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OFC. OF ENVIRONMENTAL
QUALITY CONTROL

September 27, 1990

Mr. Joseph K. Conant
Executive Director
Department of Budget and Finance
Housing and Finance Development Corporation
Seven Waterfront Plaza, Suite 300
500 Ala Moana Boulevard
Honolulu, Hawaii 96813

Dear Mr. Conant:

I am pleased to accept the final Environmental Impact Statement for the Kealakehe Planned Community as satisfactory fulfillment of the requirement of Chapter 343, Hawaii Revised Statutes. This environmental impact statement will be a useful tool in the process of deciding if the action described therein should be allowed to proceed. My acceptance of the statement is an affirmation of the adequacy of that statement under the applicable laws and does not constitute an endorsement of the proposed action.

When the decision is made regarding the proposed action itself, I expect the proposing agency to consider if the societal benefits justify the environmental impacts which will likely occur. These impacts are adequately described in the statement, and together with the comments made by reviewers, provide a useful analysis of the proposed action.

With kindest regards,

Sincerely,

JOHN WAIHEE

bcc: Hon. John C. Lewin
Dr. Bruce Anderson, OEQC

OCT - 8 1990

KEALAKEHE PLANNED COMMUNITY

Kealakehe, North Kona, Hawaii

FINAL ENVIRONMENTAL IMPACT STATEMENT

PROPOSING AGENCY:
STATE OF HAWAII
HOUSING FINANCE AND DEVELOPMENT CORPORATION

PREPARED BY:
BELT COLLINS AND ASSOCIATES
SEPTEMBER 1990

KEALAKEHE PLANNED COMMUNITY

Kealakehe, North Kona, Hawaii

FINAL

ENVIRONMENTAL IMPACT STATEMENT

This document is prepared pursuant to Chapter 343, Hawaii Revised Statutes.

PROPOSING AGENCY:

STATE OF HAWAII
HOUSING FINANCE AND DEVELOPMENT CORPORATION
7 Waterfront Plaza, Suite 300, 500 Ala Moana Boulevard
Honolulu, Hawaii 96813

PREPARED BY:

BELT COLLINS AND ASSOCIATES

RESPONSIBLE OFFICIAL:

JOSEPH K. CONANT, Executive Director

Sept 20, 1990
Date

State of Hawaii
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
220 So. King Street
Fourth Floor
Honolulu, Hawaii 96813

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

TABLE OF CONTENTS
(Continued)

TABLE OF CONTENTS
(Continued)

TABLE OF CONTENTS
(Continued)

TABLE OF CONTENTS
(Continued)

TABLE OF CONTENTS
(Continued)

TABLE OF CONTENTS
(Continued)

LIST OF FIGURES

LIST OF FIGURES
(Continued)

LIST OF TABLES

CHAPTER I

CHAPTER I
INTRODUCTION AND SUMMARY

1. APPLICANT AND BRIEF PROJECT SUMMARY

The Housing Finance and Development Corporation (HFDC) of the State of Hawaii is filing this environmental impact statement as the future landowner of the Kealakehe property. The majority of the property (approximately 800 acres) is owned by the State of Hawaii Department of Land and Natural Resources (DLNR) with an additional 10 acres owned by the Hawaii Housing Authority. The remaining 150 acres included in the proposed project area are owned by the Queen Liliuokalani Trust and intended to be purchased by the State of Hawaii for development by HFDC.

The HFDC proposes to develop the 960-acre project area as the Kealakehe Planned Community, a residential community containing approximately 4,100 units, 60% of which will be affordable for-sale and rental housing units.

2. PROPOSED GOVERNMENT ACTION

This environmental impact statement is prepared in accordance with Chapter 343, Hawaii Revised Statutes and the rules and regulations of the Office of Environmental Quality Control. It has been determined that the environmental impact statement is required pursuant to Chapter 200 of Title 11, Department of Health, Administrative Rules, Subchapter 5(b). This document is being prepared to accompany a Petition for Boundary Reclassification from Conservation and Agriculture to Urban, as well as a Conservation District Use Application for development in the Conservation District prior to requested boundary reclassification.

3. PURPOSE OF THIS DOCUMENT

The purpose of this document is to identify and assess environmental and social impacts that could result from the development of the Kealakehe Planned Community. Preparation of an Environmental Impact Statement requires a detailed analysis of the subject property and the proposed action and includes the preparation of technical support documents which are included in the appendix to the EIS. This process enables the applicant to identify weaknesses or inconsistencies in the project plan, propose mitigation measures designed to address potentially significant adverse impacts, respond to critical public and private review of the project, and ultimately create a well-planned project that is sensitive to the physical, natural and social environment within which it is proposed.

4. STATEMENT OF OBJECTIVES

The proposed project is intended to implement the Governor's Comprehensive State Housing Plan in West Hawaii. The primary objective of the Kealakehe Planned Community is to provide affordable housing units in the West Hawaii region. It is intended that the master planned residential community be developed in an economical manner. Additional objectives include: the provision of necessary infrastructure and facilities to support the residential units developed; the distribution of units such that 60% of those developed shall be targeted for persons or families meeting the income criteria for affordable housing eligibility; the provision of 40% of the developed units at market prices to generate revenue to reduce development costs of the affordable units; and, the leasing of commercial land to be developed in support of the residential uses for the purpose of deriving additional income to support the provision of affordable housing.

5. PROJECT DESCRIPTION

5.1 Project Setting

The state-owned lands of Kealakehe are located in North Kona, Hawaii approximately two miles north of Kailua-Kona and five miles south of Keahole Airport. The proposed project is situated on the western slope of Hualalai mountain on a portion of the Kealakehe property extending mauka from Queen Kaahumanu Highway to the existing Kealakehe community.

Kailua-Kona is the regional center of the western side of the Island of Hawaii. Historic Kailua Village serves as the town center and primary visitor attraction. The village is surrounded by a mix of resort, commercial, light industrial, and residential uses. In July, 1987, North Kona had a population of 20,500, compared to a population of 13,748 in 1980. Resort growth proposed in coastal areas of South Kohala and North Kona is expected to result in a significant expansion of Kailua-Kona's population over the next twenty or more years creating an increasing demand for new homes, both affordable and market-priced, as well as expanded residential-oriented public services and facilities.

5.2 Planned Community Development

The Kealakehe Planned Community is proposed as a mixed-use master planned community which will include housing, recreational uses, schools, public facilities, commercial areas, and a public golf course to be developed by the County of Hawaii. The project site is divided into fourteen villages ranging from 23 to 72 acres with an average size of 42 acres. Each village is intended to be developed as a single entity with a unifying urban design theme to be proposed and

implemented by the village's developer. While detailed design elements will be left to each village developer, the HFDC will establish overall design standards which will be included in the master plan and will be applicable to all fourteen villages. These will include guidelines to preserve viewplanes within and among villages, criteria for the sizing of infrastructure and its linkage among villages, roadway design standards to minimize through traffic on local streets, landscape requirements, and standards for the allocation and distribution of residential unit types and sales prices within the separate villages.

The master plan proposes the development of approximately 589 acres of the project site for residential land uses, with a total of 4,158 units. Each village will feature a mix of residential units equal to 60% affordable and 40% market priced. Affordable units are targeted for the elderly, special need group, assisted (very low income and lower income), and gap-group (moderate income) families and persons. Market units are targeted for families and persons of above moderate income and those earning incomes greater than 140% of the area's median income.

5.3 Proposed Infrastructure

Water: Based on the overall project demand at full buildout, a total production of 3,298 gallons per minute (gpm) will be required from wells serving the project. These wells are proposed to be located above the 1,600-foot elevation at sites yet to be determined. At full development, a total storage of about 5 million gallons (MG) will be required for the project. Storage will consist of three reservoirs. The system will also include all the necessary transmission lines to residential and non-residential land uses as well as complete fire-protection hydrant system.

Wastewater: The entire project will be linked to the Kealakehe Sewage Treatment Plant, now under construction on the makai Kealakehe parcel. The project will generate approximately 1.86 mgd of wastewater. Treated effluent from the STP will be used to irrigate the proposed Kealakehe public golf course.

Drainage: Drainage for the entire project will be handled by drywells of approximately 5 feet in diameter with a depth of 20 feet. Drywells will be situated within road right-of-ways wherever possible.

Power and Communications: The proposed development at build out will generate a demand for approximately 10.76 megawatts. This will result in the need for the development of two new 10 MVA/12 KV substation transformers and a new region-serving 69 KV transmission line. Major transmission lines will be located along primary arterial roadways.

Traffic Circulation: The project area will be intersected by two proposed region serving arterial roadways. The first will extend from Mamalahoa Highway downslope across private lands owned by Palani Ranch, through the Kealakehe property, and intersect with Queen Kaahumanu Highway. This roadway is referred to as the Kealakehe Parkway and is intended to be developed as a four to six lane arterial roadway within a 120-foot right-of-way. The roadway's intersection with Queen Kaahumanu Highway will initially require the development of channeling lanes. As traffic levels increase, the intersection will be converted to a grade separated interchange.

The second arterial roadway proposed for development bisects the project site, extending north to south, generally along the 300 foot elevation. It has been proposed by the County of Hawaii to serve as a major arterial with a 120-foot right-of-way paralleling Queen Kaahumanu Highway and extending from Palani Road to the northern end of the North Kona District. It is generally referred to as the Mid-Level roadway. Development of the Mid-Level roadway within the subject property will be timed with the phasing of residential development and related public facilities.

