Y=  .0 sec =   .0%  Ped=  .0 sec =   .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								66.6@	F	
TH+RT	12/1	.251	.217	318	379	378	.997	50.0	*E	250 ft
LT	12/1	.458	.217	130	169	325	1.879	85.9@	F	215 ft
WB ~~NB~~ Approach								6.6	B+	
LT+TH+RT	12/1	.190	.467	741	781	258	.330	6.6	B+	116 ft
SB ~~WB~~ Approach								5.9	B+	
RT	12/1	.096	.467	615	656	91	.139	5.9	B+	41 ft
LT+TH	12/1	.107	.467	711	751	121	.161	6.0	*B+	54 ft
NB ~~EB~~ Approach								6.0	B+	
LT+TH+RT	12/1	.109	.467	651	692	113	.163	6.0	B+	51 ft

Major Street:	PUKALANI ST	Print Date:	29-Jul-96
Minor Street:	IOLANI ST	Analyst:	BC
Scenario:	MASTER PLAN W/O MIT	File Name:	PUKIOL-A
Peak Hour:	AM	Intesection #:	

```
                                  |          V12       V11       V10
       Peak Hour Factor:     1.00 |
                                  |          118        16         2          <--- NORTH
---------MAJOR STREET---------    |           |          |         |
      Num of Lanes - V2:        1 |           |          |         |
     Excl LT - V1 (Y/N):        Y |           /          |         \
     Excl RT - V3 (Y/N):        Y |          <           v          >
  Stop/Yield - V3 (Y/N):        N |
     Grade - V1,V2,V3:          0 |        ^                                 ^
                                  |       /                                   \
      Num of Lanes - V5:        1 | V1   33 -----                          ----     5 V6
     Excl LT - V4 (Y/N):        N |
     Excl RT - V6 (Y/N):        N | V2  160 ------->                      <----   297 V5
  Stop/Yield - V6 (Y/N):        N |
     Grade - V4,V5,V6:          0 | V3   12 -----                          ----     1 V4
                                  |            \                          /
---------MINOR STREET---------    |             v                        v    MAJOR STREET
      Num of Lanes - V8:        1 |                                           PUKALANI ST
     Grade - V7,V8,V9:          0 |          <          ^          >
   Shared Lane-V7,8,9:          3 |           \          |         /
(0=N,1=LT,2=TR,3=LTR)             |            |         |         |
                                  |            |         |         |
      Num of Lanes - V11:       1 |          251        17         1
    Grade - V10,V11,V12:        0 |
  Shared Lane-V10,11,12:        1 |          V7         V8        V9
(0=N,1=LT,2=TR,3=LTR)             |
                                  |          MINOR STREET - IOLANI ST
```

VOLUME ADJUSTMENTS												
MOVEMENT NO.	1	2	3	4	5	6	7	8	9	10	11	12
HOURLY FLOW RATE, V(vph)	33	160	12	1	297	5	251	17	1	2	16	118
VOLUME, v (pcph)	36	160	12	1	297	5	276	19	1	2	18	130

STEP 1: RT FROM MINOR STREET				
Conflicting Flows:	Vc9 = 1/2 V3 + V2 =	160 vhp	Vc12 = 1/2 V6 + V5 =	300 vhp
Potential Capacity:	Cp,9 =	1149 pcph	Cp,12 =	976 pcph
Movement Capacity:	Cm,9=Cp,9=	1149 pcph	Cm,12=Cp,12=	976 pcph
Prb. of Queu-free State:	po,9=1-v9/Cm,9=	1.00	po,12=1-v12/Cm,12=	0.87

STEP 2: LT FROM MAJOR STREET				
Conflicting Flows:	Vc,4 = V2 + V3 =	172 vhp	Vc,1 = V5 + V6 =	302 vhp
Potential Capacity:	Cp,4 =	1419 pcph	Cp,1 =	1231 pcph
Movement Capacity:	Cm,4=Cp,4=	1419 pcph	Cm,1=Cp,1=	1231 pcph
Prb. of Queu-free State:	po,4=1-v4/Cm4=	1.00	po,1=1-v1/Cm1=	0.97
Major Left Shared Lane				
Prob. of Queue-free State	p'o,4=	1.00	p'o,1=	NA

----continued ----

Major Street:	PUKALANI ST	DATE:	29-Jul-96
Minor Street:	IOLANI ST	Analyst:	BC
Scenario:	MASTER PLAN W/O MIT	File Name:	PUKIOL-A
Peak Hour:	AM	Intesection Intesection #:	

STEP 3: TH FROM MINOR STREET

Conflicting Flows:	Vc.,8 = 1/2V3+V2+V1+V6+V5+V4 = 496 vph	Vc.,11 = 1/2V6+V5+V4+V3+V2+V1 = 491 vph
Potential Capacity:	Cp,8 = 599 pcph	Cp,11 = 603 pcph
Capacity Adj Factor:	f8 = po,4*po,1 = 0.97	f11 = po,4*po,1 = 0.97
Movement Capacity:	Cm,8 = Cp,8*f8 = 581 pcph	Cm,11 = Cp,11*f11 = 585 pcph
Prob. of Queue-free State:	po,8 = 1-v8/Cm,8 = 0.97	po,11 = 1-v11/Cm,11 = 0.97

STEP 4: LT FROM MINOR STREET

Conflicting Flows:	Vc,7 = 1/2V3+V2+V1+1/2V6+V5+V4+ 1/2(V11+V12) = 561 vph	Vc,10 = 1/2V6+V5+V4+1/2V3+V2+V1+ 1/2(V8+V9) = 523 vph
Potential Capacity:	Cp7 = 501 pcph	Cp10 = 542 pcph
Major Left, Minor Through Impedance Factor:	P''7=po,11*f11 = 0.94	P''10=po,8*f8 = 0.94
Major Left, Minor Through Adjusted Impedance Factor:	p'7 = 0.95	p'10 = 0.95
Capacity Adjustment Factor:	f7 = p'7*po,12 = 0.83	f10 = p'10*po,9 = 0.95
Movement Capacity:	Cm,7 = f7*Cp,7 = 415 pcph	Cm,10 = f10*Cp,10 = 516 pcph

DELAY AND LEVEL OF SERVICE SUMMARY

MOVEMENT	v(pcph)	cm(pcph)	csh(pcph)	AVG TOTAL DELAY	LOS
MINOR LEFT TURN (7)	276	415	SHRD	SHRD	--
MINOR THROUGH (8)	19	581	423	26.0	D
MINOR RIGHT TURN (9)	1	1149	SHRD	SHRD	----
MINOR LEFT TURN (10)	2	516	SHRD	SHRD	--
MINOR THROUGH (11)	18	585	577	6.5	B
MINOR RIGHT TURN (12)	130	976	--NA--	4.3	A
MAJOR LEFT (1)	36	1231	--NA--	3.0	A
MAJOR LEFT (4)	1	1419	--NA--	2.5	A
MINOR APPROACH (7)(8)(9)	-	-	-	26.0	D
MINOR APPROACH (10)(11)(12)	-	-	-	4.5	A
MAJOR APPROACH (1)(2)(3)	-	-	-	0.5	A
MAJOR APPROACH (4)(5)(6)	-	-	-	0.0	A
TOTAL INTERSECTION (1-12)	-	-	-	9.3	B

LEVEL OF SERVICE CRITERIA

LEVEL OF SERVICE	AVG TOTAL DELAY (SEC/VEH)
A	<=5
B	>5&<=10
C	>10&<=20
D	>20&<=30
E	>30&<=45
F	>45

```
ATA Inc.       TWO-WAY STOP CONTROLLED INTERSECTION LEVEL OF SERVICE ANALYSIS              1994 HCM
**********************************************************************************************
Major Street:  PUKALANI ST                                                  Print Date:  29-Jul-96
Minor Street:  IOLANI ST                                                       Analyst:  BC
    Scenario:  MASTER PLAN W/O MIT                                           File Name:  PUKIOL-P
   Peak Hour:      PM                                                   Intesection #:
----------------------------------------------------------------------------------------------
                             |             V12       V11       V10
       Peak Hour Factor:  1.00 |
                             |              53        10         7           <--- NORTH
---------MAJOR STREET--------- |             |         |         |
      Num of Lanes - V2:     1 |             |         |         |
     Excl LT - V1 (Y/N):     Y |             /         |         \
     Excl RT - V3 (Y/N):     Y |            <          v          >
   Stop/Yield - V3 (Y/N):    N |        ^                                 ^
       Grade - V1,V2,V3:     0 |       /                                   \
                             |
      Num of Lanes - V5:     1 | V1  137 -----                              ----     0 V6
     Excl LT - V4 (Y/N):     N |
     Excl RT - V6 (Y/N):     N | V2  285 ------->                          <----   206 V5
   Stop/Yield - V6 (Y/N):    N |
       Grade - V4,V5,V6:     0 | V3  298 -----                              ----     7 V4
                             |            \                              /
---------MINOR STREET--------- |             v                            v    MAJOR STREET
      Num of Lanes - V8:     1 |                                               PUKALANI ST
       Grade - V7,V8,V9:     0 |              <          ^         >
     Shared Lane-V7,8,9:     3 |               \         |        /
  (0=N,1=LT,2=TR,3=LTR)        |                |         |       |
                             |                |         |       |
      Num of Lanes - V11:    1 |               160        25       5
    Grade - V10,V11,V12:     0 |
  Shared Lane-V10,11,12:     1 |               V7        V8       V9
  (0=N,1=LT,2=TR,3=LTR)        |
                             |            MINOR STREET - IOLANI ST
----------------------------------------------------------------------------------------------
VOLUME ADJUSTMENTS           |
   MOVEMENT NO.              |      1    2   3     4    5    6     7    8    9    10    11    12
   HOURLY FLOW RATE, V(vph)  |    137  285 298     7  206    0   160   25    5     7    10    53
   VOLUME, v (pcph)          |    151  285 298     8  206    0   176   28    6     8    11    58
----------------------------------------------------------------------------------------------
STEP 1: RT FROM MINOR STREET |                               |
   Conflicting Flows:        |Vc9 = 1/2 V3 + V2 =    285  vhp |  Vc12 = 1/2 V6 + V5 =     206 vhp
   Potential Capacity:       |Cp,9 =                 993 pcph |  Cp,12 =                 1089 pcph
   Movement Capacity:        |Cm,9=Cp,9=             993 pcph |  Cm,12=Cp,12=            1089 pcph
   Prb. of Queu-free State:  |po,9=1-v9/Cm,9=       0.99      |  po,12=1-v12/Cm,12=      0.95
----------------------------------------------------------------------------------------------
STEP 2: LT FROM MAJOR STREET |                               |
   Conflicting Flows:        |Vc,4 = V2 + V3 =       583  vhp |  Vc,1 = V5 + V6 =         206 vhp
   Potential Capacity:       |Cp,4 =                 904 pcph |  Cp,1 =                  1367 pcph
   Movement Capacity:        |Cm,4=Cp,4=             904 pcph |  Cm,1=Cp,1=              1367 pcph
   Prb. of Queu-free State:  |po,4=1-v4/Cm4=        0.99      |  po,1=1-v1/Cm1=          0.89
   Major Left Shared Lane    |                               |
    Prob. of Queue-free State |p'o,4=               0.99      |  p'o,1=                  NA
----------------------------------------------------------------------------------------------
```


----continued ----

ATA Inc. TWO-WAY STOP CONTROLLED INTERSECTION LEVEL OF SERVICE ANALYSIS 1994 HCM

Major Street: PUKALANI ST
Minor Street: IOLANI ST
Scenario: MASTER PLAN W/O MIT
Peak Hour: PM

DATE: 29-Jul-96
Analyst: BC
File Name: PUKIOL-P
Intesection Intesection #:

STEP 3: TH FROM MINOR STREET

Conflicting Flows:	Vc.,8 = 1/2V3+V2+V1+V6+V5+V4 = 635 vph	Vc.,11 = 1/2V6+V5+V4+V3+V2+V1 = 635 vph
Potential Capacity:	Cp,8 = 506 pcph	Cp,11 = 506 pcph
Capacity Adj Factor:	f8 = po,4*po,1 = 0.88	f11 = po,4*po,1 = 0.88
Movement Capacity:	Cm,8 = Cp,8*f8 = 446 pcph	Cm,11 = Cp,11*f11 = 446 pcph
Prob. of Queue-free State:	po,8 = 1-v8/Cm,8 = 0.94	po,11 = 1-v11/Cm,11 = 0.98

STEP 4: LT FROM MINOR STREET

Conflicting Flows:	Vc,7 = 1/2V3+V2+V1+1/2V6+V5+V4+ 1/2(V11+V12) = 667 vph	Vc,10 = 1/2V6+V5+V4+1/2V3+V2+V1+ 1/2(V8+V9) = 650 vph
Potential Capacity:	Cp7 = 435 pcph	Cp10 = 445 pcph
Major Left, Minor Through Impedance Factor:	P''7=po,11*f11 = 0.86	P''10=po,8*f8 = 0.83
Major Left, Minor Through Adjusted Impedance Factor:	p'7 = 0.89	p'10 = 0.87
Capacity Adjustment Factor:	f7 = p'7*po,12 = 0.84	f10 = p'10*po,9 = 0.86
Movement Capacity:	Cm,7 = f7*Cp,7 = 368 pcph	Cm,10 = f10*Cp,10 = 383 pcph

DELAY AND LEVEL OF SERVICE SUMMARY

MOVEMENT	v(pcph)	cm(pcph)	csh(pcph)	AVG TOTAL DELAY	LOS
MINOR LEFT TURN (7)	176	368	SHRD	SHRD	--
MINOR THROUGH (8)	28	446	384	20.2	D
MINOR RIGHT TURN (9)	6	993	SHRD	SHRD	----
MINOR LEFT TURN (10)	8	383	SHRD	SHRD	--
MINOR THROUGH (11)	11	446	417	9.0	B
MINOR RIGHT TURN (12)	58	1089	--NA--	3.5	A
MAJOR LEFT (1)	151	1367	--NA--	3.0	A
MAJOR LEFT (4)	8	904	--NA--	4.0	A
MINOR APPROACH (7)(8)(9)	-	-	-	20.2	D
MINOR APPROACH (10)(11)(12)	-	-	-	4.9	A
MAJOR APPROACH (1)(2)(3)	-	-	-	0.6	A
MAJOR APPROACH (4)(5)(6)	-	-	-	0.2	A
TOTAL INTERSECTION (1-12)	-	-	-	4.3	A

LEVEL OF SERVICE CRITERIA

LEVEL OF SERVICE	AVG TOTAL DELAY (SEC/VEH)
A	<=5
B	>5&<=10
C	>10&<=20
D	>20&<=30
E	>30&<=45
F	>45

KULAMALU
MASTER PLAN W/O MIT
AM PEAK HOUR

03/27/97
17:06:23

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - KULA HWY & ROAD "A"

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	SB	WB	NB	EB
GRADES	8.0	.0	-8.0	2.0
PEDLEVELS	MODER	MODER	MODER	MODER
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	300	27	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	437	437	0	0	0	0	0	899	47	33	0	35
WIDTHS	12.0	12.0	.0	.0	.0	.0	.0	12.0	12.0	12.0	.0	12.
LANES	1	1	0	0	0	0	0	1	1	1	0	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.9
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YE
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	190
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NOR
SATURATIONFLOWS	1350	1788	0	0	0	0	0	1919	1823	1392	0	139

Phasing Parameters

SEQUENCES	31	ALL					
PERMISSIVES	YES	YES	YES	YES	LEADLAGS	NONE	NONE
OVERLAPS	YES	YES	YES	YES	OFFSET	.00	1
CYCLES	60	180	10		PEDTIME	.0	[illegible]
GREENTIMES	5.30	21.47	21.23				
YELLOWTIMES	4.00	4.00	4.00				
CRITICALS	9	2	12				
EXCESS	0						