6. SUMMARY OF IMPACTS

Impacts to the environment are expected as a result of the development of the proposed project. Adverse impacts will be mitigated where possible and offset by benefits resulting from the project.

6.1 Short-Term Construction Period Impacts

- Increases in noise and air-borne particulate matter (fugitive dust).
- Increased construction vehicle traffic.
- Potential increase in storm run-off and potential erosion of imported top soil during revegetation period.

6.2 Long-Term Impacts

- Permanent changes to the topography of the area due to grading and site improvements.
- Loss of grazing land.
- Increases in storm run-off.
- Loss of open space character of the property.
- Loss of existing flora and introduction of exotic flora species.

- Loss of some archaeological sites.
- Increase in resident population.
- Increase in vehicular traffic.
- Introduction of pollutants associated with urbanization.
- Increase in demand for public utilities, including water service, wastewater treatment, solid waste disposal, storm water drainage, and electrical energy.
- Increase in demand for public facilities and services, including recreational opportunities, public education, public health care services, and protective services.

7. SUMMARY OF PROPOSED MITIGATION MEASURES

A variety of actions are proposed to mitigate adverse environmental and social impacts. With regard to short-term constuction impacts, the use of properly muffled construction equipment should be required on the job site. State Department of Health's construction noise limits and curfew times can be enforced during project construction to reduce noise and vehicular traffic impacts. Fugitive dust can be controlled by watering active work areas, covering open bodied trucks and utilizing windscreens at construction sites. Impacts of soil runoff during the construction and pre-landscaping phases would be mitigated through careful design of residential areas, management controls established during construction, and a comprehensive landscaping program to be implemented with each phase of development.

Long-term impacts will be mitigated through the comprehensive master planning of the project and careful attention to environmentally sensitive areas and social concerns. Major mitigation measures include:

- Conformance to all appropriate regulatory guidelines and procedures.
- Preservation of significant archaeological sites and the designation of a 27-acre archaeological preserve.
- Preservation of endangered plant species, including the establishment of a 5-acre plant preserve and the funding of a long-term mitigation program.
- Design and construction of infrastructure sized to accommodate the entire project, including potable water sources and transmission lines, wastewater transmission lines, storm drainage system, all in full compliance with County Department of Public Works and State Department of Health standards.
- Implementation of a new regional roadway system including providing a 300-foot setback for Queen Kaahumanu Highway, construction of a new mauka-makai arterial

roadway and grade-separated interchange, signalization of access road intersection at Palani Road, and construction of a portion of the County's proposed Mid-Level roadway across the subject property.

- Inclusion of an elementary school site and high school site, public parks, a recreational center, neighborhood-serving commercial areas, a 30-acre Civic Center, and a public golf course in the proposed master planned community.

- Utilization of slow time release or rapid uptake fertilizers to prevent groundwater contamination.

8. SUMMARY OF ALTERNATIVES CONSIDERED

Development of the project at a small scale, that is to say, development of only a portion of the property area was considered in the course of master plan preparation. It was determined that the smaller the project, the less feasible it is to cover necessary off-site infrastructure costs, including potable water development, wastewater treatment, and roadway improvements. Many of these costs might be borne by the State regardless of the size of the project, and be passed on to the prospective owners of the housing units. Reducing the number of units in the development may, therefore, result in increasing the costs to the units and decreasing the affordability to the target group.

An alternative to the proposed project is to leave the land undeveloped (the 'no-action' alternative). While this alternative would maintain open space in an area where significant urban expansion is projected, it is not compatible with the Governor's policy promoting the utilization of State property for the development of affordable housing.

Agricultural development of the property including activities such as crop cultivation may not be economically feasible due to poor soil conditions, topography, and the lack of potable water and access roadways. The cost of developing the infrastructure necessary to support large scale crop cultivation may be prohibitive because the development costs would greatly exceed the income received from cash crops. The continued use of the property for extensive grazing of livestock may be incompatible with existing and proposed uses of neighboring properties due to primarily to odors and insects associated with large herds of cattle.

Limiting the development of the subject property to recreational purposes such as public playing fields and parks may not be economically feasible given the cost of infrastructure needed to service the site, including roadways, sewer and drainage lines, potable water, and electrical lines versus the income derived from recreational activities.

There is no evidence that the subject property would yield quarry material of sufficient quantity or quality to warrant such activity. However, the use of the property for resource extraction is not compatible with the projected uses of the neighboring Queen Liliuokalani Trust property.

The use of the property above Queen Kaahumanu Highway as a possible resort is not considered to be practical from a marketing point of view; it would simply not be competitive with ocean-oriented resorts.

Development of the entire project area for public facilities, commercial or industrial development would not contribute to the provision of affordable housing in the region, a goal clearly established by the Governor of Hawaii.

In addition to the above alternatives, eleven alternate configurations for the proposed residential community were evaluated in the course of master planning the project. The preferred project concept is based upon the refinement of these alternatives.

9. SUMMARY OF UNRESOLVED ISSUES

The cumulative result of public and private planning efforts in West Hawaii is an uncertainty at this time about the interrelationship of these plans and their collective impact upon such basic issues as the timing or phasing of regional infrastructure development and the location and phasing of major growth-inducing public and private facilities such as a new landfill, a regional hospital, a university campus and a regional sports center. Although state, county and private landowner plans are presently unresolved, the public review process of their various plans provides an adequate forum for the discussion and evaluation of the inherent issues. The publication of this environmental impact statement will contribute to the resolution of presently unresolved issues.

10. SUMMARY OF COMPATIBILITY WITH LAND USE PLANS AND POLICIES

The proposed project site is located adjacent to West Hawaii's regional center on land designated for urban expansion by the Hawaii County General Plan. A small portion of the subject property is designated Urban by the State Land Use Commission. The requested government action will permit the implementation of the project to fulfill the Governor's affordable housing goal for West Hawaii. The project has been determined to be generally consistent with State and County land use plans, goals, objectives, policies and priority guidelines.

11. NECESSARY APPROVALS AND PERMITS

Following is a list of major approvals and permits required for the implementation of the proposed project. Additional permits and approvals may be necessary. In addition to State Land Use Commission approval for redesignation of land use districts, the HFDC will seek necessary State and County approvals for the development of the project. However, pursuant to Act 15 (Session Laws of Hawaii,1988), the proposed development can be exempted from County general and development plans, and zoning requirements. HFDC, in its implementation of the Kealakehe Planned Community, will be working with the Hawaii County review agencies for the review and approval of project plans and specification and issuance of required permits as called for in Chapter 15-73A, Hawaii Administrative Rules.

Permit or Approval	Authority
Conservation District Use Permit	Board of Land and Natural Resources
Land Use Boundary Amendment	State Land Use Commission
Potable Water System Approval	State Department of Health
Underground Injection Control Line Approval	State Department of Health
Water Master Plan Approval	Hawaii County Board of Water Supply
Drainage Master Plan Approval	Hawaii County Department of Public Works
Change of Zoning	Hawaii County Council
Subdivision Approval	Hawaii County Planning Department
Building and Grading Permits	Hawaii County Planning Department

CHAPTER II

CHAPTER II
DESCRIPTION OF THE PROPOSED PROJECT

1. REGIONAL SETTING

The state-owned lands of Kealakehe are located in North Kona, Hawaii approximately two miles north of Kailua-Kona and five miles south of Keahole Airport (see Figure 2-1). The proposed project is situated on the western slope of Hualalai mountain on a portion of the Kealakehe property extending mauka from Queen Kaahumanu Highway to the existing Kealakehe community. The project consists of a total of about 960 acres of land.

Kailua-Kona is the regional center of the western side of the Island of Hawaii. Historic Kailua Village serves as the town center and primary visitor attraction. The village is surrounded by a mix of resort, commercial, light industrial, and residential uses. In July, 1987, North Kona had a population of 20,500, compared to a population of 13,748 in 1980. Resort growth proposed in coastal areas of South Kohala and North Kona is expected to result in a significant expansion of Kailua-Kona's population over the next twenty or more years creating an increasing demand for new homes, both affordable and market-priced, as well as expanded residential oriented public services and facilities and commercial and industrial uses.