KULAMALU
MASTER PLAN W/O MIT
AM PEAK HOUR

03/27/97
17:06:54

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - KULA HWY & ROAD "A"
Degree of Saturation (v/c) .72 Vehicle Delay 12.6 Level of Service B

```
       ------------------------------------------
Sq 31  |  Phase 1  |  Phase 2  |  Phase 3  |
**/**  ------------------------------------------
       |           | + *       | +         |
  .    |           | + *       | +         |
 /|\   |           |<+ *       |<+         |
  |    |           |   v       |     ^     |
  |    |         ^ |         ^ |****       |
North  |     <* +  |     <+ +  |           |
  |    |++++  * +  |      + +  |++++       |
       |    v * +  |      + +  |     v     |
       ------------------------------------------
       | G/C= .088 | G/C= .358 | G/C= .354 |
       | G=   5.3" | G=  21.5" | G=  21.2" |
       | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" |
       | OFF=  .0% | OFF=15.5% | OFF=57.9% |
       ------------------------------------------
       C= 60 sec   G= 48.0 sec = 80.0%   Y=12.0 sec = 20.0%   Ped= .0 sec = .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
SB Approach								8.8	B+	
RT	12/1	.145	.812	1095	1095	144	.132	.8	A	25 ft
TH	12/1	.290	.391	650	699	460	.658	11.3	*B	236 ft
NB Approach								15.1	C+	
TH	12/1	.509	.546	1023	1048	946	.903	15.6	C+	362 ft
LT	12/1	.000	.122	316	350	49	.140	5.0	*B+	25 ft
EB Approach								12.1	B	
RT	12/1	.046	.542	722	755	35	.046	4.2	A	25 ft
LT	12/1	.311	.387	490	539	378	.701	12.8	*B	195 ft

KULAMALU
FUTURE WITH PROJECT W/O MIT
PM PEAK HOUR

03/27/97
17:10:24

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - KULA HWY & ROAD "A"

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	SB	WB	NB	EB
GRADES	8.0	.0	-8.0	2.0
PEDLEVELS	MODER	MODER	MODER	MODER
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	300	65	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	499	590	0	0	0	0	0	557	89	117	0	47
WIDTHS	12.0	12.0	.0	.0	.0	.0	.0	12.0	12.0	12.0	.0	12.
LANES	1	1	0	0	0	0	0	1	1	1	0	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.9
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YE
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	190
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NOR
SATURATIONFLOWS	1350	1788	0	0	0	0	0	1919	246	1392	0	139

Phasing Parameters

SEQUENCES	11	ALL					
PERMISSIVES	YES	YES	YES	YES	LEADLAGS	NONE	NON
OVERLAPS	YES	YES	YES	YES	OFFSET	.00	1
CYCLES	60	180	10		PEDTIME	.0	[illegible]
GREENTIMES	29.14	22.86					
YELLOWTIMES	4.00	4.00					
CRITICALS	9	12					
EXCESS	0						

KŪLAMALU
FUTURE WITH PROJECT W/O MIT
PM PEAK HOUR

03/27/97
17:11:02

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - KULA HWY & ROAD "A"
Degree of Saturation (v/c) .62 Vehicle Delay 10.3 Level of Service [illegible]

```
        -----------------------------
Sq 11  |  Phase 1   |   Phase 2    |
**/**  -----------------------------
       | + +        | +            |
       | + +        | +            |
  .    |<+ +        |<+            |
 /|\   |    v       |     ^        |
  |    |        ^   |****          |
  |    |            |              |
North  |      <* +  |              |
  |    |        * + |++++          |
       |        * + |    v         |
        -----------------------------
       | G/C= .486  | G/C= .381    |
       | G=  29.1"  | G=  22.9"    |
       | Y+R= 4.0"  | Y+R= 4.0"    |
       | OFF=  .0%  | OFF=55.2%    |
        -----------------------------
       C= 60 sec   G= 52.0 sec = 86.7%   Y= 8.0 sec = 13.3%   Ped= .0 sec = .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
SB Approach								6.1	B+	
RT	12/1	.196	1.000	1350	1350	209	.155	.0	A	25 ft
TH	12/1	.376	.519	897	928	621	.669	8.2	B+	252 ft
NB Approach								8.9	B+	
TH	12/1	.334	.519	966	996	586	.588	7.1	B+	238 ft
LT	12/1	.493	.519	101	124	94	.734	20.1	*C	38 ft
EB Approach								17.3	C+	
RT	12/1	.124	.414	531	577	123	.213	7.3	B+	61 ft
LT	12/1	.395	.414	531	577	501	.868	19.8	*C+	247 ft

```
ATA Inc.              STOP CONTROLLED T-INTERSECTION LEVEL OF SERVICE ANALYSIS                       1994 HCM
=========================================================================================================
Major Street: KULA HWY                                                          Print Date:   26-Jul
Minor Street: OHANA ST                                                             Analyst:       BC
   Peak Hour:      AM                                                            File Name:  KULOHA-A
    Scenario: MASTER PLAN W/O MIT                                              Intersection:
---------------------------------------------------------------------------------------------------------
Peak Hour Factor:      1.00 |
--------MAJOR STREET-------- | V2      929 ----------->                <---- -----  460      V5
    Num of Lanes - V2:    1 |
   Excl RT - V3 (Y/N):    N | V3        4 -----                           -----    9      V4
 Stop/Yield - V3 (Y/N):   N |                  \                        /
     % Grade - V2,V3:     3 |                   v                      v       MAJOR STREET:
                            |                                                  KULA HWY
    Num of Lanes - V5:    1 |                          <         >
   Excl LT - V4 (Y/N):    N |                           \       /
     % Grade - V4,V5:    -3 |                            |      |
                            |                            |      |
--------MINOR STREET-------- |                             3     17                    NORTH--->
  Num of Lanes - V7,V9:   1 |
    Shared Lane (Y/N):    Y |                          V7      V9
     % Grade - V7&V9:     0 |                 MINOR STREET: OHANA ST
---------------------------------------------------------------------------------------------------------
VOLUME ADJUSTMENTS
  MOVEMENT NO.                      2           3           4           5          7          9
  VOLUME, V (vph)                 929           4           9         460          3         17
  VOLUME, v (pcph)                929           4           8         460          3         19
---------------------------------------------------------------------------------------------------------
STEP 1: RT FROM MINOR STREET - V9
  Conflicting Flows:     | Vc,9 = 1/2*V3+V2 =               2  +  929        =        931   vph
  Potential Capacity:    | Cp,9 =                                                     467   pcph
  Movement Capacity:     | Cm,p = Cp,9 =                                              467   pcph
---------------------------------------------------------------------------------------------------------
STEP 2: LT FROM MAJOR STREET - V4
  Conflicting Flows:              |  Vc,4 = V3+V2 =              4  +   929  =        933   vph
  Potential Capacity:             |  Cp,4 =                                           616   pcph
  Movement Capacity:              |  Cm,4 = Cp,4 =                                    616   pcph
  Prob. of Queue-free State:      |  po,4 = 1-v4/Cm,4 =                              0.99
  Major Left Shared Lane          |
   Prob. of Queue-free State:     |  p*o,4 =                                         0.98
---------------------------------------------------------------------------------------------------------
STEP 3: LT FROM MINOR STREET - V7
  Conflicting Flows:              |  Vc,7 = 1/2V3+V2+V5+V4 =                         1400   vph
  Potential Capacity:             |  Cp,7 =                                           164   pcph
  Capacity Adjustment Factor      |
   Due To Impeding Movements:     |  f7=po,4=                                        0.98
  Movement Capacity:              |  Cm,7 = Cp,7 =                                    161   pcph
---------------------------------------------------------------------------------------------------------
DELAY AND LEVEL OF SERVICE SUMMARY                              csh    AVG TOTAL
   Movement                     v(vcph)           cm(pcph)     (pcph)    DELAY       LOS
  ------------               -------------        --------     ------   -------     ------

  MINOR LEFT TURN   (7)           3                 161          SHRD     SHRD        SHRD
  MINOR RIGHT TURN  (9)          19                 467          363      10.5          C
  MAJOR LEFT TURN   (4)           8                 616         ------     5.9          B
---------------------------------------------------------------------------------------------------------
    AVERAGE MINOR APPROACH DELAY =    10.5 sec/veh   |  AVERAGE TOTAL INTERSECTION DELAY =     0.2 sec/veh
                 LEVEL OF SERVICE =    C               |                  LEVEL OF SERVICE =     A
=========================================================================================================
```

```
ATA Inc.                STOP CONTROLLED T-INTERSECTION LEVEL OF SERVICE ANALYSIS                 1994 HCM
=========================================================================================================
Major Street: KULA HWY                                                         Print Date:   27-Jul
Minor Street: OHANA ST                                                           Analyst:        BC
  Peak Hour:        PM                                                         File Name:   KULOHA-P
   Scenario: MASTER PLAN W/O MIT                                             Intersection:
---------------------------------------------------------------------------------------------------------
Peak Hour Factor:     1.00  |
--------MAJOR STREET--------  | V2      629 ----------->                <---- -----  689      V5
    Num of Lanes - V2:     1  |
    Excl RT - V3 (Y/N):    N  | V3        0 -----                           -----  17       V4
Stop/Yield - V3 (Y/N):     N  |                   \                        /
       % Grade - V2,V3:    3  |                    v                      v       MAJOR STREET:
                              |                                                   KULA HWY
    Num of Lanes - V5:     1  |                          <          >
    Excl LT - V4 (Y/N):    N  |                           \         /
       % Grade - V4,V5:   -3  |                            |        |
                              |                            |        |
--------MINOR STREET--------  |                            2        17                      NORTH--->
 Num of Lanes - V7,V9:     1  |
    Shared Lane (Y/N):     Y  |                            V7       V9
       % Grade - V7&V9:    0  |                  MINOR STREET: OHANA ST
---------------------------------------------------------------------------------------------------------
VOLUME ADJUSTMENTS
  MOVEMENT NO.                        2          3          4            5         7         9
  VOLUME, V (vph)                   629          0         17          689         2        17
  VOLUME, v (pcph)                  629          0         15          689         2        19
---------------------------------------------------------------------------------------------------------
STEP 1: RT FROM MINOR STREET - V9
  Conflicting Flows:      | Vc,9 = 1/2*V3+V2 =          0  +   629         =          629   vph
  Potential Capacity:     | Cp,9 =                                                   665   pcph
  Movement Capacity:      | Cm,p = Cp,9 =                                            665   pcph
---------------------------------------------------------------------------------------------------------
STEP 2: LT FROM MAJOR STREET - V4
  Conflicting Flows:            | Vc,4 = V3+V2 =          0  +   629   =          629   vph
  Potential Capacity:           | Cp,4 =                                          860   pcph
  Movement Capacity:            | Cm,4 = Cp,4 =                                   860   pcph
  Prob. of Queue-free State:    | po,4 = 1-v4/Cm,4 =                             0.98
  Major Left Shared Lane        |
   Prob. of Queue-free State:   | p*o,4 =                                        0.97
---------------------------------------------------------------------------------------------------------
STEP 3: LT FROM MINOR STREET - V7
  Conflicting Flows:            | Vc,7 = 1/2V3+V2+V5+V4 =                       1335   vph
  Potential Capacity:           | Cp,7 =                                          179   pcph
  Capacity Adjustment Factor    |
   Due To Impeding Movements:   | f7=po,4=                                       0.97
  Movement Capacity:            | Cm,7 = Cp,7 =                                   173   pcph
---------------------------------------------------------------------------------------------------------
DELAY AND LEVEL OF SERVICE SUMMARY                          csh    AVG TOTAL
  Movement                    v(vcph)         cm(pcph)     (pcph)     DELAY       LOS
  -----------               -------------     --------     ------    -------     ------
  MINOR LEFT TURN   (7)           2              173         SHRD      SHRD        SHRD
  MINOR RIGHT TURN  (9)          19              665         512        7.3          B
  MAJOR LEFT TURN   (4)          15              860        ------      4.3          A
---------------------------------------------------------------------------------------------------------
     AVERAGE MINOR APPROACH DELAY =    7.3 sec/veh  |  AVERAGE TOTAL INTERSECTION DELAY =    0.2 sec/veh
                 LEVEL OF SERVICE =    B            |                  LEVEL OF SERVICE =    A
=========================================================================================================
```

KULAMALU 07/27/96
MASTER PLAN W/MIT 08:48:36
AM PEAK HOUR

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int 0   0 - HALEAKALA HWY & HANA HWY

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	EB ~~SB~~	SB ~~WB~~	WB ~~NB~~	NB ~~EB~~
GRADES	.0	.0	.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	0	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	5	39	17	49	748	83	54	156	2728	931	266	41
WIDTHS	12.0	12.0	.0	12.0	24.0	12.0	12.0	12.0	12.0	12.0	24.0	12.0
LANES	1	1	0	1	2	1	1	1	1	1	2	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	FFLW	NORM	DOPT	FFLW	NORM	NORM
SATURATIONFLOWS	1539	1835	0	1539	3725	832	0	1783	1770	0	3725	486

Phasing Parameters

SEQUENCES ·	71	ALL					
PERMISSIVES	NO	NO	NO	NO	LEADLAGS	NONE	NONE
OVERLAPS	NO	NO	NO	NO	OFFSET	.00	1
CYCLES	60	180	10		PEDTIME	.0	0
GREENTIMES	9.09	25.59	13.32				
YELLOWTIMES	4.00	4.00	4.00				
CRITICALS	2	9	5				
EXCESS	0						

KULAMALU   07/27/96
MASTER PLAN W/MIT   08:48:40
AM PEAK HOUR

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - HALEAKALA HWY & HANA HWY

Degree of Saturation (v/c) 1.48 Vehicle Delay 39.5@ Level of Service D

@ expect more delay due to extreme v/c's (see EVALUATE)

```
        --------------------------------------
Sq 71 | Phase 1  | Phase 2  | Phase 3  |
**/** --------------------------------------
      | + * *    |          |       ^  |
  .   | + * *    |          |      ++++|
 /|\  |(+ * *)   |          |     (****|
  |   |   v      |          |   ^  ++++|
West  |          |       ^  |++++   v  |
~~North~~ |      |    (* +  |++++)     |
  |   |          |     * +  |          |
      |          |     * +  |          |
      --------------------------------------
      | G/C= .152 | G/C= .426 | G/C= .222 |
      | G=   9.1" | G=  25.6" | G=  13.3" |
      | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" |
      | OFF=  .0% | OFF=21.8% | OFF=71.1% |
      --------------------------------------
```

C= 60 sec   G= 48.0 sec = 80.0% Y=12.0 sec = 20.0% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								13.3	B	
RT	12/1	.009	.185	227	284	5	.018	12.9	B	25 ft
LT+TH	12/1	.053	.185	277	339	59	.174	13.3	*B	41 ft
WB ~~NB~~ Approach								49.9@	E+	
TH	12/1-	.857	.460	780	820	1557	1.899	49.80@	E+	709 ft
LT	12/1+	.824	.460	774	814	1479	1.817	49.90@	*E+	674 ft
SB ~~WB~~ Approach								17.1	C+	
RT	12/1	.057	.255	335	393	52	.132	11.1	B	33 ft
TH	24/2	.230	.255	884	951	787	.828	17.9	*C+	247 ft
LT	12/1	.152	.255	167	212	87	.408	12.7	B	55 ft
NB ~~EB~~ Approach								11.0	B	
TH	24/2	.095	.255	884	951	280	.294	11.7	B	88 ft
LT	12/1	.000	.255	90	118	43	.347	12.5	B	27 ft

KULAMALU 07/27/96
MASTER PLAN W/MIT 09:20:42
PM PEAK HOUR

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int 0 0 - HALEAKALA HWY & HANA HWY

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	~~SB~~ EB	~~WB~~ SB	~~NB~~ WB	~~EB~~ NB
GRADES	.0	.0	.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	0	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	25	274	161	40	506	85	63	54	1213	1956	607	2
WIDTHS	12.0	12.0	.0	12.0	24.0	12.0	12.0	12.0	12.0	12.0	24.0	12.0
LANES	1	1	0	1	2	1	1	1	1	1	2	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	FFLW	NORM	DOPT	FFLW	NORM	NORM
SATURATIONFLOWS	1539	1829	0	1539	3725	645	0	1781	1770	0	3725	645

Phasing Parameters

SEQUENCES	71	ALL					
PERMISSIVES	YES	YES	YES	YES	LEADLAGS	NONE	NONE
OVERLAPS	NO	NO	NO	NO	OFFSET	.00	1
CYCLES	60	120	10		PEDTIME	.0	0
GREENTIMES	15.07	23.37	9.56				
YELLOWTIMES	4.00	4.00	4.00				
CRITICALS	2	8	11				
EXCESS	0						

```
KULAMALU                                               07/27/96
MASTER PLAN W/MIT                                      09:20:46
PM PEAK HOUR
```

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - HALEAKALA HWY & HANA HWY
Degree of Saturation (v/c) .84 Vehicle Delay 21.0 Level of Service C

```
       -------------------------------------
Sq 71 | Phase 1  | Phase 2  | Phase 3  |
**/** -------------------------------------
      | + * *    |          |        ^ |
  .   | + * *    |          |      ++++|
 /|\  |(+ * *)   |          |     (++++|
  |   |   v      |          |    ^ ++++|
Wc|st |          |       ^  |++++   v  |
North |          |   (+ *   |****)     |
  |   |          |    + *   |          |
      |          |    + * - |          |
      -------------------------------------
      | G/C= .251 | G/C= .390 | G/C= .159 |
      | G=  15.1" | G=  23.4" | G=   9.6" |
      | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" |
      | OFF=  .0% | OFF=31.8% | OFF=77.4% |
      -------------------------------------
      C= 60 sec   G= 48.0 sec = 80.0%  Y=12.0 sec = 20.0%  Ped=  .0 sec =   .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								23.6	C	
RT	12/1	.033	.285	381	438	26	.059	10.1	B	25 ft
LT+TH	12/1	.282	.285	461	520	457	.879	24.3	*C	276 ft
WB ~~NB~~ Approach								13.5	C+	
TH	12/1-	.410	.423	708	753	684	.908	21.2	*C	333 ft
LT	12/1+	.395	.423	703	748	650	.869	17.8	C+	316 ft
SB ~~WB~~ Approach								13.5	C+	
RT	12/1	.048	.193	238	296	42	.142	13.0	B	29 ft
TH	24/2	.164	.193	642	718	533	.742	17.6	C+	181 ft
LT	12/1	.196	.193	87	117	89	.718	25.5	D+	61 ft
NB ~~EB~~ Approach								24.6	C	
TH	24/2	.192	.193	642	718	639	.890	24.7	*C	218 ft
LT	12/1	.000	.193	87	117	2	.016	12.7	B	25 ft

KULAMALU 03/27/97
FUTURE W/PROJ & MIT 17:13:57
AM PEAK HOUR

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - BYPASS & HALEAKALA HY

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	~~SB~~ EB	~~WB~~ SB	~~NB~~ WB	~~EB~~ NB
GRADES	6.0	.0	-6.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	0	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	413	536	0	0	0	0	0	1713	0	0	0	1105
WIDTHS	12.0	24.0	.0	.0	.0	.0	.0	24.0	.0	.0	.0	24.0
LANES	1	2	0	0	0	0	0	2	0	0	0	2
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	FFLW	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	0	3614	0	0	0	0	0	3837	0	0	0	3078

Phasing Parameters

SEQUENCES	11	ALL					
PERMISSIVES	YES	YES	YES	YES	LEADLAGS	NONE	NONE
OVERLAPS	YES	YES	YES	YES	OFFSET	.00	1
CYCLES	60	120	10		PEDTIME	.0	0
GREENTIMES	28.64	23.36					
YELLOWTIMES	4.00	4.00					
CRITICALS	8	12					
EXCESS	0						

KULAMALU
FUTURE W/PROJ & MIT
AM PEAK HOUR

03/27/97
17:14:28

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - BYPASS & HALEAKALA HY
Degree of Saturation (v/c) .81 Vehicle Delay 13.6 Level of Service B

```
        -------------------------
Sq 11  |  Phase 1   |  Phase 2  |
**/**   -------------------------
       |    +       |           |
  .    |    +       |           |
 /|\   |    +       |           |
  |    |    v       |     ^     |
West   |        ^   |****       |
North  |        *   |           |
  |    |        *   |           |
       |        *   |           |
        -------------------------
       | G/C= .477  | G/C= .389 |
       | G=  28.6"  | G=  23.4" |
       | Y+R= 4.0"  | Y+R= 4.0" |
       | OFF=  .0%  | OFF=54.4% |
        -------------------------
       C= 60 sec   G= 52.0 sec = 86.7%  Y= 8.0 sec = 13.3%  Ped=  .0 sec =   .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								5.5	B+	
TH	24/2	.177	.511	1841	1845	564	.306	5.5	B+	116 ft
WB ~~NB~~ Approach								14.3	B	
TH	24/2	.473	.511	1959	1960	1803	.920	14.3	*B	372 ft
NB ~~EB~~ Approach								16.3	C+	
LT	24/2	.392	.423	1266	1301	1163	.894	16.3	*C+	283 ft

KULAMALU
MASTER PLAN W/MIT
PM PEAK HOUR

03/27/97
17:15:32

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - BYPASS & HALEAKALA HY

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	EB ~~SB~~	SB ~~WB~~	WB ~~NB~~	NB ~~EB~~
GRADES	6.0	.0	-6.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	0	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	927	1236	0	0	0	0	0	883	0	0	0	42
WIDTHS	12.0	24.0	.0	.0	.0	.0	.0	24.0	.0	.0	.0	24.
LANES	1	2	0	0	0	0	0	2	0	0	0	2
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.9
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YE
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	190
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
GROUPTYPES	FFLW	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NOR
SATURATIONFLOWS	0	3614	0	0	0	0	0	3837	0	0	0	307

Phasing Parameters

SEQUENCES	11	ALL					
PERMISSIVES	YES	YES	YES	YES	LEADLAGS	NONE	NONE
OVERLAPS	YES	YES	YES	YES	OFFSET	.00	1
CYCLES	60	120	10		PEDTIME	.0	0
GREENTIMES	36.45	15.55					
YELLOWTIMES	4.00	4.00					
CRITICALS	2	12					
EXCESS	0						

KULAMALU
MASTER PLAN W/MIT
PM PEAK HOUR

03/27/97
17:16:04

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - BYPASS & HALEAKALA HY
Degree of Saturation (v/c) .49 Vehicle Delay 5.1 Level of Service B+

```
        -----------------------------
Sq 11  |  Phase 1    |  Phase 2     |
**/**  -----------------------------
       |    *        |              |
  .    |    *        |              |
 /|\   |    *        |              |
  |    |    v        |      ^       |
West   |        ^    |****          |
~~North~~  |        +    |              |
  |    |        +    |              |
       |        +    |              |
        -----------------------------
       | G/C= .608   | G/C= .259    |
       | G=  36.5"   | G=  15.6"    |
       | Y+R= 4.0"   | Y+R= 4.0"    |
       | OFF=  .0%   | OFF=67.4%    |
        -----------------------------
       C= 60 sec   G= 52.0 sec = 86.7%   Y= 8.0 sec = 13.3%   Ped=  .0 sec =   .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								4.1	A	
TH	24/2	.372	.641	2316	2316	1301	.562	4.1	*A	197 ft
WB ~~NB~~ Approach								3.3	A	
TH	24/2	.259	.641	2459	2459	929	.378	3.3	A	141 ft
NB ~~EB~~ Approach								11.7	B	
LT	24/2	.170	.292	839	900	448	.498	11.7	*B	134 ft

KULAMALU
MASTER PLAN W/MIT
AM PEAK HOUR

03/27/97
17:22:04

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - PUKALANI BYP & MAKANI ST

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	EB ~~SB~~	SB ~~WB~~	WB ~~NB~~	NB ~~EB~~
GRADES	2.0	.0	-2.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	0	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	0	541	1	275	58	13	12	1365	9	51	76	14
WIDTHS	.0	24.0	12.0	12.0	12.0	12.0	.0	24.0	12.0	12.0	12.0	12.0
LANES	0	2	1	1	1	1	0	2	1	1	1	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	0	3688	207	1539	1863	1422	0	3757	625	1539	1863	1492

Phasing Parameters

SEQUENCES	11	ALL					
PERMISSIVES	YES	YES	YES	YES	LEADLAGS	NONE	NONE
OVERLAPS	YES	YES	YES	YES	OFFSET	.00	1
CYCLES	60	120	10		PEDTIME	.0	0
GREENTIMES	33.64	18.36					
YELLOWTIMES	4.00	4.00					
CRITICALS	8	4					
EXCESS	0						

KULAMALU
MASTER PLAN W/MIT
AM PEAK HOUR

03/27/97
17:22:35

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - PUKALANI BYP & MAKANI ST
Degree of Saturation (v/c) .50 Vehicle Delay 6.2 Level of Service B+

```
          -------------------------------
Sq 11   |  Phase 1    |  Phase 2    |
**/**   -------------------------------
        |   + +       |        ^    |
  .     |   + +       |        **** |
 /|\    |   + +>      |       <++++ |
  |     |   v         |    ^   ++++ |
West    |        ^    |++++    v    |
~~North~~   |    <+ * *>|++++>        |
  |     |     + * *   |++++         |
        |     + * *   |    v        |
          -------------------------------
        | G/C= .561   | G/C= .306   |
        | G=  33.6"   | G=  18.4"   |
        | Y+R= 4.0"   | Y+R= 4.0"   |
        | OFF=  .0%   | OFF=62.7%   |
          -------------------------------
```

C= 60 sec G= 52.0 sec = 86.7% Y= 8.0 sec = 13.3% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								3.8	A	
TH	24/2	.175	.594	2191	2191	569	.260	3.8	A	97 ft
LT	12/1	.000	.594	98	120	1	.008	3.2	A	25 ft
WB ~~NB~~ Approach								5.7	B+	
TH+RT	24/2	.395	.594	2232	2232	1450	.650	5.7	*B+	248 ft
LT	12/1	.000	.594	338	371	9	.024	3.2	A	25 ft
SB ~~WB~~ Approach								10.8	B	
RT	12/1	.226	.339	469	522	289	.554	11.4	*B	161 ft
TH	12/1	.054	.339	578	632	61	.097	8.7	B+	34 ft
LT	12/1	.000	.339	430	483	14	.029	8.5	B+	25 ft
NB ~~EB~~ Approach								8.8	B+	
RT	12/1	.059	.339	469	522	54	.103	8.8	B+	30 ft
TH	12/1	.067	.339	578	632	80	.127	8.8	B+	45 ft
LT	12/1	.000	.339	453	506	15	.030	8.5	B+	25 ft

KULAMALU
MASTER PLAN W/MIT
PM PEAK HOUR

03/27/97
17:23:34

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - PUKALANI BYP & MAKANI ST

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	EB ~~SB~~	SB ~~WB~~	WB ~~NB~~	NB ~~EB~~
GRADES	2.0	.0	-2.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	0	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	25	994	196	39	37	4	25	809	18	26	60	2
WIDTHS	.0	24.0	12.0	12.0	12.0	12.0	.0	24.0	12.0	12.0	12.0	12.0
LANES	0	2	1	1	1	1	0	2	1	1	1	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	0	3673	1752	1539	1863	1448	0	3743	342	1539	1863	1557

Phasing Parameters

SEQUENCES	21						
PERMISSIVES	YES	YES	YES	YES	LEADLAGS	NONE	NONE
OVERLAPS	YES	YES	YES	YES	OFFSET	.00	1
CYCLES	60	120	10		PEDTIME	.0	[illegible]
GREENTIMES	14.00	20.00	14.00				
YELLOWTIMES	4.00	4.00	4.00				
CRITICALS	3	8	5				
EXCESS	0						

KULAMALU
MASTER PLAN W/MIT
PM PEAK HOUR

03/27/97
17:24:06

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - PUKALANI BYP & MAKANI ST
Degree of Saturation (v/c) .48 Vehicle Delay 6.6 Level of Service B+

```
         -------------------------------------
Sq 21  |  Phase 1   |  Phase 2   |  Phase 3   |
**/**  -------------------------------------
       | + + * ^    | + + +      |         ^  |
   .   | + + * ++++ | + + +      |      ++++  |
  /|\  |<+ + *>     |<+ + +>     |     <****  |
   |   |    v       |    v       |     ^ ++++ |
 West  |            |        ^   |++++    v   |
 ~~North~~ |        |    <+ * *> |++++>       |
   |   |            |     + * *  |++++        |
       |            |     + * *  |    v       |
       -------------------------------------
       | G/C= .233  | G/C= .333  | G/C= .233  |
       | G=  14.0"  | G=  20.0"  | G=  14.0"  |
       | Y+R= 4.0"  | Y+R= 4.0"  | Y+R= 4.0"  |
       | OFF=  .0%  | OFF=30.0%  | OFF=70.0%  |
       -------------------------------------
```

C= 60 sec G= 48.0 sec = 80.0% Y=12.0 sec = 20.0% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								3.2	A	
TH+RT	24/2	.307	.667	2448	2448	1072	.438	3.1	A	151 ft
LT	12/1	.067	.267	551	590	206	.349	3.8	*A	58 ft
WB ~~NB~~ Approach								10.8	B	
TH+RT	24/2	.253	.367	1331	1373	878	.639	10.9	*B	234 ft
LT	12/1	.000	.367	94	120	19	.152	8.3	B+	25 ft
SB ~~WB~~ Approach								7.3	B+	
RT	12/1	.047	.567	844	872	41	.047	3.7	A	25 ft
TH	12/1	.038	.267	437	497	39	.078	10.6	*B	25 ft
LT	12/1	.000	.267	330	386	4	.010	10.5	B	25 ft
NB ~~EB~~ Approach								10.7	B	
RT	12/1	.034	.267	353	410	27	.066	10.6	B	25 ft
TH	12/1	.055	.267	437	497	63	.127	10.8	B	39 ft
LT	12/1	.000	.267	357	415	2	.005	10.4	B	25 ft

KULAMALU
MASTER PLAN W/MIT
AM PEAK HOUR

07/27/96
09:08:13

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int #   0 - PUKALANI BYPASS & MAKAWAO AV

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	~~SB~~ EB	~~WB~~ SB	~~NB~~ WB	~~EB~~ NB
GRADES	6.0	.0	-6.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	12	94	236	1

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	12	485	134	376	308	403	273	919	2	21	163	22
WIDTHS	12.0	24.0	12.0	12.0	12.0	12.0	12.0	24.0	12.0	12.0	12.0	12.0
LANES	1	2	1	1	1	1	1	2	1	1	1	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.03	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1493	3614	1717	1539	1863	1770	1585	3837	676	1539	1863	818

Phasing Parameters

SEQUENCES	22	ALL						
PERMISSIVES	YES	YES	YES	YES		LEADLAGS	NONE	NONE
OVERLAPS	YES	YES	YES	YES		OFFSET	.00	1
CYCLES	60	180	10			PEDTIME	.0	0
GREENTIMES	6.63	17.87	12.39	7.11				
YELLOWTIMES	4.00	4.00	4.00	4.00				
CRITICALS	3	8	6	11				
EXCESS	0							

KULAMALU
MASTER PLAN W/MIT
AM PEAK HOUR

07/27/96
09:08:18

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - PUKALANI BYPASS & MAKAWAO AV
Degree of Saturation (v/c) .55 Vehicle Delay 10.3 Level of Service B

```
       -------------------------------------------------
Sq 22 | Phase 1  | Phase 2  | Phase 3  | Phase 4  |
**/** -------------------------------------------------
      | + + * ^  | + + +    |        ^ |        ^ |
  .   | + + * ++++| + + +   |     ++++ |.    ++++|
 /|\  |(+ + *)   |(+ + +)   |    (++++ |    (++++|
  |   |   v      |   v      |     **** |  ^  ++++|
West  |          |       ^  |      v   |++++  v  |
~~North~~ |          |   (+ * +)|      +)|****)    |
  |   |          |     + * +|       +  |++++     |
      |          |     + * +|       +  |  v      |
       -------------------------------------------------
      | G/C= .110 | G/C= .298 | G/C= .207 | G/C= .118 |
      | G=  6.6"  | G=  17.9" | G=  12.4" | G=  7.1"  |
      | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" |
      | OFF=  .0% | OFF=17.7% | OFF=54.2% | OFF=81.5% |
       -------------------------------------------------
```

C= 60 sec G= 44.0 sec = 73.3% Y=16.0 sec = 26.7% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								5.8	B+	
RT	12/1	.002	.508	723	759	1	.001	4.7	A	25 ft
TH	24/2	.163	.508	1832	1837	511	.278	5.5	B+	106 ft
LT	12/1	.035	.144	332	367	141	.384	6.8	*B+	58 ft
WB ~~NB~~ Approach								13.1	B	
RT	12/1	.044	.604	936	958	39	.041	3.1	A	25 ft
TH	24/2	.269	.331	1221	1271	967	.761	13.5	*B	273 ft
LT	12/1	.000	.331	166	207	2	.010	8.7	B+	25 ft
SB ~~WB~~ Approach								9.0	B+	
RT	12/1	.231	.602	904	927	297	.320	3.9	A	100 ft
TH	12/1	.207	.425	748	792	324	.409	8.0	B+	157 ft
LT	12/1	.195	.240	508	548	424	.774	13.4	*B	206 ft
NB ~~EB~~ Approach								17.3	C+	
RT	12/1	.028	.152	179	233	21	.090	14.1	B	25 ft
TH	12/1	.123	.152	223	283	172	.608	18.0	*C+	123 ft
LT	12/1	.000	.152	85	117	23	.185	14.4	B	25 ft

KULAKALU
MASTER PLAN W/MIT
PM PEAK HOUR

07/27/96
09:31:22

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - PUKALANI BYPASS & MAKAWAO AV

METROAREA	NONCBD	
LOSTTIME		2.0
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

	EB	SB	WB	NB
APPLABELS	~~SB~~	~~WB~~	~~NB~~	~~EB~~
GRADES	6.0	.0	-6.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	14	103	138	1

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	44	682	278	103	313	239	317	698	2	9	316	20
WIDTHS	12.0	24.0	12.0	12.0	12.0	12.0	12.0	24.0	12.0	12.0	12.0	12.0
LANES	1	2	1	1	1	1	1	2	1	1	1	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1493	3614	1717	1539	1863	1770	1585	3837	464	1539	1863	1770

Phasing Parameters

SEQUENCES	24	ALL		
PERMISSIVES	YES	YES	YES	YES
OVERLAPS	YES	YES	YES	YES
CYCLES	60	120	10	
GREENTIMES	7.64	14.55	7.15	14.66
YELLOWTIMES	4.00	4.00	4.00	4.00
CRITICALS	3	8	6	11
EXCESS	0			

LEADLAGS	NONE	NONE
OFFSET	.00	1
PEDTIME	.0	0

KULAMALU
MASTER PLAN W/MIT
PM PEAK HOUR

07/27/96
09:31:26

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - PUKALANI BYPASS & MAKAWAO AV
Degree of Saturation (v/c) .57 Vehicle Delay 11.1 Level of Service B