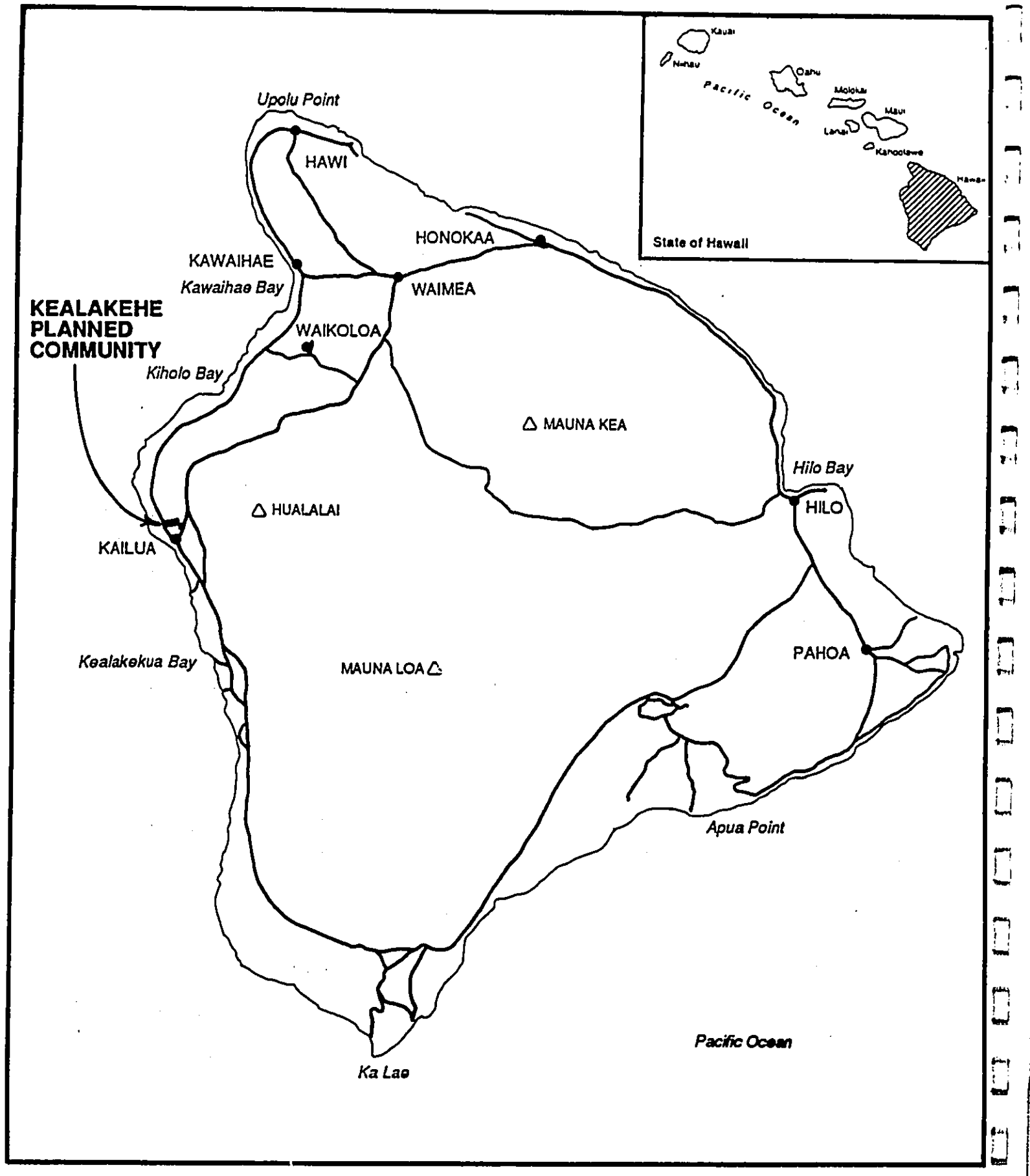
Kailua-Kona is presently served by three principal arterial roadways; Queen Kaahumanu Highway, Palani Road, and Kuakini Highway.

2. EXISTING AND SURROUNDING USES

The proposed project site consists of four primary properties identified in Table 2-1 below (see Figure 2-2a and 2-2b). All four of the properties are presently vacant.

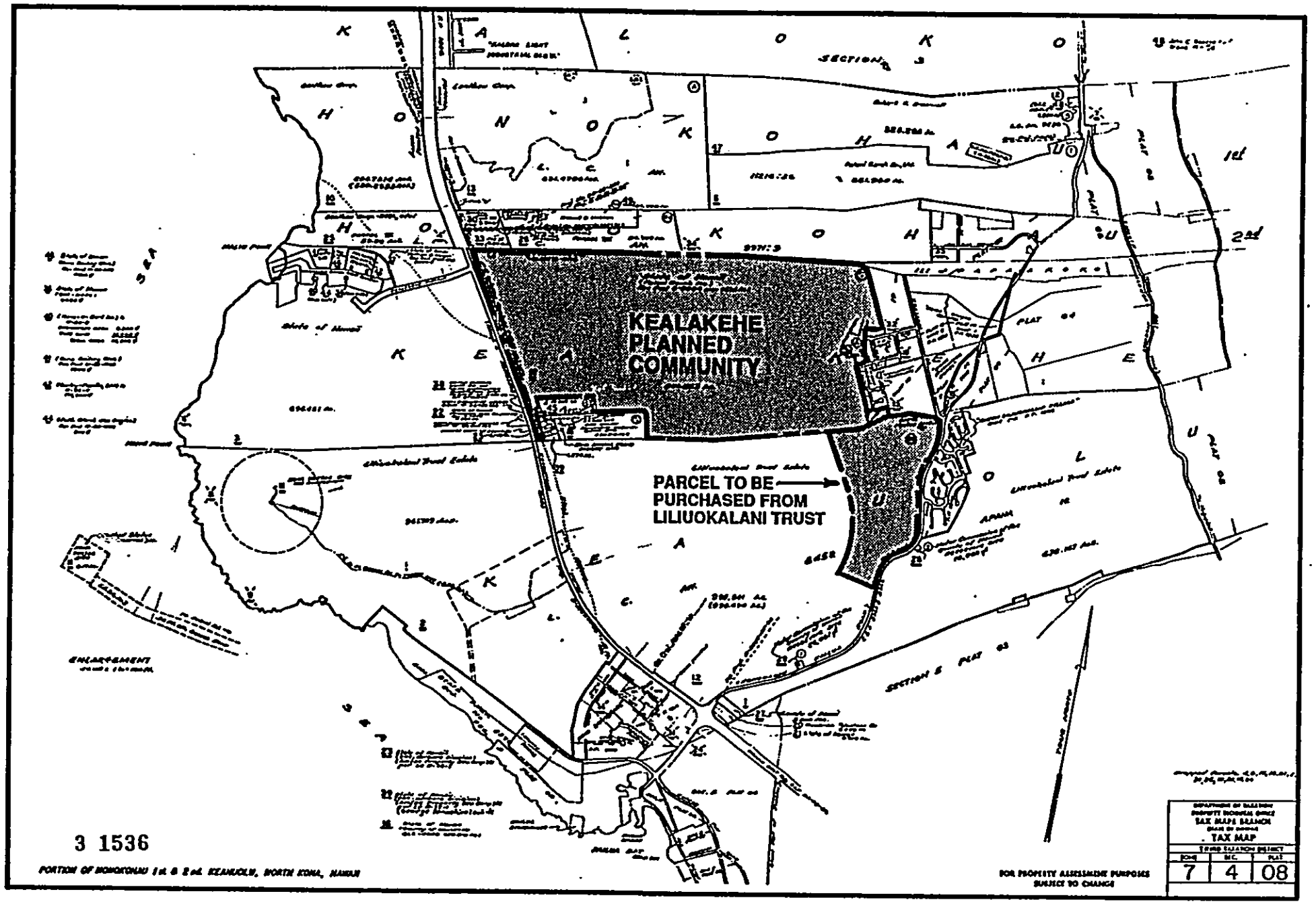
TABLE 2-1: TAX MAP PARCELS

TMK 7-4-08:	Acreage	Owner
7-4-8: 17	800.823	State of Hawaii
7-4-8: por. 12	150.000	Queen Liliuokalani Trust
7-4-8: 43	8.041	State of Hawaii
7-4-19: por. 43	2.000	State of Hawaii
TOTAL:	960.863	