```
        -----------------------------------------------
Sq 24 | Phase 1   | Phase 2   | Phase 3   | Phase 4   |
**/** -----------------------------------------------
      | + + * ^   | + + +     | +         |         ^ |
  .   | + + * ++++| + + +     | +         |      ++++|
 /|\  |(+ + *)    |(+ + +)    |(+         |     (++++|
  |   |   v       |   v       |   ^   ****|   ^  ++++|
  |   |           |       ^   |++++   v   |++++  v   |
North |           |   (+ * +) |        +) |****)     |
West  |           |    + * +  |        +  |++++      |
      |           |    + * +  |        +  |  v       |
      -----------------------------------------------
      | G/C= .127 | G/C= .243 | G/C= .119 | G/C= .244 |
      | G=   7.6" | G=  14.6" | G=   7.2" | G=  14.7" |
      | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" |
      | OFF=  .0% | OFF=19.4% | OFF=50.3% | OFF=68.9% |
      -----------------------------------------------
```

C= 60 sec G= 44.0 sec = 73.3% Y=16.0 sec = 26.7% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								8.3	B+	
RT	12/1	.040	.656	963	979	32	.033	2.3	A	25 ft
TH	24/2	.219	.478	1682	1698	718	.423	6.9	B+	161 ft
LT	12/1	.123	.161	360	396	293	.740	12.5	*B	131 ft
WB ~~NB~~ Approach								12.4	B	
RT	12/1	.154	.462	691	732	188	.257	6.4	B+	85 ft
TH	24/2	.211	.276	996	1059	735	.694	14.0	*B	224 ft
LT	12/1	.000	.276	94	122	2	.016	10.2	B	25 ft
SB ~~WB~~ Approach								12.2	B	
RT	12/1	.002	.472	686	726	1	.001	5.4	B+	25 ft
TH	12/1	.210	.278	457	517	329	.636	14.1	B	200 ft
LT	12/1	.094	.153	358	394	252	.640	9.7	*B+	114 ft
NB ~~EB~~ Approach								13.7	B	
RT	12/1	.013	.278	370	427	8	.019	10.2	B	25 ft
TH	12/1	.212	.278	457	517	333	.644	14.3	*B	203 ft
LT	12/1	.000	.153	358	394	21	.053	6.2	B+	25 ft

KULAMALU
FUTURE W/PROJ & MIT
AM PEAK HOUR

03/27/97
17:25:2

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - BYPASS/KULA HWY & HALEAKALA HY

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	SB	WB	NB	EB
GRADES	6.0	.0	-6.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	1	65	44	127

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	L
VOLUMES	1	830	93	109	35	64	92	1104	182	295	41	1
WIDTHS	12.0	12.0	12.0	12.0	12.0	.0	12.0	12.0	12.0	12.0	12.0	.
LANES	1	1	1	1	1	0	1	1	1	1	1	0
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.9
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YE
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	190
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NOR
SATURATIONFLOWS	1493	1807	1717	1539	1562	0	1585	1919	1823	1539	1847	0

Phasing Parameters

SEQUENCES	41	ALL		
PERMISSIVES	YES	YES	YES	YES
OVERLAPS	YES	YES	YES	YES
CYCLES	60	120	10	
GREENTIMES	5.44	37.12	5.44	
YELLOWTIMES	4.00	4.00	4.00	
CRITICALS	3	8	5	
EXCESS	0			

LEADLAGS	NONE	NON
OFFSET	.00	1
PEDTIME	.0	0

KULAMALU   03/27/97
FUTURE W/PROJ & MIT   17:26:01
AM PEAK HOUR

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int #   0 - BYPASS/KULA HWY & HALEAKALA HY
Degree of Saturation (v/c) .73 Vehicle Delay 10.9   Level of Service B

```
          ----------------------------------------
Sq 41   |   Phase 1    |   Phase 2    |   Phase 3    |
**/**   ----------------------------------------
        |       * ^    | + + +        |         ^    |
   .    |       * ++++ | + + +        |         ++++ |
  /|\   |       *>     |<+ + +>       |        <**** |
   |    |              |    v         |     ^   **** |
   |    |              |        ^     |++++    v     |
 North  |     <+       |     <+ * +>  |++++>         |
   |    |++++ +        |       + * +  |++++          |
        |   v +        |       + * +  |  v           |
        ----------------------------------------
        | G/C= .091    | G/C= .619    | G/C= .091    |
        | G=    5.4"   | G=   37.1"   | G=    5.4"   |
        | Y+R= 4.0"    | Y+R= 4.0"    | Y+R= 4.0"    |
        | OFF=   .0%   | OFF=15.7%    | OFF=84.3%    |
        ----------------------------------------
        C= 60 sec    G= 48.0 sec = 80.0%   Y=12.0 sec = 20.0%   Ped=  .0 sec =   .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
SB Approach								6.6	B+	
RT	12/1	.002	.652	956	973	1	.001	2.3	A	25 ft
TH	12/1	.503	.652	1169	1178	874	.742	6.3	B+	257 ft
LT	12/1	.009	.124	285	333	98	.294	8.7	*B+	51 ft
NB Approach								13.2	B	
RT	12/1	.055	.652	1019	1034	51	.049	2.4	A	25 ft
TH	12/1	.613	.652	1244	1251	1162	.929	14.8	*B	341 ft
LT	12/1	.052	.124	312	354	192	.542	6.8	B+	53 ft
WB Approach								15.8	C+	
RT	12/1	.052	.281	376	433	46	.106	10.3	B	28 ft
LT+TH	12/1	.097	.124	142	190	104	.536	18.2	*C+	77 ft
EB Approach								12.4	B	
RT	12/1	.151	.281	376	433	177	.409	11.7	B	107 ft
LT+TH	12/1	.042	.124	172	227	44	.192	15.3	C+	33 ft

KULAMALU
FUTURE W/PROJ & MIT
PM PEAK HOUR

03/27/9
17:27:1

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - BYPASS/KULA HWY & HALEAKALA HY

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	SB	WB	NB	EB
GRADES	6.0	.0	-6.0	.0
PEDLEVELS	LOW	LOW	LOW	LOW
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	1	52	28	140

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	L
VOLUMES	1	969	74	87	39	39	42	892	200	332	49	
WIDTHS	12.0	12.0	12.0	12.0	12.0	.0	12.0	12.0	12.0	12.0	12.0	.
LANES	1	1	1	1	1	0	1	1	1	1	1	
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.9
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YE
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	190
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.0
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NOR
SATURATIONFLOWS	1493	1807	214	1539	1620	0	1585	1919	1823	1539	1863	

Phasing Parameters

SEQUENCES	31	ALL		
PERMISSIVES	YES	YES	YES	YES
OVERLAPS	YES	YES	YES	YES
CYCLES	60	120	10	
GREENTIMES	5.77	36.45	5.77	
YELLOWTIMES	4.00	4.00	4.00	
CRITICALS	9	2	5	
EXCESS	0			

LEADLAGS	NONE	NON
OFFSET	.00	1
PEDTIME	.0	

KULAMALU 03/27/97
FUTURE W/PROJ & MIT 17:27:49
PM PEAK HOUR

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - BYPASS/KULA HWY & HALEAKALA HY
Degree of Saturation (v/c) .67 Vehicle Delay 8.1 Level of Service B+

```
         ------------------------------------
Sq 31  |  Phase 1   |  Phase 2   |  Phase 3   |
**/**   ------------------------------------
       |            | +  *  +    |        ^   |
  .    |            | +  *  +    |       ++++ |
 /|\   |            |<+  *  +>   |      <**** |
  |    |            |    v       |       **** |
  |    |         ^  |        ^   |        v   |
North  |     <*  + +>|   <+  + +>|++++>       |
  |    |++++  *  + + |     +  + +|++++        |
       |    v *  + + |     +  + +|    v       |
         ------------------------------------
       | G/C= .096  | G/C= .608  | G/C= .096  |
       | G=    5.8" | G=   36.5" | G=    5.8" |
       | Y+R= 4.0"  | Y+R= 4.0"  | Y+R= 4.0"  |
       | OFF= -.0%  | OFF=16.3%  | OFF=83.7%  |
         ------------------------------------
       C= 60 sec   G= 48.0 sec = 80.0%  Y=12.0 sec = 20.0%  Ped=  .0 sec =   .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
SB Approach								11.3	B	
RT	12/1	.002	.641	939	957	1	.001	2.5	A	25 ft
TH	12/1	.577	.641	1147	1158	1020	.881	11.5	*B	309 ft
LT	12/1	.086	.641	112	135	78	.569	7.9	B+	25 ft
NB Approach								3.3	A	
RT	12/1	.021	.804	1274	1274	15	.012	.8	A	25 ft
TH	12/1	.506	.804	1542	1542	939	.609	2.0	A	155 ft
LT	12/1	.066	.130	318	364	211	.580	9.5	*B+	84 ft
WB Approach								15.8	C+	
RT	12/1	.043	.130	147	195	37	.186	15.1	C+	27 ft
LT+TH	12/1	.077	.130	156	207	82	.390	16.1	*C+	60 ft
EB Approach								12.4	B	
RT	12/1	.168	.292	394	450	202	.449	11.7	B	121 ft
TH	12/1	.048	.130	183	240	52	.216	15.2	C+	38 ft

KULAMALU
MASTER PLAN W/MIT
AM PEAK HOUR

07/27/96
08:52:17

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & PUKALANI ST

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	EB ~~SB~~	SB ~~WB~~	WB ~~NB~~	NB ~~EB~~
GRADES	8.0	.0	-8.0	2.0
PEDLEVELS	MODER	MODER	MODER	MODER
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	252	0	0	141

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	257	157	0	0	0	0	0	249	218	171	0	701
WIDTHS	12.0	12.0	.0	.0	.0	.0	.0	12.0	12.0	12.0	.0	12.0
LANES	1	1	0	0	0	0	0	1	1	1	0	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1350	1788	0	0	0	0	0	1919	1061	1392	0	1392

Phasing Parameters

SEQUENCES	11	ALL		
PERMISSIVES	YES	YES	YES	YES
OVERLAPS	NO	NO	NO	NO
CYCLES	60	180	10	
GREENTIMES	16.11	35.89		
YELLOWTIMES	4.00	4.00		
CRITICALS	9	12		
EXCESS	0			

LEADLAGS	NONE	NONE
OFFSET	.00	1
PEDTIME	.0	0

KULAMALU
MASTER PLAN W/MIT
AM PEAK HOUR

07/27/96
08:52:21

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 8 - HALEAKALA HWY & PUKALANI ST
Degree of Saturation (v/c) .67 Vehicle Delay 11.7 Level of Service B

```
        -------------------------
Sq 11 | Phase 1  | Phase 2  |
**/** -------------------------
      | + +      |          |
  .   | + +      |          |
 /|\  |(+ +      |          |
  |   |   v      |    *     |
West  |       *  |****      |
~~North~~ |     (* + |          |
  |   |      * + |++++      |
      |      * + |    v     |
        -------------------------
      | G/C= .268 | G/C= .598 |
      | G=  16.1" | G=  35.9" |
      | Y+R= 4.0" | Y+R= 4.0" |
      | OFF=  .0% | OFF=33.5% |
        -------------------------
```

C= 60 sec G= 52.0 sec = 86.7% Y= 8.0 sec = 13.3% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								10.5	B	
RT	12/1	.010	.302	353	407	5	.012	9.5	B+	25 ft
TH	12/1	.124	.302	483	540	165	.306	10.5	B	97 ft
WB ~~NB~~ Approach								14.0	B	
TH	12/1	.169	.302	521	579	262	.453	11.3	B	154 ft
LT	12/1	.264	.302	270	320	229	.716	17.1	*C+	135 ft
NB ~~EB~~ Approach								10.4	B	
RT	12/1	.043	.632	857	879	32	.036	2.7	A	25 ft
LT	12/1	.554	.632	857	879	738	.840	10.7	*B	229 ft

KULAMALU
MASTER PLAN W/MIT
PM PEAK HOUR

07/27/96
09:23:27

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & PUKALANI ST

METROAREA	NONCBD	
LOSTTIME		2.0
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	EB ~~SB~~	SB ~~WB~~	WB ~~NB~~	NB ~~EB~~
GRADES	8.0	.0	-8.0	2.0
PEDLEVELS	MODER	MODER	MODER	MODER
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	223	0	0	203

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	609	334	0	0	0	0	0	171	305	340	0	300
WIDTHS	12.0	12.0	.0	.0	.0	.0	.0	12.0	12.0	12.0	.0	12.0
LANES	1	1	0	0	0	0	0	1	1	1	0	1
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	NO	YES	YES	NO	YES	YES	NO	YES	YES	NO	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	1350	1788	0	0	0	0	0	1919	1823	1392	0	1392

Phasing Parameters

SEQUENCES	31	ALL						
PERMISSIVES	YES	YES	YES	YES		LEADLAGS	NONE	NONE
OVERLAPS	YES	YES	YES	YES		OFFSET	.00	1
CYCLES	60	120	10			PEDTIME	.0	0
GREENTIMES	8.45	18.07	21.48					
YELLOWTIMES	4.00	4.00	4.00					
CRITICALS	3	2	12					
EXCESS	0							

KULAMALU 07/27/96
MASTER PLAN W/MIT 09:23:30
PM PEAK HOUR

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - HALEAKALA HWY & PUKALANI ST
Degree of Saturation (v/c) .49 Vehicle Delay 7.3 Level of Service B+

```
      ------------------------------------
Sq 31 | Phase 1  | Phase 2  | Phase 3  |
**/** ------------------------------------
      |          | + *      | +        |
  .   |          | + *      | +        |
 /|\  |          |(+ *      |(+        |
  |   |          |   v      |    ^     |
West  |      ^   |       ^  |****      |
North |    (* +  |   (+ +   |          |
  |   |**** * +  |     + +  |****      |
      |   v * +  |     + +  |   v      |
      ------------------------------------
      | G/C= .141 | G/C= .301 | G/C= .358 |
      | G=   8.5" | G=  18.1" | G=  21.5" |
      | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" |
      | OFF=  .0% | OFF=20.8% | OFF=57.5% |
      ------------------------------------
     C= 60 sec   G= 48.0 sec = 80.0%  Y=12.0 sec = 20.0%  Ped=  .0 sec =   .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								6.4	B+	
RT	12/1	.340	.759	1020	1025	406	.396	1.7	A	82 ft
TH	12/1	.231	.335	543	598	352	.589	11.8	*B	198 ft
WB ~~NB~~ Approach								7.7	B+	
TH	12/1	.124	.542	1014	1040	180	.173	4.5	A	70 ft
LT	12/1	.122	.174	417	452	321	.710	9.5	*B+	124 ft
NB ~~EB~~ Approach								8.4	B+	
RT	12/1	.140	.599	607	633	144	.173	3.5	A	49 ft
LT	12/1	.271	.391	496	545	320	.587	10.5	*B	164 ft

KULAMALU
MASTER PLAN W/MIT
AM PEAK HOUR

07/27/96
08:50:17

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int # 0 - HALEAKALA HWY & MAKAWAO AV

METROAREA		NONCBD
LOSTTIME		2.0
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

	EB	SB	WB	NB
APPLABELS	~~SB~~	~~WB~~	~~NB~~	~~EB~~
GRADES	8.0	.0	-8.0	.0
PEDLEVELS	MODER	MODER	MODER	MODER
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	64	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	6	246	103	225	52	24	31	198	25	45	67	26
WIDTHS	.0	12.0	12.0	12.0	12.0	.0	.0	12.0	.0	.0	12.0	.0
LANES	0	1	1	1	1	0	0	1	0	0	1	0
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	0	1778	876	1406	1685	0	0	1571	0	0	1476	0

Phasing Parameters

SEQUENCES	11	ALL					
PERMISSIVES	YES	YES	YES	YES	LEADLAGS	NONE	NONE
OVERLAPS	NO	NO	NO	NO	OFFSET	.00	1
CYCLES	60	180	10		PEDTIME	.0	0
GREENTIMES	29.78	22.22					
YELLOWTIMES	4.00	4.00					
CRITICALS	8	4					
EXCESS	0						

KULAMALU
MASTER PLAN W/MIT
AM PEAK HOUR

07/27/96
08:50:21

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int # 0 - HALEAKALA HWY & MAKAWAO AV
Degree of Saturation (v/c) .27 Vehicle Delay 6.1 Level of Service B+

```
        -------------------------
Sq 11  | Phase 1   | Phase 2   |
**/**  -------------------------
       | + + +     |        ^  |
  .    | + + +     |      ****|
 /|\   |(+ + +)    |     (++++|
  |    |   v       |    ^  ++++|
  |    |        ^  |++++   v   |
 West  |    (* * *)|++++)      |
       |     * * * |++++       |
       |     * * * |  v        |
       -------------------------
       | G/C= .496 | G/C= .370 |
       | G=  29.8" | G=  22.2" |
       | Y+R= 4.0" | Y+R= 4.0" |
       | OFF=  .0% | OFF=56.3% |
       -------------------------
```

C= 60 sec   G= 52.0 sec = 86.7% Y= 8.0 sec = 13.3% Ped= .0 sec = .0%

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
~~SB~~ EB Approach								5.0	B+	
TH+RT	12/1	.184	.530	912	942	265	.281	5.1	B+	105 ft
LT	12/1	.172	.530	427	464	108	.233	4.9	A	43 ft
~~NB~~ WB Approach								5.2	B+	
LT+TH+RT	12/1	.208	.530	800	832	267	.321	5.2	*B+	106 ft
~~WB~~ SB Approach								7.7	B+	
RT	12/1	.158	.404	520	567	169	.298	7.9	*B+	85 ft
LT+TH	12/1	.073	.404	633	680	80	.118	7.2	B+	40 ft
~~EB~~ NB Approach								7.7	B+	
LT+TH+RT	12/1	.134	.404	548	596	145	.243	7.7	B+	73 ft

KULAMALU
MASTER PLAN W/MIT
PM PEAK HOUR

07/27/96
09:22:16

SIGNAL94/TEAPAC[V1 L1.4] - Summary of Parameter Values

Intersection Parameters for Int 0 0 - HALEAKALA HWY & MAKAWAO AV

METROAREA	NONCBD	
LOSTTIME	2.0	
LEVELOFSERVICE	C	S
NODELOCATION	0	0

Approach Parameters

APPLABELS	EB ~~SB~~	SB ~~WB~~	WB ~~NB~~	NB ~~EB~~
GRADES	8.0	.0	-8.0	.0
PEDLEVELS	MODER	MODER	MODER	MODER
PARKINGSIDES	NONE	NONE	NONE	NONE
PARKVOLUMES	20	20	20	20
BUSVOLUMES	0	0	0	0
RIGHTTURNONREDS	0	205	0	0

Movement Parameters

MOVLABELS	RT	TH	LT	RT	TH	LT	RT	TH	LT	RT	TH	LT
VOLUMES	33	326	309	291	66	49	29	190	26	31	57	19
WIDTHS	.0	12.0	12.0	12.0	12.0	.0	.0	12.0	.0	.0	12.0	.0
LANES	0	1	1	1	1	0	0	1	0	0	1	0
UTILIZATIONS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
TRUCKPERCENTS	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PEAKHOURFACTORS	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95
ARRIVALTYPES	3	3	3	3	3	3	3	3	3	3	3	3
ACTUATIONS	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
REQCLEARANCES	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MINIMUMS	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
IDEALSATFLOWS	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
FACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DELAYFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NSTOPFACTORS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
GROUPTYPES	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
SATURATIONFLOWS	0	1748	1699	1406	1591	0	0	1450	0	0	1445	0

Phasing Parameters

SEQUENCES	21	ALL					
PERMISSIVES	YES	YES	YES	YES	LEADLAGS	NONE	NONE
OVERLAPS	YES	YES	YES	YES	OFFSET	.00	1
CYCLES	60	180	10		PEDTIME	.0	0
GREENTIMES	11.97	24.06	11.97				
YELLOWTIMES	4.00	4.00	4.00				
CRITICALS	3	8	5				
EXCESS	0						

KULAMALU
MASTER PLAN W/KIT
PM PEAK HOUR

07/27/96
09:22:21

SIGNAL94/TEAPAC[V1 L1.4] - Capacity Analysis Summary

Intersection Averages for Int 0   0 - HALEAKALA HWY & MAKAWAO AV
Degree of Saturation (v/c) .35 Vehicle Delay   5.6 Level of Service B+

```
      -----------------------------------
Sq 21 |  Phase 1  |  Phase 2  |  Phase 3  |
**/** -----------------------------------
      | + + * ^   | + + +     |         ^ |
  .   | + + * ++++| + + +     |      ++++|
 /|\  |(+ + *)    |(+ + +)    |     <****|
  |   |   v       |   v       |    ^  ****|
West  |           |        ^  |++++   v   |
North |           |    (* * *)|++++)      |
  |   |           |     * * * |++++       |
      |           |     * * * |   v       |
      -----------------------------------
      | G/C= .199 | G/C= .401 | G/C= .199 |
      | G=  12.0" | G=  24.1" | G=  12.0" |
      | Y+R= 4.0" | Y+R= 4.0" | Y+R= 4.0" |
      | OFF=  .0% | OFF=26.6% | OFF=73.4% |
      -----------------------------------
      C= 60 sec   G= 48.0 sec = 80.0%  Y=12.0 sec = 20.0%  Ped=  .0 sec =   .0%
```

Lane Group	Width/ Lanes	g/C Reqd	g/C Used	Service Rate @C (vph)	Service Rate @E	Adj Volume	v/c	HCM Delay	L S	90% Max Queue
EB ~~SB~~ Approach								2.6	A	
TH+RT	12/1	.251	.701	1221	1224	378	.309	2.3	A	95 ft
LT	12/1	.021	.233	715	731	325	.445	3.0	*A	82 ft
WB ~~NB~~ Approach								7.8	B+	
LT+TH+RT	12/1	.218	.434	585	630	258	.410	7.8	*B+	123 ft
SB ~~WB~~ Approach								9.4	B+	
RT	12/1	.096	.499	664	702	91	.130	5.2	B+	38 ft
LT+TH	12/1	.108	.233	311	370	121	.327	12.5	*B	78 ft
NB ~~EB~~ Approach								12.6	B	
LT+TH+RT	12/1	.112	.233	279	336	113	.336	12.6	B	73 ft

Appendix E

Preliminary Engineering Report

PRELIMINARY ENGINEERING REPORT

FOR THE

KULAMALU SUBDIVISION - UPPER SECTION

AT

Kula, Maui, Hawaii

TMK: (2) 2-3-08:portion of 5, 38 and 39

Prepared for
Kulamalu Limited Partnership

BY

Austin, Tsutsumi & Associates, Inc.
Engineers * Surveyors

July 1996
February 1997

Revised March 1997

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

Preliminary Engineering Report
for the
Kulamalu Subdivision - Upper Section Rezoning
at
Kula, Maui, Hawaii
Tax Map Key: (2) 2-3-08: portion 5, 38 and 39

I. INTRODUCTION

The purpose of this report is to summarize the preliminary civil engineering design criteria for the Kulamalu Subdivision - Upper Section Rezoning. It evaluates the existing conditions and defines the grading requirements, storm drainage system and the utility provisions for the proposed project.

II. PROPOSED PROJECT

A. Location

The project site is located in Kula, Maui, Hawaii, just south of the town of Pukalani and adjacent to Kula Highway. The Tax Map Key for this site are portions of TMK: 2-3-08:5, 38 and 39. Refer to Exhibit 1.

B. Project Description

The rezoning of the upper section of the Kulamalu Subdivision will create the following parcels and uses:

Business	19.41 acres
Halau	5.03 acres

Elderly Housing	4.88 acres
Public/Quasi-Public	5.10 acres
Park/Public	14.74 acres
Single Family	4.51 acres
Total	53.67 acres

The lower portion of the Kulamalu Subdivision is zoned for single and multi-family housing, and will also include the proposed Kamehameha Schools/Bishop Estate campus.

III. EXISTING CONDITIONS

A. Adjacent Land Uses

The northern boundary of the project site abuts Kaluapulani/Haakakai Gulch. The southern boundary abuts existing agricultural lots and an unnamed drainageway (tributary of Kaluapulani Gulch).The eastern boundary of the project site abuts Kula Highway. The western boundary abuts the remainder of the Kulamalu Subdivision. Refer to Exhibit 2.

B. Topography and Soil Conditions

The site was formerly planted in pineapple and is currently used as pasture land, with ground cover of grasses, low shrubs and weeds. The site has a moderate slope from east to west, ranging from 5 to 20 percent. The elevations on the site range from 1860 to 1750 feet mean sea level (msl).

The soil classification of the site is primarily from the Keahua Series. The specific soil types include Keahua cobbly silty clay (KnhC), Keahua silty clay loam (KnB) and Keahua cobbly silty clay loam (KnaD), as described by the Soil Survey of the Islands of Kauai, Oahu, Molokai, Maui and Lanai. Runoff is slow to medium and the erosion hazard is slight to moderate.

C. <u>Roadways</u>

There are no improved roads on the project site; remnants of pineapple field roads traverse the site.

Kula Highway, a State-owned, two-lane arterial highway, runs along the eastern boundary of the site.

D. <u>Drainage</u>

Runoff sheet flows across the project site and enters Kaluapulani/Haakakai Gulch. There are no underground drainage systems on the site.

Offsite runoff flows through Kaluapulani Gulch and its tributary from mauka lands. The Kaluapulani Gulch crossing at Kula Highway consists of 2 - 10 foot diameter corrugated metal pipe culverts. The tributary crossing at Kula Highway consists of 2 - 5 foot diameter corrugated metal pipe culverts. Flow is contained within the gulch walls.

E. <u>Wastewater</u>

The site is currently unoccupied and generates no wastewater flow. There is an offsite gravity system within the Pukalani Terrace, Unit II Subdivision, located west of the project site, that conveys wastewater to a privately-owned treatment plant. There are no County wastewater treatment or transmission facilities in the vicinity.

The treated effluent is currently used for irrigation of the Pukalani Golf Course.

F. Water

1. Source

The Makawao-Haiku Water System is supplied by surface water runoff collected on the eastern slopes of Haleakala. The water is collected and conveyed by the Wailoa Ditch and Tunnel System, which is owned, operated and maintained by the East Maui Irrigation Company (EMI), a subsidiary of A & B Hawaii, Inc. The Wailoa Ditch has a capacity of approximately 190 million gallons per day (mgd). The Department of Water Supply (DWS), County of Maui, has an agreement with EMI to draw up to 12 mgd of water to service the area.

2. Treatment

The water from Wailoa Ditch is treated at the Kamole Weir Water Treatment Plant, operated by DWS. The plant is capable of treating up to 8 mgd in compliance with the EPA Safe Drinking Water Standards. The plant is located east of the town of Haliimaile, near the intersection of Baldwin Avenue and Haliimaile Road. Refer to Exhibit 3.

3. Storage and Transmission

Treated water is stored in a 300,000 gallon concrete reservoir with a floor elevation of 1114 feet msl, then pumped via high lift pumps to Makawao through a 24-inch force main along Baldwin Avenue and

Olinda Road. Storage is provided by the 0.3 and 2.0 mg Pookela Reservoirs at elevations 1808 ft. and 1830 ft. msl, respectively. The water is then pumped via an 18-inch force main to the 0.5 mg Maluhia Tank at 2051 ft. msl.

There is a 12-inch main running along Olinda Road, Hanamu Road and Haleakala Highway from the Maluhia Tank to the new King Kekaulike High School. There are no water mains within the Kula Highway right-of-way fronting the project site.

There is a 0.85 mg reservoir on the lower portion of the Kulamalu Subdivision, with a floor elevation of 1416 ft. msl. This reservoir is filled with treated water from the Kamole Plant. There is a 12-inch main that runs through the subdivision along the boundary adjacent to Kalialinui Gulch, from the 0.85 mg reservoir to Liholani Street, where it branches off into the Pukalani Terrace Subdivision, Unit II. Refer to Exhibit 4.

G. <u>Flood Zone</u>

The project site is in Zone "C", an area of minimal flooding, as designated by the Flood Insurance Rate Map (FEMA; community panel number 150003 0260B).

IV. GRADING AND DRAINAGE PLAN

A. <u>Grading</u>

Grading for the proposed improvements will involve excavation and embankment for the construction of building pads, parking areas and roadways. Erosion control measures and best management practices will be implemented during the construction period to minimize soil loss and erosion hazards. A detailed grading and erosion control plan will be prepared and submitted to the County of Maui, Department of Public Works for approval. An application for a National Pollutant Discharge Elimination System (NPDES) permit will be submitted to the State Department of Health for review and approval.

B. Drainage Plan

Onsite runoff will be collected by underground drainage systems and will be conveyed to Kaluapulani/Haakakai Gulch. Detention facilities will be incorporated within the drainage system to release stormwater into Kaluapulani/Haakakai Gulch at predevelopment rates. Offsite runoff will be allowed to flow through Kaluapulani/Haakakai Gulch unimpeded.

All drainage improvements will be designed in accordance with County Standards. A detailed drainage report will be submitted to the County of Maui, Department of Public Works for review and approval.

C. Hydrology

The onsite drainage system will be sized by using a 50-year recurrence interval based on a one-hour storm. The rate of runoff will be determined by using the Rational Method, as described in the "Rules for the Design of Storm Drainage Facilities in the County of Maui" (11/12/95). See Appendix A for hydrological calculations.

V. UTILITIES

A. Water

1. Source Improvements

The Kulamalu project, by agreement with DWS, will install a well at Huluhulunui Gulch near Kaupakulua. The well improvements will include the drilling of the well, installation of the well pump, reservoir and associated water lines to connect to the existing system. Refer to Exhibits 6, 7 and 8.

2. Storage Improvements

An offsite storage reservoir of approximately 1,000,000 gallons is proposed on Maui Land & Pineapple Company land at elevation 1975 ft. msl above King Kekaulike High School. This storage is sized for use by Maui Land & Pineapple Company, The Malama Group, King Kekaulike High School and the service area between the 1860 ft. to 1600 ft. elevations (Area 1) of the Kulamalu project. Area 1 of the Kulamalu project includes the Upper Section Rezoning portion of the subdivision. The reservoir size is based on the requirements set forth by the "Water System Standards, Volume I, 1985, Department of Water Supply". The Department of Water Supply has the option of increasing the reservoir size and to participate in the funding for the upsize costs. Refer to Exhibits 4 & 5.

Improvements not within the rezoning area include an onsite storage reservoir of approximately 350,000 gallons, proposed at elevation 1690 ft. msl on the project site to service area 1690 ft. to 1320 ft. (Area 2). This reservoir is also sized by maximum daily demand plus fire flow. The existing 850,000 gallon reservoir at elevation 1416 ft. msl will service the area below 1320 ft. msl (Area 3). Refer to Exhibit 9.

3. Offsite Water Transmission

The offsite storage reservoir at elevation 1975 ft. msl will be fed via a 12-inch inflow main connecting to the existing 12-inch Kekaulike High School main at Haleakala Highway. The outflow main will be a 12-inch main installed along Haleakala Highway to Five Trees, then up along Kula Highway to the project site (see Exhibits 4 & 5).