Prepared By: BELT COLLINS AND ASSOCIATES • JUNE 1990

Figure 2-1
ISLAND OF HAWAII



0 1000 2000 4000

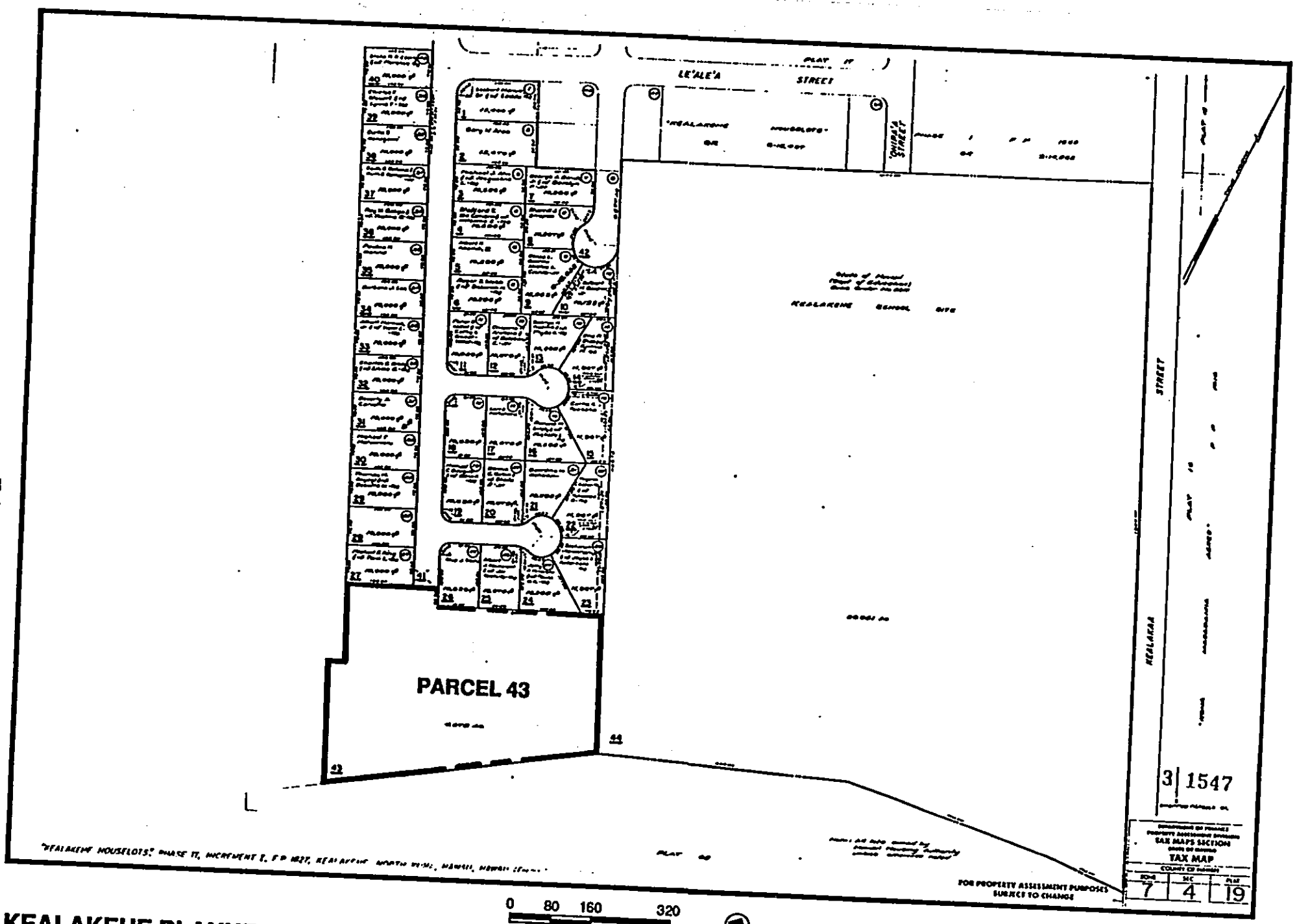
SCALE IN FEET

NORTH

KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

Prepared by: BELT COLLINS & ASSOCIATES
Date: JUNE 1990

Figure 2-2a
TAX MAP 7-4-8



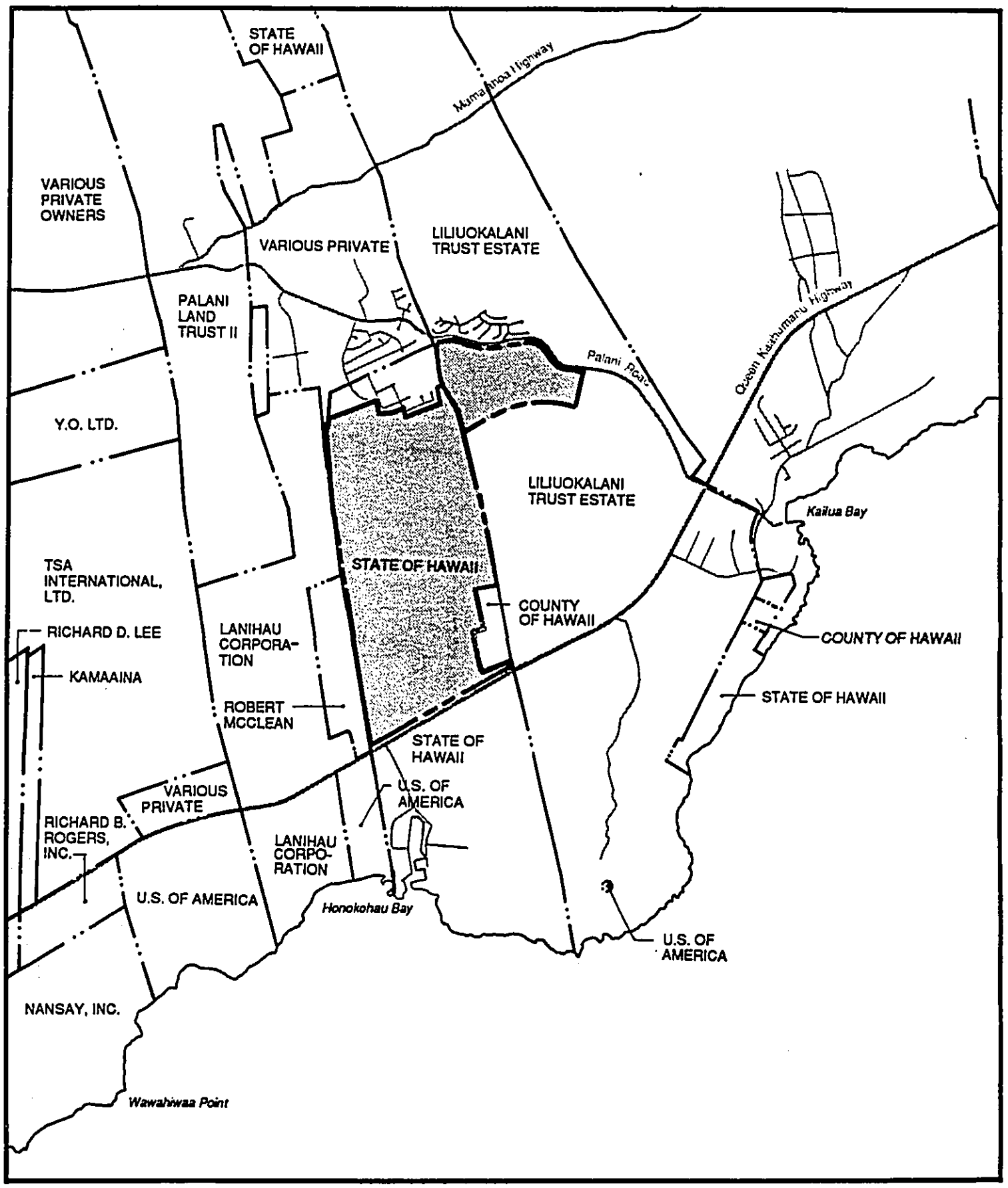
KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

0 80 160 320
SCALE IN FEET

NORTH

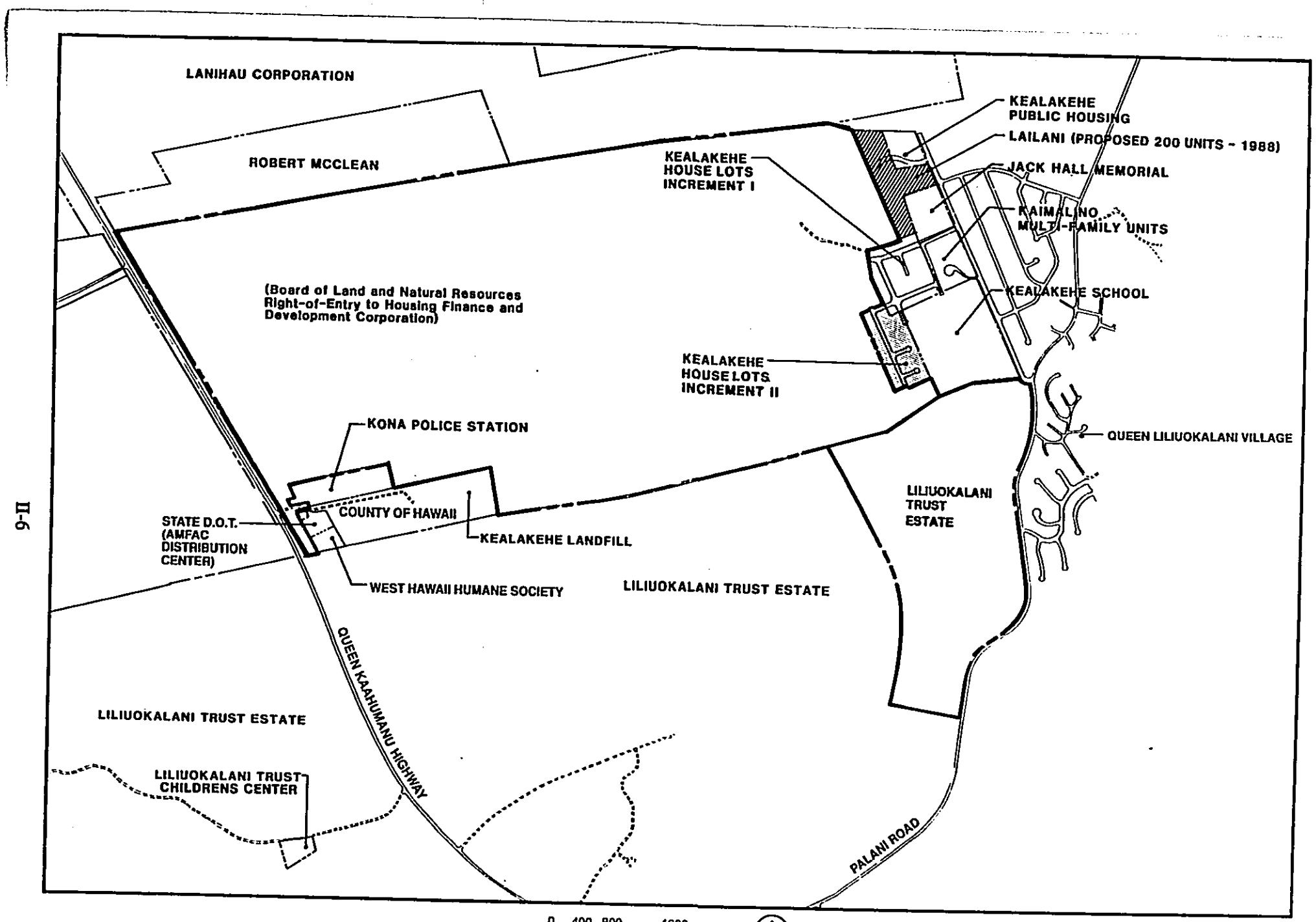
Prepared by: BELT COLLINS & ASSOCIATES
Date: JUNE 1990

Figure 2-2b
TAX MAP 7-4-19: 43



Source: COUNTY OF HAWAII, REAL PROPERTY TAX DIVISION
Prepared By: BELT COLLINS AND ASSOCIATES • JUNE 1990

Figure 2-3
REGIONAL LAND OWNERSHIP



KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

Prepared by: BELT COLLINS & ASSOCIATES
Date: JUNE 1990

Figure 2-4
PROPERTY OWNERSHIP & LAND USE

The project area is bordered on its southwestern corner by a parcel of property totaling approximately 43 acres which contains a variety of uses including the Kealakehe Landfill, a County transfer station, the West Hawaii Humane Society animal shelter, a privately operated terminal freight storage facility, an electrical substation, and a County police substation. The 43 acre area is depicted in the project's master plan as the site of a proposed Civic Center. However, the area is not included in the HFDC's Petition for Boundary Reclassification to Urban nor this Environmental Impact Statement because it is under the jurisdiction of the County of Hawaii.