4. Onsite Water Transmission

The onsite mains along the backbone road within the project between reservoirs will be sized at 12 inch (see Exhibit 9).

B. Wastewater

Wastewater from the project site will gravity flow through the subdivision and enter the existing gravity system within the Pukalani Terrace, Unit II Subdivision, located to the west of the project site. The wastewater will then be conveyed to the privately owned and operated treatment plant.

The private wastewater treatment plant will be able to accommodate the project's flow. Refer to Appendix C for calculations. The treated effluent will continue to be used for irrigation by the Pukalani Golf Course.

VI. ROAD IMPROVEMENTS

Access to the project site will be from a divided four-lane parkway, with a raised median for landscaping and turning lanes. The right-of-way for the parkway will be 160 feet. The parkway will connect to Kula Highway and create a T-intersection. Appropriate lengths of left turn and deceleration lanes on Kula Highway will be constructed, and conduits for future traffic signals will be installed.

All improvements will be designed in accordance with State and County Standards. A traffic impact analysis report has been prepared for the project.

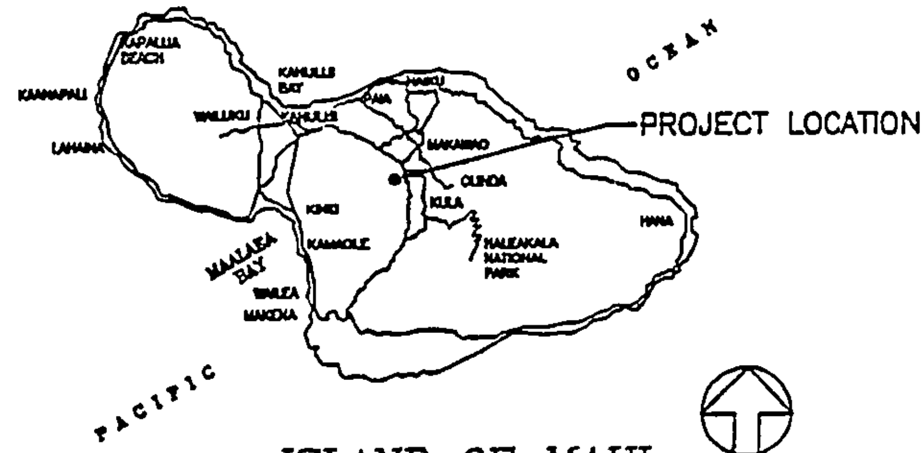
VII. CONCLUSION

The proposed improvements for the project will be designed to produce no adverse effects to existing facilities or to the surrounding environment. All improvements will be designed in accordance with the applicable regulatory agencies.

ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS · SURVEYORS

EXHIBITS

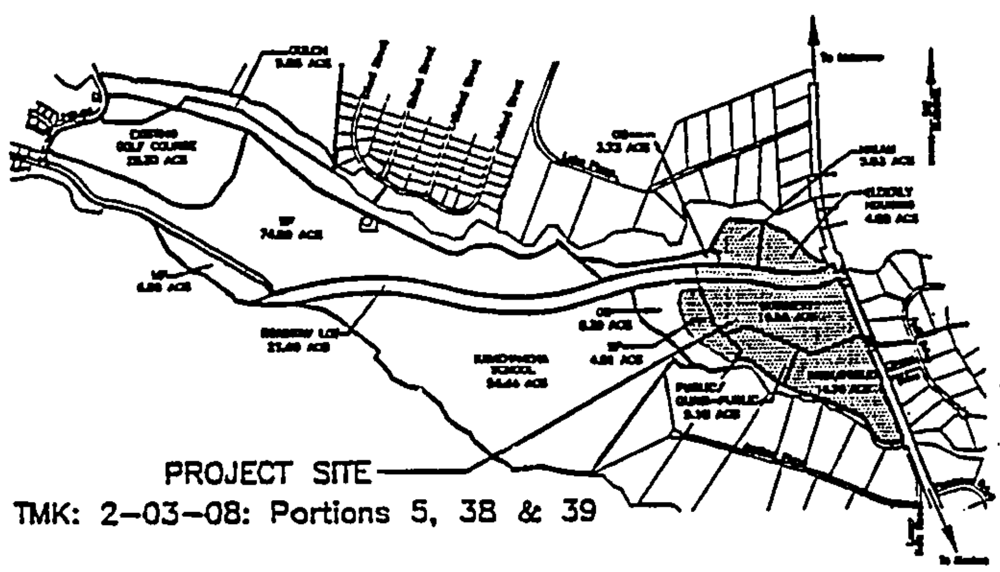
PROJECT LOCATION MAP



ISLAND OF MAUI

5 0 5 10 15
SCALE IN MILES

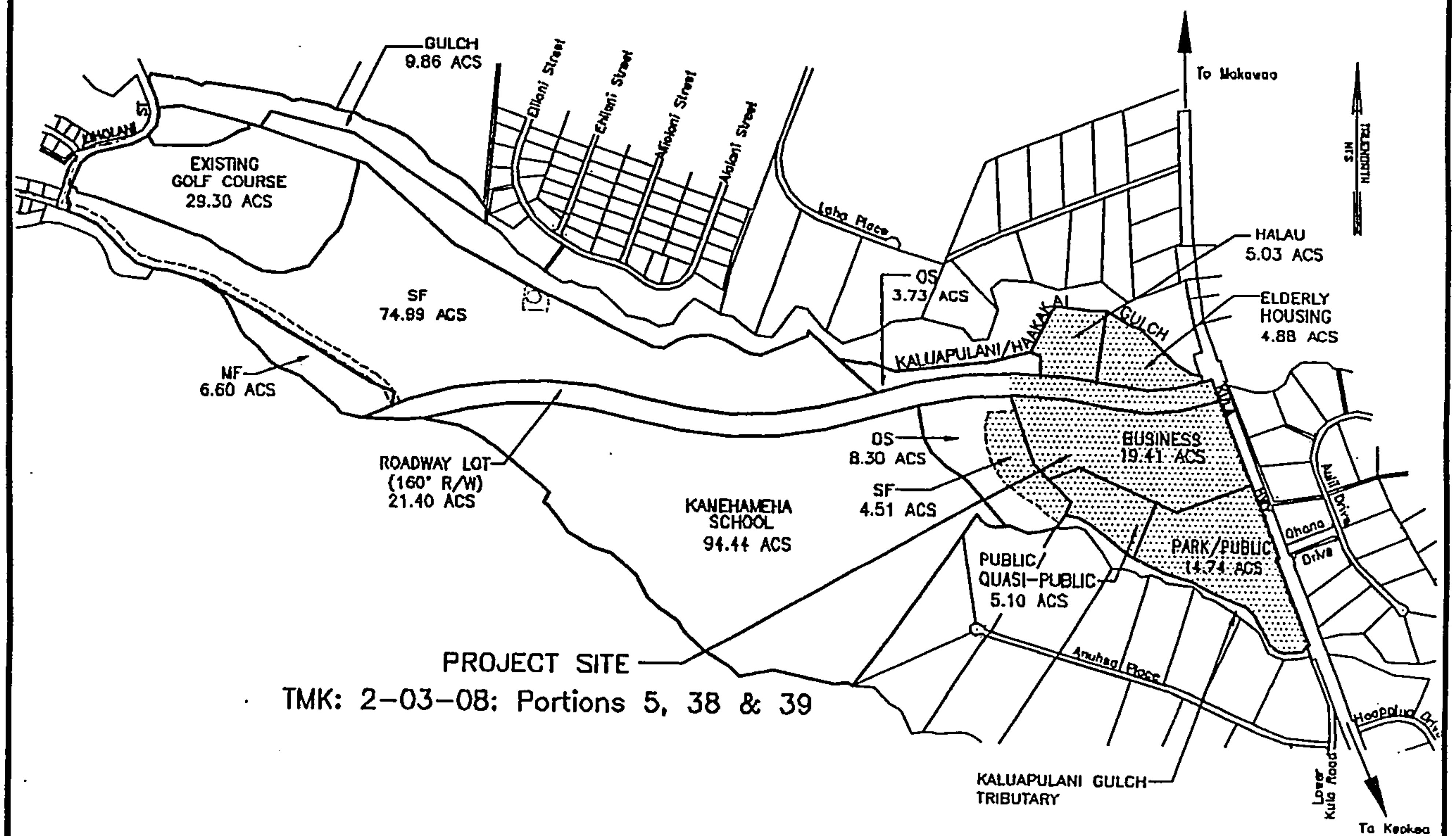
VICINITY MAP



KULAMALU KULA, MAUI, HAWAII	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS • SURVEYORS HONOLULU, HILO, WAILUKU, HAWAII LOCATION AND VICINITY MAP	EXHIBIT 1

955555LDWG\KYT\RRF

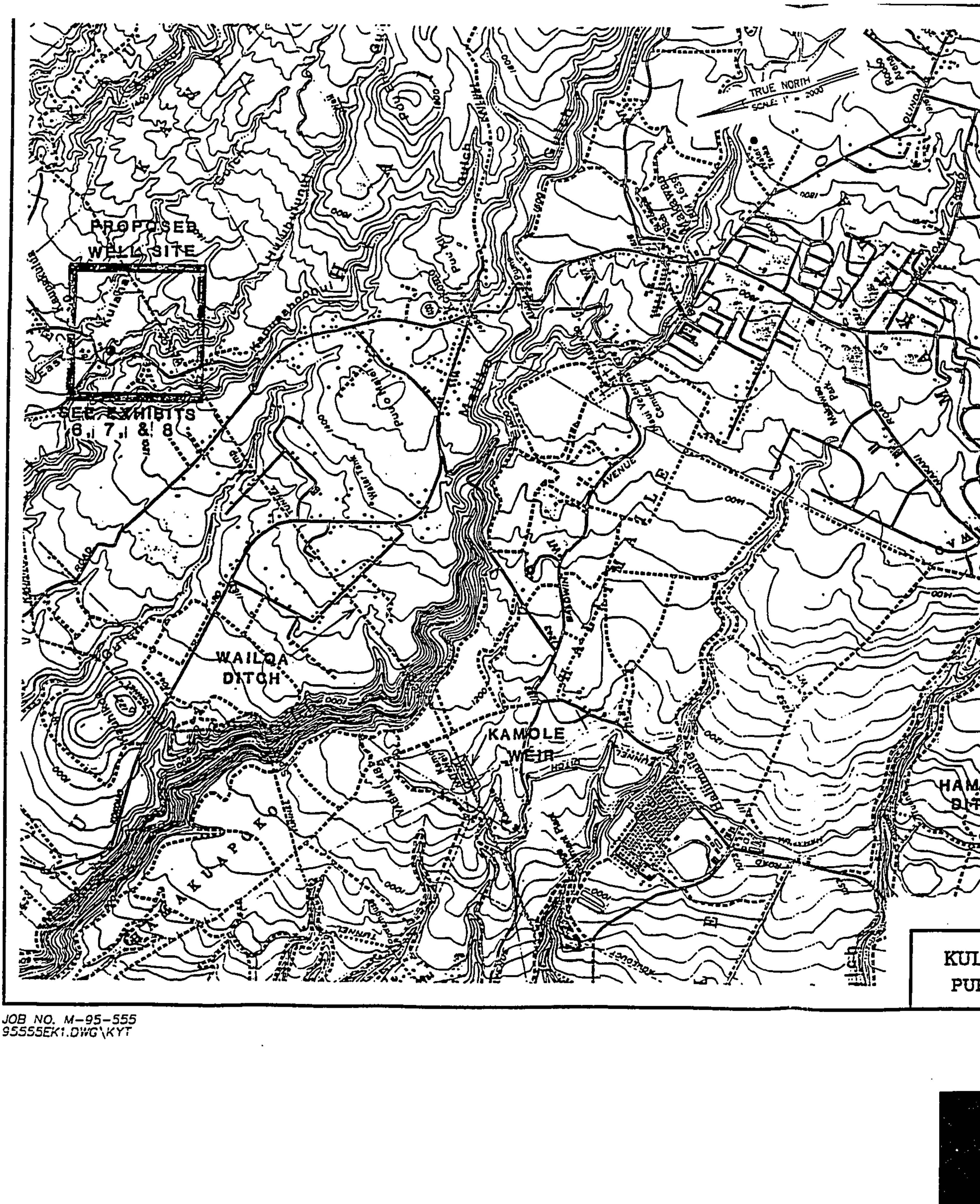
MARCH 22, [illegible]
Rev. Feb. [illegible]



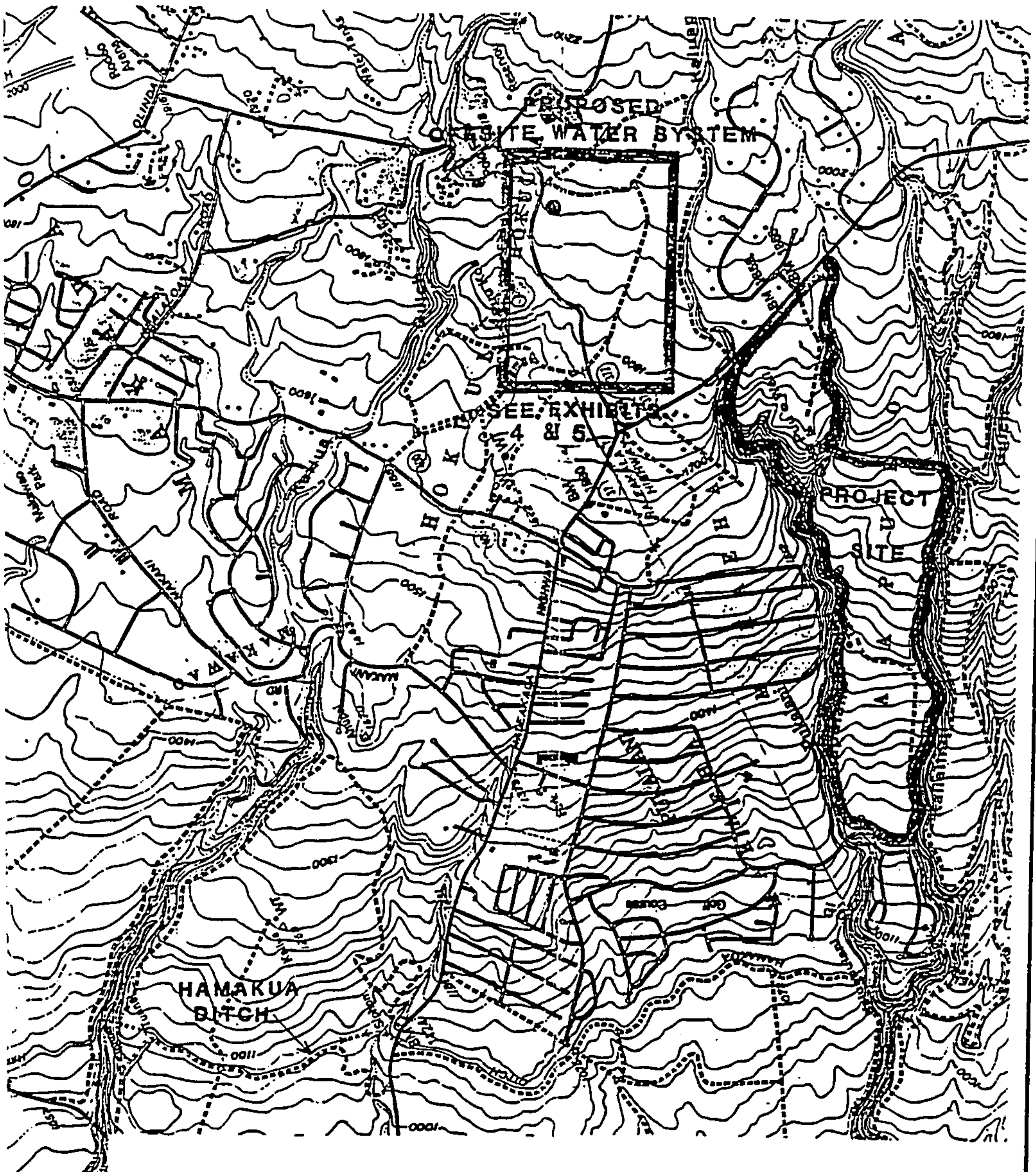
KULAMALU KULA, MAUI, HAWAII	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS • SURVEYORS HONOLULU, HILO, WAILUKU, HAWAII MASTER PLAN	EXHIBIT 2

95555E2 DWG\KYT\RRF

REV FEB 20, 1997



JOB NO. M-95-555
95555EK1.DWG\KYT



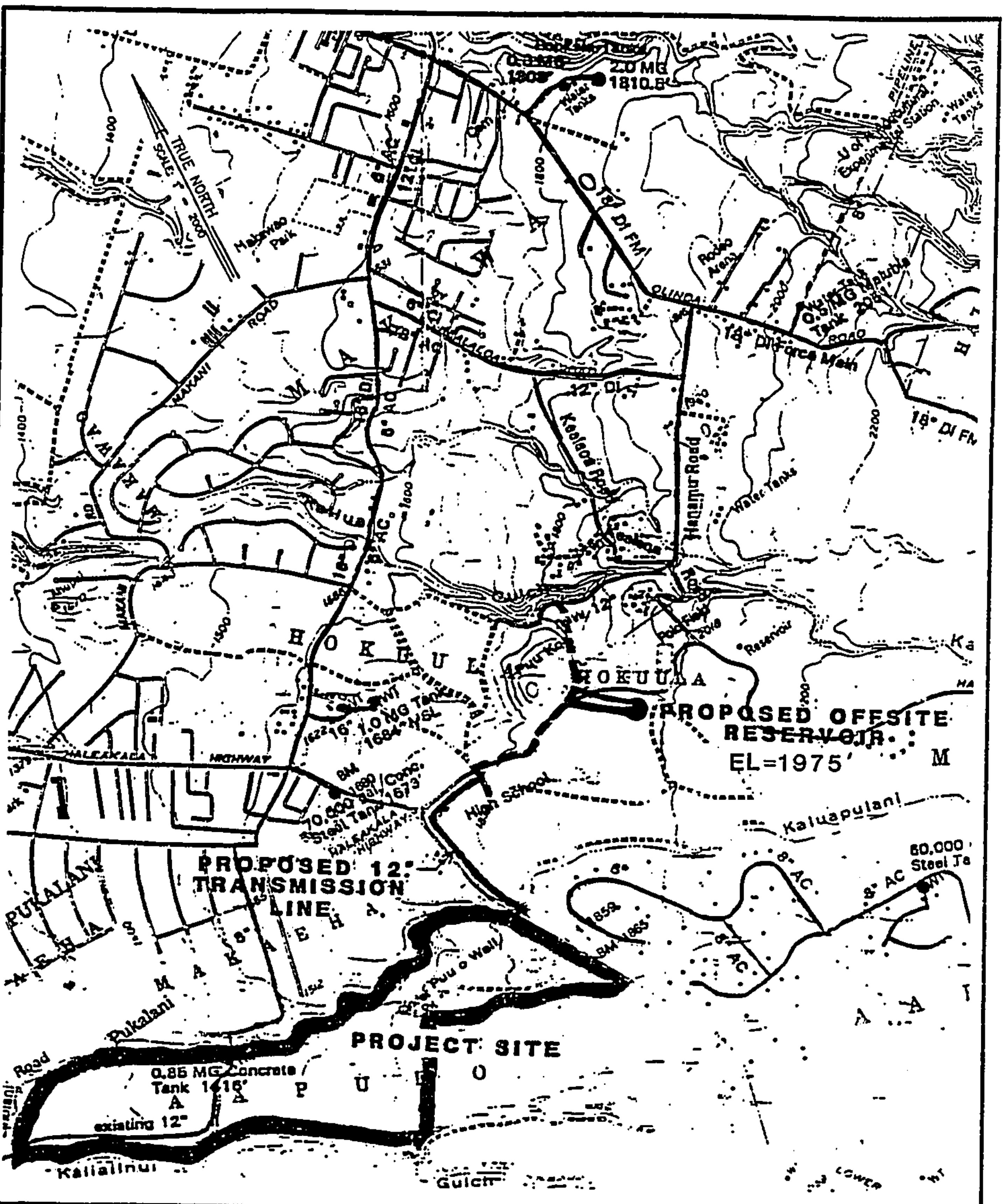
KULAMALU SUBDIVISION
PUKALANI, MAUI, HAWAII

ATA

OVERALL
PROJECT LOCATION MAP

EXHIBIT
3

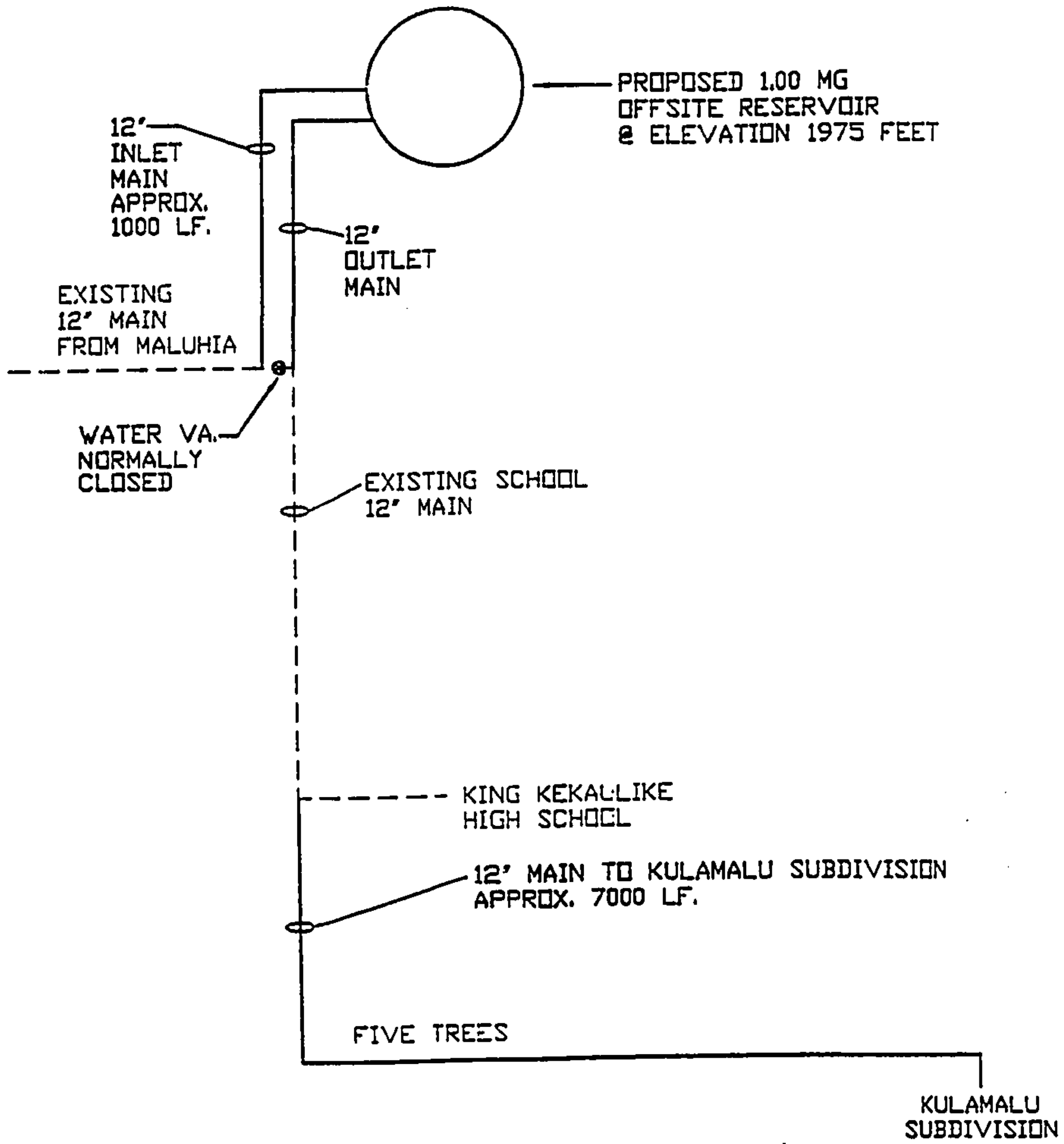
MARCH 22, 1996



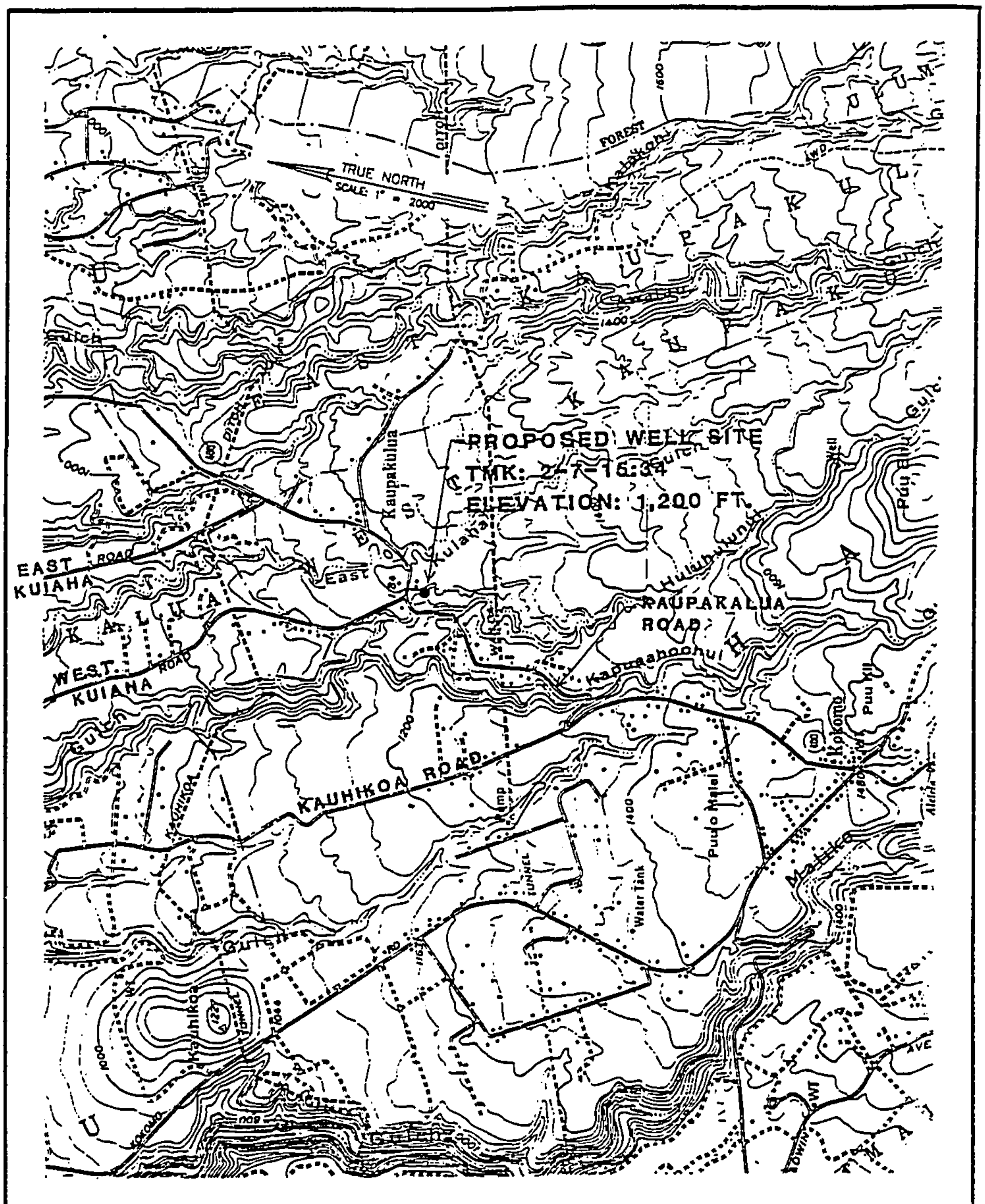
KULAMALU SUBDIVISION PUKALANI, MAUI, HAWAII	PROPOSED OFFSITE WATER SYSTEM PLAN	EXHIBIT 4

95555EK2.DWG\KYT

MARCH 22, 1996
APRIL 1997



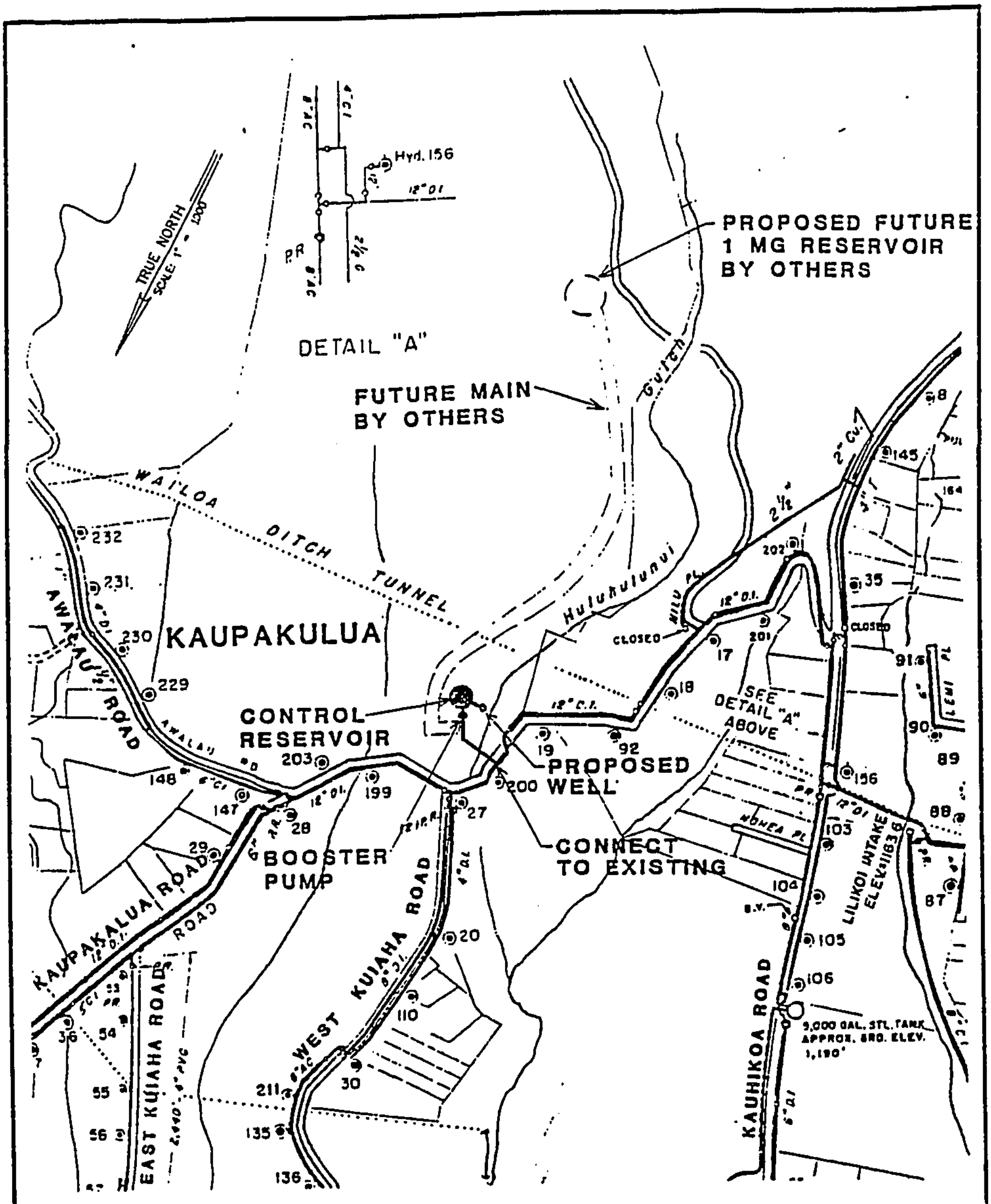
KULAMALU SUBDIVISION PUKALANI, MAUI, HAWAII	SCHEMATIC OFFSITE WATER SYSTEM	EXHIBIT 5



HULUHULUNUI GULCH TMK: 2-7-15:34 KAUPAKULUA, MAUI, HAWAII	AUSTIN, TSUTSUMI & ASSOCIATES, INC. ENGINEERS • SURVEYORS PROPOSED WELL SITE LOCATION MAP	EXHIBIT 6