As depicted in Figure 2-3, the project area is bordered on the northeast by land belonging to Palani Ranch and used primarily for cattle grazing, and on the northwest by land owned by Robert McClean and used for quarrying of rock, a ready-mix concrete batch plant, and boat storage and repair. To the east, the property is bordered by the existing Kealakehe community (Figure 2-4) which includes a number of State-assisted public housing and affordable housing projects: Kealakehe House Lots Increments I and II (fee simple); Kealakehe Public Housing; Kaimalino Multi-Family Units; and La'ilani Multi-Family Rental Housing project; as well as the privately developed Jack Hall Memorial Housing. Together, these projects contain a total of 428 single family and multi-family units. Located adjacent to the existing housing projects are the Kealakehe Elementary and Intermediate Schools. A privately owned residential subdivision consisting of approximately 268 lots lies further east, across Kealakaa Street. To the south, the property is bordered by lands owned by the Queen Liliuokalani Trust, including the Queen Liliuokalani Village which contains 183 single family leasehold units, and a portion of Palani Road, as well as the County owned property discussed above. Queen Kaahumanu Highway borders the property on the west. The Honokohau Small Boat Harbor and the Kealakehe Sewage Treatment Plant (presently under construction) are located on State owned land makai of the highway and the subject property. The state owned Kealakehe property makai of the highway is not included in the project master plan or this environmental impact statement.

3. IDENTIFICATION OF THE APPLICANT AND THE PROPOSED ACTION

The Housing Finance and Development Corporation (HFDC) of the State of Hawaii is filing this environmental impact statement as the future landowner of the Kealakehe property. The majority of the Kealakehe property (approximately 800 acres) is owned by the State of Hawaii Department of Land and Natural Resources (DLNR). The State of Hawaii Housing Finance and Development Corporation (HFDC) intends to acquire Kealakehe lands from the DLNR for the development of residential and support uses. Two small parcels, totaling approximately 10 acres, located makai of and adjacent to the existing Kealakehe I and II projects are owned by the Hawaii Housing Authority and are available for development by the HFDC (see Figure 2-2b).

The remaining 150 acres included in the proposed project area are owned by the Queen Liliuokalani Trust and intended to be purchased by the DLNR for eventual sale to the HFDC to serve as a residential expansion area for the Kealakehe Planned Community.

The HFDC has prepared this environmental impact statement for inclusion with its application to the State Land Use Commission for a boundary amendment to redesignate the subject property from Conservation and Agriculture to Urban.

4. INTENDED USE OF THIS DOCUMENT

This environmental impact statement is prepared in accordance with Chapter 343, Hawaii Revised Statutes and the rules and regulations of the Office of Environmental Quality Control. It has been determined that the environmental impact statement is required pursuant to Chapter 200 of Title 11, Department of Health, Administrative Rules, Subchapter 5(b). This document is being prepared to accompany a Petition for Boundary Reclassification, as well as a Conservation District Use Application for development in the Conservation District prior to requested boundary reclassification.

5. ACCEPTING AUTHORITY

The accepting authority for this EIS is the Governor of the State of Hawaii.

6. PROJECT BACKGROUND

The proposed project, to be known as the Kealakehe Planned Community, is intended to implement the Governor's Comprehensive State Housing Plan in West Hawaii. Master planning of the Kealakehe Planned Community is being undertaken by the State of Hawaii through its Housing Finance and Development Corporation.

The primary goal of the project is to provide affordable housing opportunities in response to existing and projected increases in demand for affordable housing units in the West Hawaii area. It is estimated that there is a need of approximately 30,000 to 40,000 new housing units in this area of the Big Island over the next 20 years.

Planning for the Kealakehe Planned Community began in 1987 with the preparation of a Concept Feasibility Study which evaluated a number of development alternatives for the State owned Kealakehe property. Following publication and review of the Concept Feasibility Study,

the original project area which encompassed State owned land on both sides of Queen Kaahumanu Highway was reduced to include only that portion of land located mauka of the highway. Once the project area was determined, efforts were directed to the preparation of a project master plan. This environmental impact statement is based upon a master plan which is presently nearing completion.

7. DEVELOPMENT CONCEPT

On July 1, 1987, the development, financing, residential leasehold and relocation functions of the Hawaii Housing Authority (HHA) were assumed by the newly created Housing Finance and Development Corporation (HFDC). Prior to the transfer of these functions, the HHA's former Executive Director, Russell N. Fukumoto, prepared a memorandum titled *Affordable Housing Development Concept* (March 20, 1986) which stated:

> "The development concept basically incorporates a planned development with emphasis on providing a large percentage of residential units affordable to lower-income and gap-group families. This concept is predicated on government acquiring, master planning, and developing large parcels of land in the various counties...Section 359G-10.5 allows the [Hawaii Housing] Authority to develop projects that include market units. Under this concept, the net income derived from the sale of these market units could be used to reduce the cost of some or all of the affordable units within the development."

The memorandum also presented the criteria for development of affordable housing by the HHA. The Kealakehe Planned Community proposal is generally consistent with four criteria set forth in the memorandum:

- reasonably priced land
- adjacent to existing or planned infrastructure
- relatively flat land; and
- close to employment centers, existing communities and/or areas of growth.

The proposed project consists of a residential community of approximately 4,100 housing units, with 60% of the units to be sold at prices affordable to persons earning low and moderate incomes and the remaining 40% of the units to be sold at market prices. As set forth in the State Housing Functional Plan (1989), "affordable housing" is defined as for-sale and for-rent units targeted for persons or families within the following income groups:

1. Very low income - those earning 50% of the area median income and below;
2. Lower income - those earning between 50% and 80% of the area median income;
3. Moderate income - those earning between 80% and 120% of the area median income;
4 Above-moderate income - those earning between 120% and 140% of the area median income.

However, it should be noted that the affordable housing to be developed in the Kealakehe Planned Community is targeted only for the first three income groups presented above. Housing units priced to meet the needs of the fourth group, above-moderate income, are considered to be market-priced units.

Development of the project will be phased over a period of approximately twenty years with the construction of a total of 14 Villages, each with the requisite 60/40 distribution of affordable and market housing units. The HFDC believes that the inclusion of a variety of housing types and families and individuals of varying income levels within each village is preferred to the establishment of homogeneous residential areas which lack variety in unit types and group people of similar incomes. The development of the market housing component within each village is intended to assist in offsetting, to some degree, the cost of providing a mix of affordable housing units targeted for a range of need groups. A developer will be selected for the construction of each village. The actual character and aesthetic design of the village and its various components will be left to the developer. The HFDC intends to coordinate the provision of regional infrastructure to serve the villages.

Under this development concept, the State will act as the lead in the development of the proposed project and assumes all risks associated with land acquisition, master planning and obtaining the necessary land use and zoning permits.

8. STATEMENT OF PROJECT OBJECTIVES

The primary objective of the Kealakehe Planned Community is to provide sorely needed affordable housing units in the West Hawaii region. It is intended that the master planned residential community be developed in an economical manner. Additional objectives include: the provision of necessary infrastructure and facilities to support the residential units developed; the distribution of units such that 60% of those developed shall be targeted for persons or families meeting the income criteria for affordable housing eligibility; the provision of 40% of the developed units at market prices to generate revenue to reduce development costs of the affordable units; and, the leasing of commercial land to be developed in support of the residential uses for the purpose of deriving additional income to support the provision of affordable housing.

9. MASTER PLAN

The Kealakehe Planned Community is proposed as a mixed-use master planned community which will include housing, recreational uses, schools, public facilities, and commercial areas. As

discussed earlier the total master planned area encompasses approximately 960 acres. The master plan includes the eventual development of a 30-acre Civic Center on County owned land in the vicinity of the existing police substation. However, analysis of this element is not included in the environmental impact statement. A land use summary of the master plan, including the Civic Center, is contained in Table 2-2. The master plan land use concept is presented in Figure 2-5.

The project site also includes a 195 acre area located immediately east (mauka) of the Queen Kaahumanu Highway which is reserved for development by the County of Hawaii as an effluent disposal area for the County's Kealakehe Sewage Treatment Plant which is presently under construction on the west (makai) side of the highway. The effluent disposal area will be transferred by Executive Order of the Governor from the State to the County. As a means of putting the land to its most productive and beneficial use, the County of Hawaii proposes to develop the area as a public golf course serving the Kailua-Kona area. While the golf course site has been included in the environmental analysis herein, details of its specific layout and operation fall under the jurisdiction of the County and are unknown at this time.