95555EX5.DWG\KYT

MARCH 22, 1996



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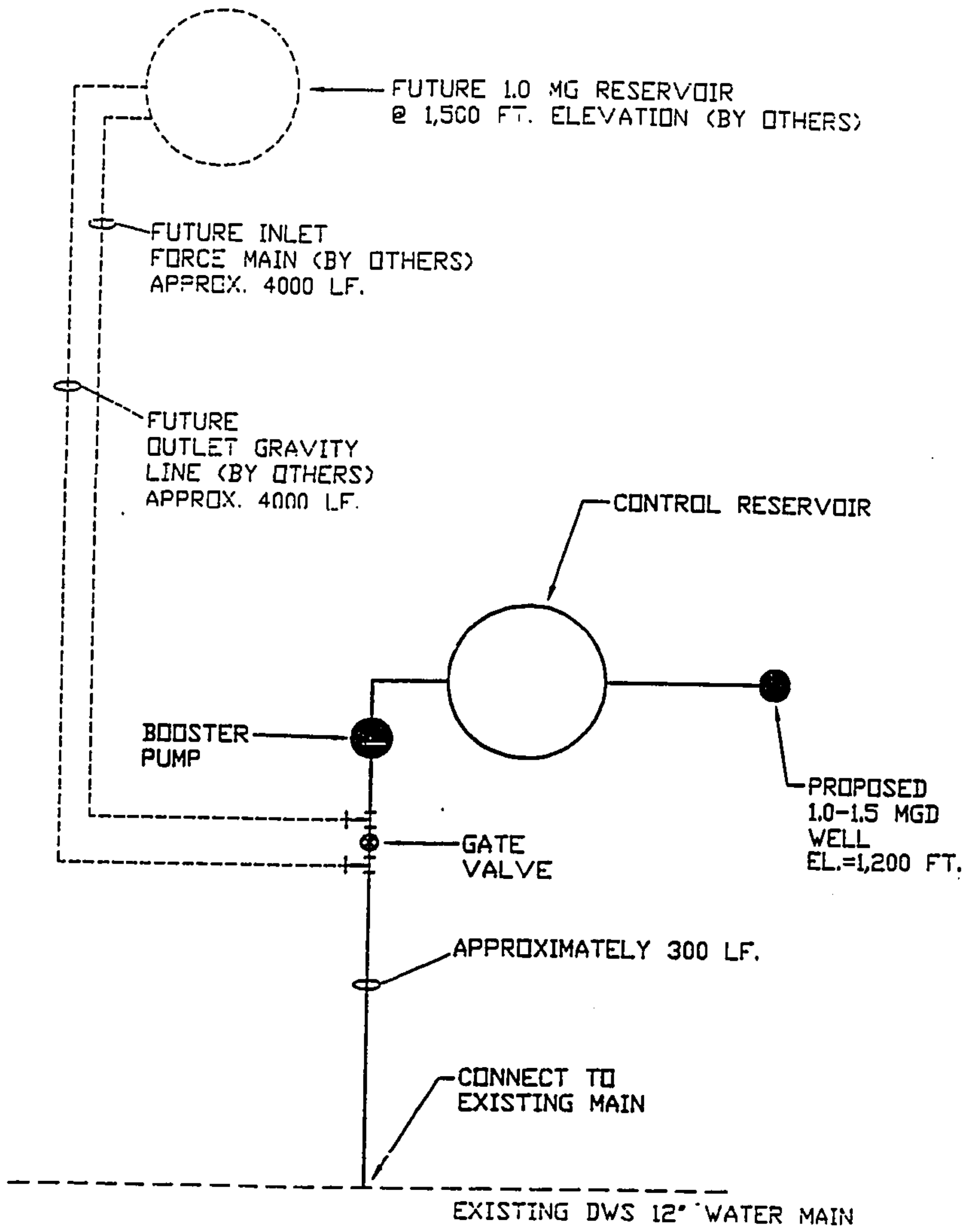
PSESEEX6.DWG\KYT

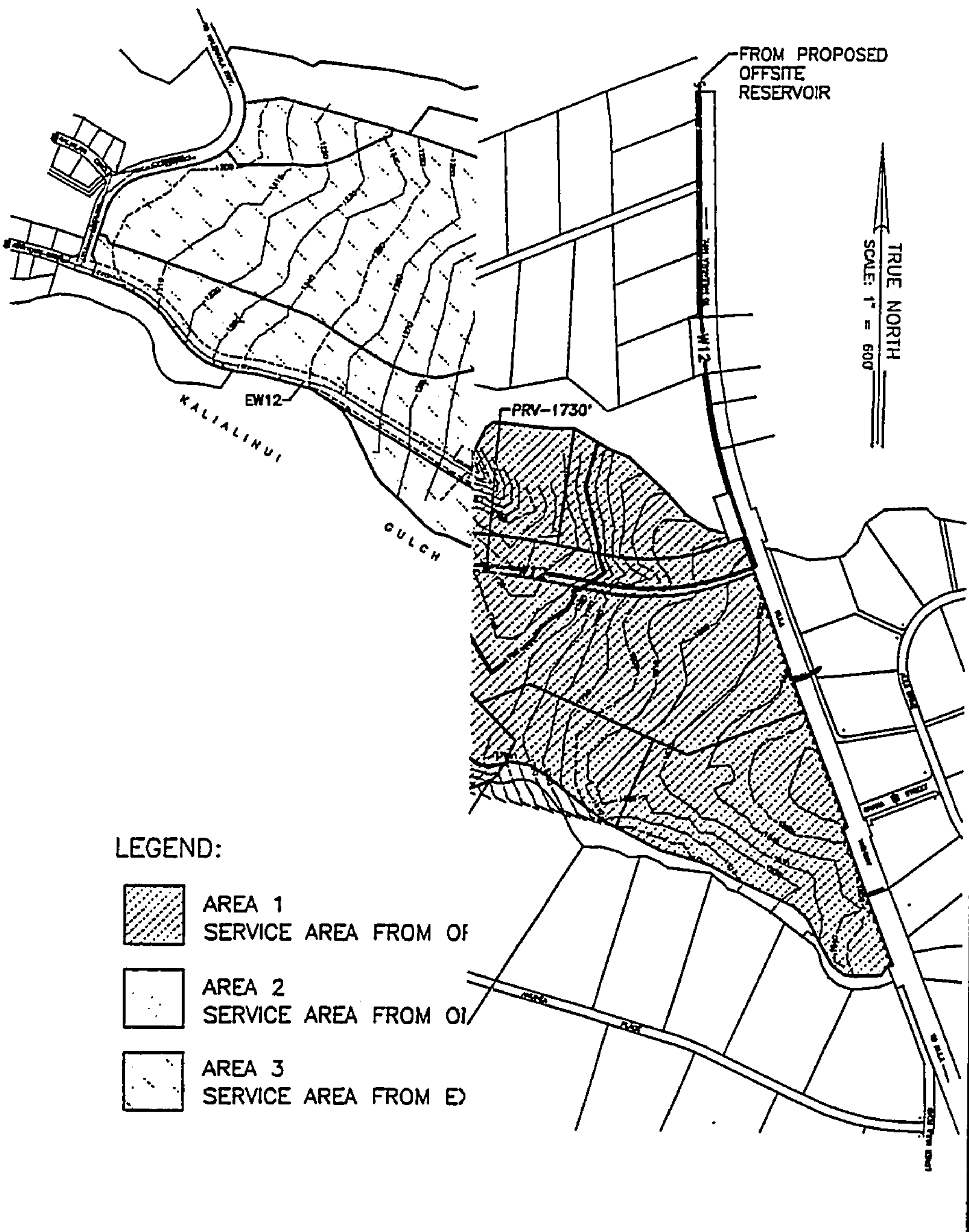
MARCH 22, 1996



HULUHULUNUI GULCH TMK: 2-7-15:34 KAUPAKULUA, MAUI, HAWAII	SCHEMATIC WELL SITE SYSTEM	EXHIBIT 8

95555EK7.DWG\KYT

MARCH 22, 1995



ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.

PROPOSED
ONSITE WATER SYSTEM

EXHIBIT
9

JOB NO. M-95-555
95555E9.DWG\KYT\RRF

MARCH 22, 1996
Rev. Feb. 20, 1997

APPENDICES

ATA AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

APPENDIX A

PRELIMINARY HYDROLOGICAL CALCULATIONS

KALUAPULANI GULCH (ABOVE KULA HIGHWAY)

DRAINAGE AREA = 1100 ACRES

100 YR-24 HR POINT RAINFALL = 11 INCHES

HYDROLOGIC SOIL GROUP = B (HALIIMAILE, PANE)

CURVE NUMBER (TABLE 25)

AG. LOT (SAY 100 ac.) = 68

PASTURE LAND (SAY 1000 ac.) = 61

WEIGHTED CURVE NUMBER = $\frac{68(100)+61(1000)}{1100} \cong 62$ ⟵

AVE. SLOPE IN FLOWLINE = $\frac{4800'-1800'}{26{,}000'} \cong 11.5\%$

RUNOFF DEPTH (TABLE 24)

RAINFALL = 11 IN

CURVE NO. = 62

RUNOFF DEPTH = 6.01 IN ⟸

PEAK DISCHARGE RATE (CHART 3 OF 3 AND TABLE 28)

DRAINAGE AREA = 1100 ac.

CURVE NO. = 62

PEAK DISCHARGE (10% SLOPE) = 210 CFS/IN. OF RUNOFF

" (11.5% SLOPE) = 210 (0.88) ≅ 185 CFS/IN. OF RUNOFF ⟸

PEAK DISCHARGE

$Q = (6.01)(185) \cong \boxed{1110 \text{ CFS}}$

REFERENCE: "EROSION AND SEDIMENT CONTROL - GUIDE FOR HAWAII", USDA/NATURAL RESOURCES CONSERVATION SERVICE, MARCH 1981.

PROJECT: KULAMALU - HYDROLOGY - KALUAPULANI GULCH FLOW AT KULA HWY CULVERT	JOB NO. 95-555	BY PKM DATE 7/9/96
		CHKD. DATE
		SHT. NO. OF

AUSTIN, TSUTSUMI & ASSOCIATES, INC. CIVIL ENGINEERS • SURVEYORS

HONOLULU, HAWAII • HILO, HAWAII WAILUKU, MAUI, HAWAII

UNNAMED GULCH (TRIBUTARY OF KALUAPULANI GULCH)

DRAINAGE AREA = 200 ACRES

100 YR - 24 HR POINT RAINFALL = 11 INCHES

HYDROLOGIC SOIL GROUP = B (HALIIMAILE, PANE)

CURVE NUMBER (TABLE 25)

AG. LOT (SAY 100 ac.) = 68

PASTURE LAND (SAY 100 ac.) = 61

$$\text{WEIGHTED CURVE NUMBER} = \frac{68(100) + 61(100)}{200} \cong 65 \Longleftarrow$$

$$\text{AVERAGE SLOPE IN FLOW LINE} = \frac{2600' - 1850'}{7000'} \cong 11\%$$

RUNOFF DEPTH (TABLE 24)

RAINFALL = 11 IN

CURVE NO. = 65

RUNOFF DEPTH = 6.44 IN ⟸

PEAK DISCHARGE RATE (CHART 3 OF 3 AND TABLE 28)

DRAINAGE AREA = 200 ac.

CURVE NO. = 62

PEAK DISCHARGE (10% SLOPE) = 66 CFS/IN. OF RUNOFF

" (11% SLOPE) = 66 (0.89) ≅ 59 CFS/IN. OF RUNOFF ⟸

PEAK DISCHARGE

$$Q = (6.44)(59) \cong \boxed{380 \text{ cfs}}$$

REFERENCE: "EROSION AND SEDIMENT CONTROL - GUIDE FOR HAWAII", USDA/NATURAL RESOURCES CONSERVATION SERVICE, MARCH 1981

ATA	PROJECT: KULAMALU	JOB NO.	BY PKM DATE 7/9/96
	HYDROLOGY - TRIBUTARY GULCH	95-555	CHKD. DATE
	FLOW AT KULA HWY CULVERT		SHT. NO. OF

AUSTIN, TSUTSUMI & ASSOCIATES, INC. CIVIL ENGINEERS • SURVEYORS HONOLULU, HAWAII • HILO, HAWAII WAILUKU, MAUI, HAWAII

HYDROLOGY COMPUTATION

Drainage Area	Area, A. (Acre)	Runoff Coefficient, C	Rainfall Intensity, I. (In./Hr.)	Length of Reach, L. (Ft.)	Slope, S, (Ft./Ft.)	Time of Concentration, T_c, (Min.)	Correction Factor	Runoff Discharge Q = CIA, (CFS)	Accumulated Q, (CFS)	Remarks
Business	19.41	0.4	2.8	1500	0.08	22	1.7	37		Pre-Development Condition
Aalau	5.03			500	0.17	9	2.3	13		
Elderly Housing	4.88			600	0.12	18	1.8	10		
Public/Quasi-P	5.10			500	0.14	15	2.0	11		
Park	14.74			700	0.10	20	1.7	28		
Single Family	4.51			250	0.09	13	2.1	11		
Business	19.41	0.7	2.8	—	—	15	2.0	76		Post-Development Condition
Aalau	5.03	0.6		—	—	15	2.0	17		
Elderly Housing	4.88	0.7		—	—	15	2.0	19		
Public/Quasi-P	5.10	0.6		—	—	15	2.0	17		
Park	14.74	0.5		—	—	20	1.7	35		
Single Family	4.51	0.6		—	—	11	2.2	17		

Reference:

PROJECT: Kulamalu - Upper Section Rezoning
Preliminary Hydrology Calculations

JOB NO. 95-[illegible].4

BY AW DATE 3/19/97
CHKD. ____ DATE ____
SHT. NO. 1 OF 1

AUSTIN, TSUTSUMI & ASSOCIATES, INC. CIVIL ENGINEERS • SURVEYORS
1871 WILI PA LOOP SUITE [illegible]
WAILUKU, MAUI, HAWAII [illegible]

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

APPENDIX B

PRELIMINARY WATER DEMAND CALCULATIONS

LAND USE	AREA (AC.)	UNITS	PER UNIT WATER USE	AVE. DAILY DEMAND
BUSINESS	19.41	178,000 SF + 15 AC	140 gal/1000 SF + 1700 gal/AC	50,420 GPD
HALAU	5.03	–	1700 gal/AC	8,600
ELDERLY HOUSING	4.88	50 UNITS	560 gal/UNIT	28,000
PUBLIC/QUASI-PUBLIC	5.10	–	1700 gal/AC	8,700
PARK/PUBLIC	14.74	–	1700 gal/AC	25,100
SINGLE FAMILY	4.51	3 UNITS	600 gal/UNIT	1,800
TOTAL	53.67 AC.			122,620 GPD

REFERENCE: "WATER SYSTEM STANDARDS, VOLUME I 1985", DEPARTMENT OF WATER SUPPLY, COUNTY OF MAUI

PROJECT: KULAMALU - UPPER SECTION REZONING
PRELIMINARY WATER DEMAND CALCULATIONS

JOB NO. 95-555.4

BY AW DATE 3/29/97
CHKD. DATE
SHT. NO. 1 OF 1

AUSTIN, TSUTSUMI & ASSOCIATES, INC. CIVIL ENGINEERS • SURVEYORS
HONOLULU, HAWAII • HILO, HAWAII
WAILUKU, MAUI, HAWAII

AUSTIN, TSUTSUMI & ASSOCIATES, INC.
CIVIL ENGINEERS • SURVEYORS

APPENDIX C

PRELIMINARY WASTEWATER CALCULATIONS

LAND USE	AREA (AC.)	DENSITY (CAPITA PER ACRE)	POPULATION	WASTEWATER GENERATION (gpcd)	(gpd) Q_{AVE}
BUSINESS	19.41	140	2717	80	217,360
HALAU	5.03	—	SAY 1000	5	5,000
ELDERLY HOUSING	4.88	390	1903	80	152,240
PUBLIC/QUASI-PUBLIC	5.10	—	—	2000 gpd/ac	10,200
PARK/PUBLIC	14.74	—	SAY 500	5	2,500
SINGLE FAMILY	4.51 (3 UNITS)	—	12	80	960
TOTAL AREA	53.67			TOTAL AVE. FLOW	388,260

REFERENCE: "DESIGN STANDARDS OF THE DEPARTMENT OF WASTEWATER MANAGEMENT - VOL I"
CITY AND COUNTY OF HONOLULU, JULY 1993

PROJECT: KULAMALU – UPPER SECTION REZONING
PRELIMINARY WASTEWATER CALCULATIONS

JOB NO. 95-555.4

BY AN DATE 3/24/97
CHKD. DATE
SHT. NO. 1 OF 1

AUSTIN, TSUTSUMI & ASSOCIATES, INC. CIVIL ENGINEERS • SURVEYORS
HONOLULU, HAWAII • HILO, HAWAII
WAILUKU, MAUI, HAWAII