The project site is divided into fourteen "villages" or neighborhoods ranging from 23 to 72 acres with an average size of 42 acres. The configuration of the 14 villages is presented in Figure 2-6. Each village is intended to be developed as a single entity with a unifying urban design theme to be proposed and implemented by the village's developer. While detailed design elements will be left to each village developer, the HFDC will establish overall design standards which will be included in the master plan and will be applicable to all fourteen villages. These will include guidelines to preserve viewplanes within and among villages, criteria for the sizing of infrastructure and its linkage among villages, roadway design standards to minimize through traffic on local streets, landscape requirements, and standards for the allocation and distribution of residential unit types and sales prices within each village.

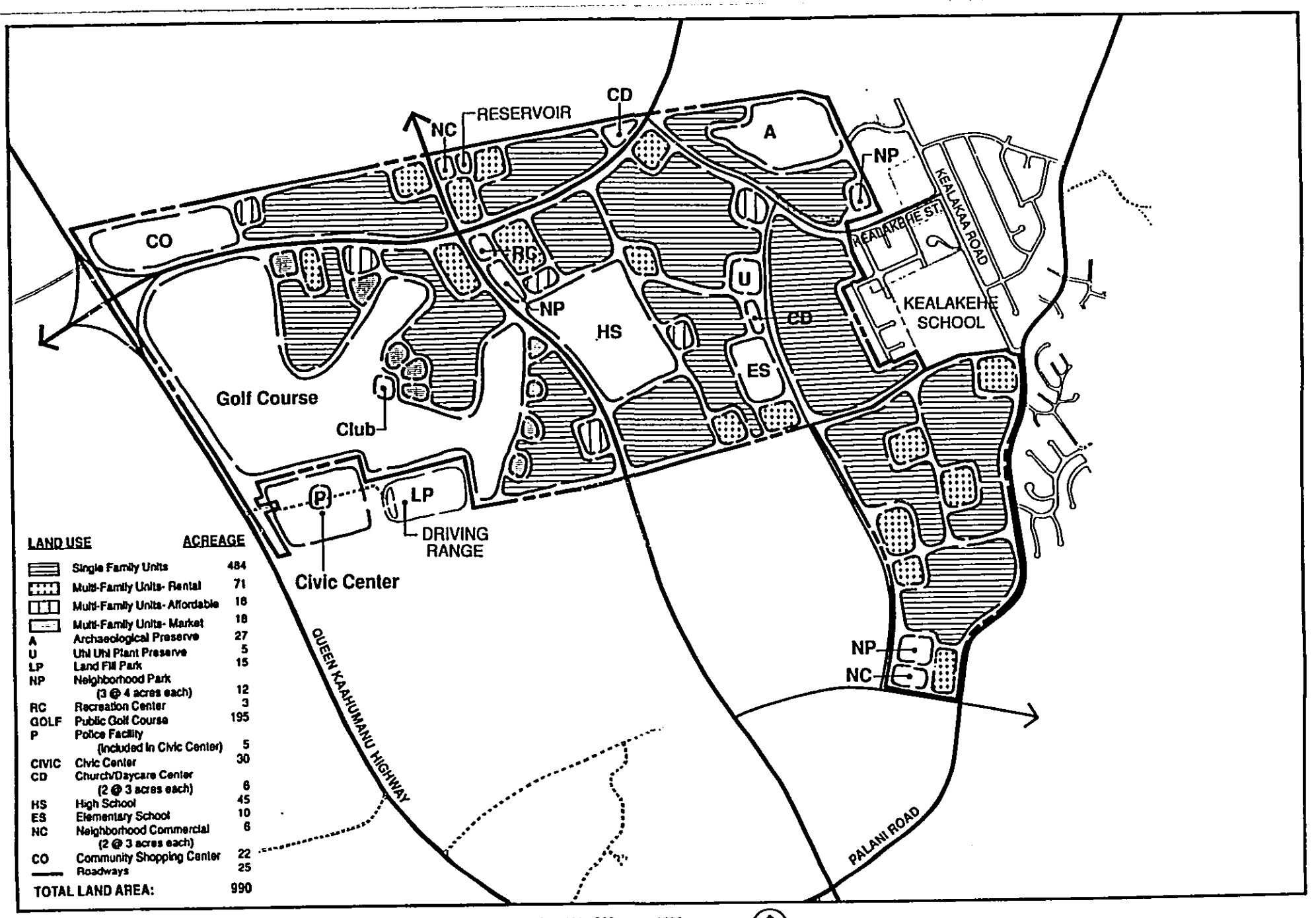
The major entry to the project is proposed at Queen Kaahumanu Highway and will offer a panoramic view of the entire community extending upslope from the eastern edge of the proposed golf course. A large commercial shopping area serving the entire community will be situated along the left (north) side of the roadway which will be bordered on the right by the public golf course. Residential development will begin at the eastern boundaries of the commercial center and the golf course. A secondary entry, which will serve as the project's initial entry during the first phase of development, will be situated at the makai end of Kealakehe Street which presently deadends at the project's eastern property boundary. Views from this entry will offer an uninterrupted vista of the entire region's coastline extending from Kailua town to Kaloko Point. Landscaped entry features will be developed at both locations. Eventually, additional entry features will be developed at

TABLE 1: LAND USE SUMMARY

VILLAGE	RENTAL (MFU)	% of TOTAL	ACREAGE	AFFORDABLE (MFU)	% of TOTAL	ACREAGE	AFFORDABLE<120% (SFU)	% of TOTAL	ACREAGE	MARKET 120%-140% (SFU)	% of TOTAL	ACREAGE
VILLAGE 1							212	60%	35	48	13%	8
VILLAGE 2							112	60%	19	24	13%	4
VILLAGE 3	96	19%	8	36	7%	3	170	34%	28	24	5%	4
VILLAGE 4	96	23%	8	24	6%	2	136	32%	23	20	5%	3
VILLAGE 5							114	60%	19	14	7%	2
VILLAGE 6	96	40%	8	30	12%	3	18	7%	3			
VILLAGE 7	94	43%	8				36	17%	6			
VILLAGE 8	46	18%	4	24	10%	2	80	32%	13	38	15%	6
VILLAGE 9	46	15%	4	48	16%	4	90	29%	15			
VILLAGE 10	54	19%	5				114	40%	19			
VILLAGE 11				30	17%	3	74	43%	12			
VILLAGE 12	120	33%	10				96	27%	16	30	8%	5
VILLAGE 13	120	33%	10				96	27%	16	30	8%	5
VILLAGE 14	84	28%	7				96	32%	16			
TOTAL:	852	20%	71	192	5%	16	1444	35%	241	228	5%	38

TABLE 1: LAND USE SUMMARY (continued)

VILLAGE	MARKET (SFU)	% of TOTAL	ACREAGE	MARKET (MFU)	% of TOTAL	ACREAGE	TOTAL ACREAGE	TOTAL UNITS	% AFFORD.	% MARKET	VILLAGE DENSITY
VILLAGE 1	96	27%	16				59	356	60%	40%	6
VILLAGE 2	52	28%	9				31	188	60%	40%	6
VILLAGE 3	174	35%	29				72	500	60%	40%	7
VILLAGE 4	148	35%	25				61	424	60%	40%	7
VILLAGE 5	62	33%	10				32	190	60%	40%	6
VILLAGE 6	98	40%	16				30	242	60%	40%	8
VILLAGE 7	88	40%	15				29	218	60%	40%	8
VILLAGE 8	64	25%	11				36	252	60%	40%	7
VILLAGE 9	40	13%	7	84	27%	7	37	308	60%	40%	8
VILLAGE 10	36	13%	6	78	28%	7	36	282	60%	40%	8
VILLAGE 11	22	13%	4	48	28%	4	23	174	60%	40%	8
VILLAGE 12	116	32%	19				50	362	60%	40%	7
VILLAGE 13	116	32%	19				50	362	60%	40%	7
VILLAGE 14	120	40%	20				43	300	60%	40%	7
TOTAL:	1232	30%	205	210	5%	18	589	4158	60%	40%	7

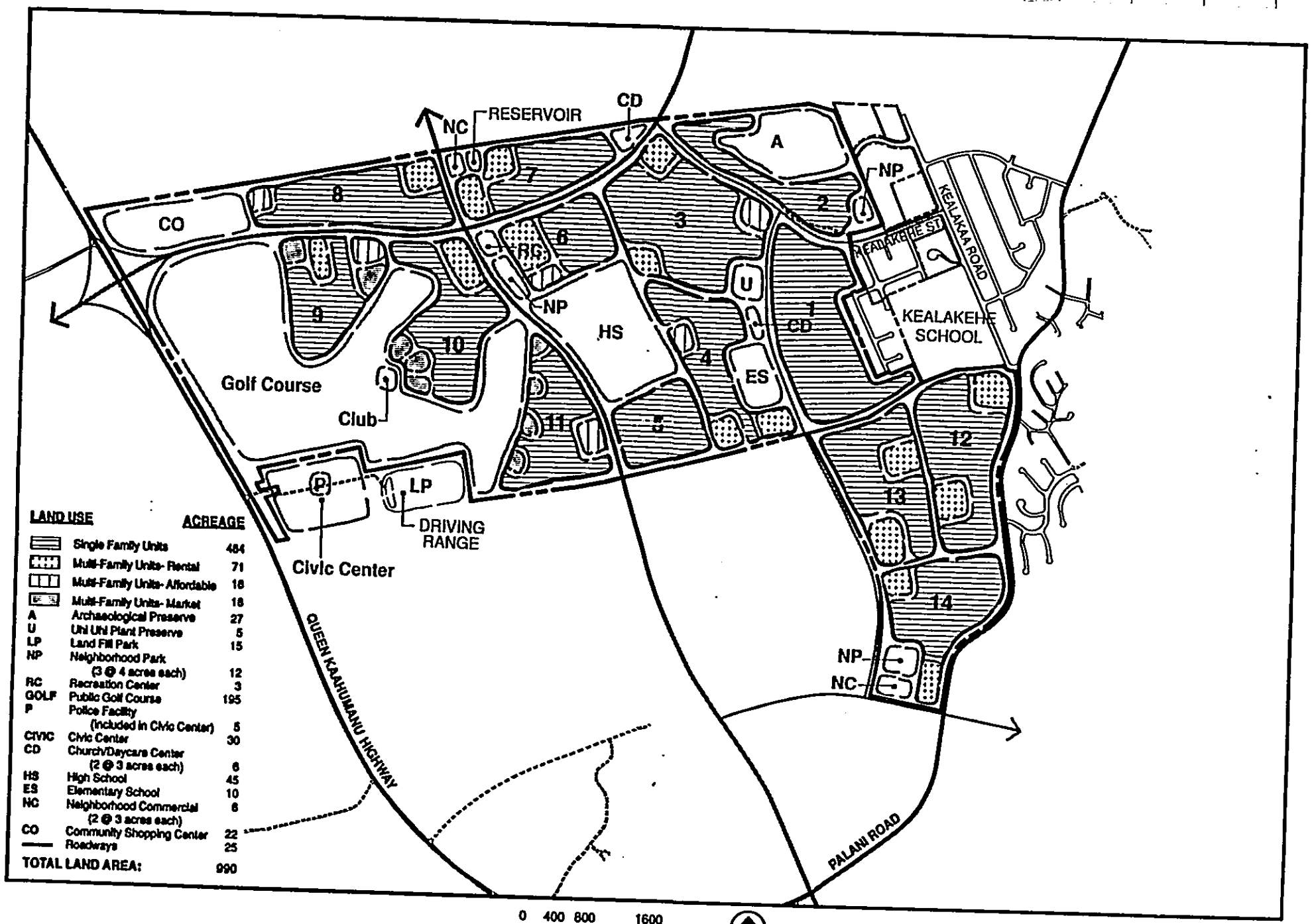


LAND USE		ACREAGE
	Single Family Units	484
	Multi-Family Units- Rental	71
	Multi-Family Units- Affordable	16
	Multi-Family Units- Market	18
A	Archaeological Preserve	27
U	Uhi Uhi Plant Preserve	5
LP	Land Fill Park	15
NP	Neighborhood Park (3 @ 4 acres each)	12
RC	Recreation Center	3
GOLF	Public Golf Course	195
P	Police Facility (included in Civic Center)	5
CIVIC	Civic Center	30
CD	Church/Daycare Center (2 @ 3 acres each)	6
HS	High School	45
ES	Elementary School	10
NC	Neighborhood Commercial (2 @ 3 acres each)	6
CO	Community Shopping Center	22
	Roadways	25
TOTAL LAND AREA:		990

KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

Prepared by: BELT COLLINS & ASSOCIATES
Date: JUNE 1990

Figure 2-5
LAND USE CONCEPT PLAN



KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

Prepared by: BELT COLLINS & ASSOCIATES
Date: JUNE 1990

Figure 2-6
VILLAGE CONCEPT PLAN

Kealakehe Parkway's northern entrance to the property, at the Mid-Level roadway's north and south entrances, and at the intersection of Palani Road and Waena Drive, an additional roadway extending across the upper elevation of the project from Kealakehe Street.

9.1 Residential Uses

The master plan proposes the development of approximately 589 acres of the project site for residential land uses, with a total of 4,158 units. These units are distributed among the fourteen villages as presented in Table 2-2 with an average village size of about 300 units. Further, each village will feature a mix of residential units equal to 60% affordable and 40% market priced. Affordable units are targeted for the elderly, special need group, assisted (very low income and lower income), and gap-group (moderate income) families and persons. Market units are targeted for families and persons of above moderate income and those earning incomes greater than 140% of the area's median income.

Housing unit types are distributed within the Kealakehe Planned Community according to the proportions presented in Table 2-3. However, the distribution of units within each individual village varies as a result of specific design considerations. For example, because of the high density of multi-family units in the existing Kealakehe community, no multi-family units are included in the two villages abutting the existing community. Similarly, because of the opportunity to capture increased revenue, the largest number of multi-family market units occurs in the villages abutting the public golf course. However, in an effort to maintain a uniform density among the various villages, small clusters of multi-family units are scattered throughout the community. The distribution of unit types within each village is included in Table 2-2.

TABLE 2-3: DISTRIBUTION OF UNIT TYPES

UNITS	TOTAL	PERCENTAGE
Multi-Family Rental	852	20%
Multi-Family Affordable	192	5%
Single Family Affordable (low/moderate)	1,444	35%
Subtotal:	2,488	60%
Single Family Market (above moderate)	228	5%
Single Family Market	1,232	30%
Multi-Family Market	210	5%
Subtotal:	1,670	40%
TOTAL:	4,158	100%

Single Family (for sale) Units

Kealakehe Planned Community contains a total of 2,872 single family units intended for sale. This equals approximately 69% of the total units to be built. These units, which include both affordable and market units, are distributed throughout the fourteen villages on a total of approximately 479 acres of land with an average density of six units per acre. About 81% of the total amount of residential land in the community is designated for these units. Affordable and market units are scattered within each village rather than clustered to ensure a heterogeneous distribution.

Multi-Family (for sale) Units

Multi-Family units for sale total 402 units or approximately 10% of the total units in the community. At a general density of 12 units per acre, these units occupy a total of 33 acres, or almost 6% of the total residential land. The multi-family for sale units are distributed in clusters from two to four acres in size. More than half of the total number of units are market units situated in small clusters fronting the public golf course fairways and clubhouse to maximize value. The remaining units are situated in small clusters near major public facilities such as schools and shopping areas.

Assisted Multi-Family (rental) Units

In recognition of the need for assisted units for the elderly, lower income persons and families, and special need groups including single-parent families, 20% of the total units, or 852 units, have been set aside as multi-family rental units. With a density equal to that of the market and affordable multi-family units (12 per acre), these units account for 71 acres of land or nearly 12% of the total available residential land. Distributed among ten of the fourteen villages, the multi-family rental units are clustered in areas averaging about 7 acres and are located adjacent to schools, commercial areas, parks and recreation areas.

9.2 Recreation, Parks and Open Space

Nearly a quarter of the total area of the Kealakehe Planned Community is allocated to recreational, park and open space uses. The master plan distributes these uses in a manner that enhances the character of the overall community while providing visual relief and reducing urban densities within individual villages.

Public Golf Course

As discussed previously, a 195 acre site situated on the lower portion of the project area is proposed for transfer to the County of Hawaii for development of an 18-hole public golf course and effluent disposal area for the County sewage treatment plant being constructed makai of Queen Kaahumanu Highway. As presently designed, the proposed sewage treatment plant will require a minimum of 150 acres for the disposal of effluent derived from the treatment process. The use of effluent for irrigation purposes provides an efficient and cost effective method for recycling a valuable resource and lessening demand for potable water.

The golf course design features three distinct lobes intended to maximize residential frontage along fairways which, in turn, increases revenues derived from the market housing to be sited there. The golf course design provides adequate buffer areas within each lobe to ensure the safety of housing fronting the fairways. This design is intended to lessen the danger in residential areas from errant golf balls.

In addition, the course is designed to provide a physical buffer around the existing Kealakehe landfill. While the HFDC is relying upon the County of Hawaii to close the landfill in a timely manner and undertake measures that will result in the site's eventual conversion to an alternate use, it is not expected that the site will become available within the next decade. Therefore, the landfill site must be buffered to whatever extent possible from residential activity. Once the landfill has been closed, and hopefully mined so that underground fires are permanently extinguished, the site offers an excellent location for a driving range or a passive open space park area.

Finally, the proposed golf course area includes a three-acre club house site near the central lobe. This site is readily accessible from major roadways and the surrounding community, should the County wish to expand the club house use to include meeting rooms for non-golf related activities, as is the case with other golf course club houses located adjacent to residential areas.

Parks and Recreation

The proposed master plan includes three separate neighborhood parks, each approximately four acres in size. The first park is located at the mauka end of the planned community in Village #2 adjacent to the existing multi-family development along Kealakehe Street. This park provides a long-overdue recreation area for the existing community and fulfills a previous commitment by the HFDC to provide a park for the community. A second park is located near the intersection of the

Mid-Level roadway and Kealakehe Parkway in Village #6 adjacent to two multi-family unit projects. The third park is situated in Village #14 along Waena Drive near Palani Road.

A three-acre recreation center site has been proposed adjacent to the second park. The recreation center is intended to serve as a focus of activity for the entire community and is sited at the corner of Kealakehe Parkway and the Mid-Level roadway to maximize access as well as to serve as a distinctive visual element.

Natural Preserves

Two environmentally sensitive areas identified within the project site are proposed to be set aside as natural open space preserves. The first is a twenty-one acre area located in the northeastern corner of the project area which contains a number of unique archaeologic sites. By setting aside the area as a preserve, the integrity and cultural value of the site is ensured. Interpretive signage within the area could be provided as a means of informing visitors of the meaning and significance of the archaeological sites.

The second preserve consists of a five acre site along Waena Drive about midway between the property boundaries near the 550 foot elevation. The purpose of this preserve is to protect a cluster of eight uhi uhi trees, a federally designated endangered species. A total of nineteen adult trees have been located within the project area; the cluster of eight and eleven additional trees scattered throughout the project area. The HFDC has been advised by the State Attorney General's Office that no endangered plant can be moved or relocated under existing state law. Therefore, in addition to preserving each individual tree, the designation of an Uhi uhi Preserve for the cluster of eight provides an opportunity to establish a passive open space area within the community that may provide educational and scientific benefits (note: detailed information concerning the Uhi uhi trees and mitigation measures to ensure their preservation are discussed in this environmental impact statement under the section pertaining to Flora).

It is anticipated that both preserves will have limited or controlled public access due to their sensitive character, although, control at the archaeological preserve may be less stringent utilizing limited hours of operation and posted instructions or rules rather than security fencing or regulated access.

9.3 Public and Quasi-public Facilities

Included in the Kealakehe Planned Community are a variety of land uses that support the

residential community, including schools, churches and day care centers, and a Civic Center. The location of these facilities within the project area helps to reduce commuting time, increases pedestrian access and enhances the overall quality of life in the community by making a full range of services readily available.

Schools

Two school sites are proposed for development within the community. A ten acre site has been selected along Waena Drive near the project's southern property boundary as the location for an elementary school to be operated by the State Department of Education. The site will provide space for a facility serving up to 900 students, play courts, library, dining room and administrative building. A forty-five acre site located on the makai side of the Mid-Level roadway, south of Kealakehe Parkway is proposed as the site of public high school to also be operated by the Department of Education. The high school is expected to accommodate a maximum of 1,700 within 75 classrooms. Included among the high school's facilities are administrative offices, a dining hall, library, physical education building, gymnasium, football/soccor and baseball fields, and tennis courts. The slope of the high school site averages from 5 to 10%. Since this is steeper than a typical facility, additional land has been provided for the site. Thus, the total area of the high school is consistent with what is required by the facilities branch of the Department of Education.

Both the elementary school and high school will be served by project infrastructure including roadways, water, sewer and electricity.

Civic Center

Included in the master plan is a 30 acre area that is designated as a Civic Center, located on County land in the vicinity of the existing police station, makai of Kealakehe landfill. While this specific property is not included in this environmental impact statement, it is included in the master plan as a long term use for the property. It is recognized that the ultimate disposition of the landfill will determine the actual use and phasing of new construction on the property.

It is recommended that the Civic Center include the existing police station, a fire station, county government office building, a judicial complex serving West Hawaii, and similar public buildings which might include a public library and federal post office.

Churches and Day Care Centers

Two separate three-acre sites have been set aside for quasi-public facilities, which would consist of a church/day care center complex. The first site is located in Village #4 along Waena Drive between a proposed Elementary School and the Uhi uhi Plant Preserve. This location helps to centralize the destination for pre-schoolers and elementary school age children. The second site is located within Village #7 near the entrance of Kealakehe Parkway into the project area. This site was selected to help buffer the intersection from the adjacent residential community by providing a complimentary land use that can serve as a visual amenity.

Commercial

The master plan also includes three separate commercial areas to serve the Kealakehe Planned Community. The first is a 20-acre site located at the intersection of Kealakehe Parkway and Queen Kaahumanu Highway. This site serves as a buffer for the main highway and the neighboring light industrial land uses proposed for the property just north of the site, and will provide commuters as well as area residents with efficient access to a variety of shopping opportunities, due to its close proximity to both region serving roadways. It is expected that the 20- acre site will be developed as a community shopping center and will include anchor tenants such as a major grocery store and department store, as well as speciality shops and consumer oriented retail outlets.

In addition to the community shopping center, two smaller neighborhood commercial centers are provided in the master plan. The first is located at the northern border of the property at the point where the Mid-Level roadway enters the project area. The second will be located on Waena Drive near its intersection with Palani Road. Both sites will be about three acres in size and could include a "mom-and-pop" type of grocery store, drug store and sundry shop, or similar facility. These centers will provide additional convenience to the residents of the community while helping to reduce the need to commute greater distances for small item or spur-of-the-moment purchases.

9.4 Infrastructure

General descriptions of the infrastructure designed to support development of the proposed community are presented below. More specific information, including graphic presentations of the individual systems are included in Chapter VI.

9.4.1 Water

Based on the overall project demand at full buildout, a total production of 3,298 gallons per minute (gpm) will be required from wells serving the project. HFDC has contributed to source development with DWS for a portion of this demand (the 276,000 gallons discussed above), so the remaining 4.47 million gallons (MG) will need to come from new supply wells. These wells are proposed to be located above the 1,600-foot elevation at sites yet to be determined.

At full development, a total storage of about 5.0 MG will be required for the project. This storage will be required as follows: a 2.5 MG reservoir at the 325 foot elevation; a 1.5 MG reservoir at the 595 foot elevation; and a 1.0 MG reservoir at the 935 foot elevation.

Three separate water line systems are proposed based on the established pressure zones. The 935-foot elevation zone will be served by a system including the 1.0 MG reservoir, a 12-inch diameter transmission line and a 12-inch branch main. The 595-foot zone will be served by the 1.5 MG reservoir, a 24-inch transmission line, a 16-inch branch line, and a 12-inch line at the mid-level road. The proposed system for the 325-foot zone includes the 2.5 MG reservoir, a 24-inch transmission main, and a 12-inch transmission line.

The system will also include all the necessary transmission lines to individual residences and non-residential land uses as well as complete fire-protection hydrant system.

9.4.2 Wastewater

The entire project will be linked to the Kealakehe Sewage Treatment Plant, now under construction on the makai Kealakehe parcel. The project will generate approximately 1.86 mgd of wastewater. The Kealakehe STP, which is presently designed with a capacity of 2.8 mgd and is planned to serve Kailua Village and areas to the south of the project, will need to be expanded to accommodate the proposed development. Treated effluent from the STP will be used to irrigate the proposed Kealakehe public golf course. The 195-acre golf course is of sufficient size to accommodate the ultimate capacity of the STP, including Kealakehe generated wastewater.

9.4.3 Drainage

Drainage for the entire project will be handled by drywells of approximately 5 feet in diameter with a depth of 20 feet. Drywells will be situated within road right-of-ways wherever possible.

9.4.4 Power and Communications

The proposed development at build out will generate a demand for approximately 14,350 kva, which is equal to 10,762 Kilowatts or 10.76 MW. This will result in the need for the development of two new 10 MVA/12 KV substation transformers and a new region-serving 69 KV transmission line to serve the proposed community. Major transmission lines will be located along primary arterial roadways.

9.4.5 Traffic Circulation

The project area is intersected by two proposed region serving arterial roadways. The first will extend from Mamalahoa Highway downslope across private lands owned by Palani Ranch and will enter the project site at its northern boundary approximately 2,100 feet west of existing Lai'lani housing development. The roadway continues downslope in a gentle curve approximately 600 to 900 feet inside the northern property boundary and eventually intersects with Queen Kaahumanu Highway just south of the intersection of the highway and the Honokohau Harbor entrance road. This roadway is referred to as the Kealakehe Parkway and is intended to be developed as a four to six lane arterial roadway within a 120-foot right-of-way. It is proposed to be developed in three phases. The first phase will consist of that portion of the Kealakehe Parkway located within the Kealakehe property. It will be linked to the existing Kealakehe community via an extension of Kealakehe Street. A second phase is proposed by the State Department of Transportation to extend makai from the highway to Honokohau Harbor and follow the shoreline into Kailua town. The third phase will link the Parkway to Mamalahoa Highway at some future date. The roadway's intersection with Queen Kaahumanu Highway will initially require the development of channeling lanes. As traffic levels increase, the intersection will be converted to a grade separated interchange.

The second arterial roadway proposed for development bisects the project site, extending north to south, generally along the 300 foot elevation. It has been proposed by the County of Hawaii to serve as a major arterial with a 120-foot right-of-way paralleling Queen Kaahumanu Highway and extending from Palani Road to the northern end of the North Kona District. It is generally referred to as the Mid-Level roadway. Development of the Mid-Level roadway within the subject property will be timed with the phasing of residential development and related public facilities; most notably the proposed high school.

A third roadway running mauka of and parallel to the Mid-Level roadway will link Kealakehe Parkway to Palani Drive. This roadway, referred to as Waena Drive by the County of

Hawaii, is proposed as a 60-foot right-of-way and will eventually require signalization on Palani Road.

9.5 Project Phasing

The project will be developed in 14 phases with a sequence corresponding to the 14-village configuration presented in Figure 2-6. Construction will begin in the mauka portion of the project area once all necessary land use approvals have been obtained and move in a westerly direction downslope to the Queen Kaahumanu Highway. It is likely that the villages fronting the golf course will not be constructed until the existing Kealakehe landfill is closed.

The first phase of the project will include the construction of the portion of the mauka-makai roadway, with the property boundaries. Construction of the mauka portion of the roadway linking it to Mamalahoa Highway will be undertaken once a specific alignment has been subjected to the necessary environmental and design analyses and land acquisition has been completed. Construction of the first phase of the roadway is targeted for commencement before the end of 1990, if all necessary land use approvals are received in a timely manner.

9.6 Project Costs

Infrastructure costs correlate to specific utilities and have been allocated in terms of off-site and on-site costs. These costs reflect only actual construction and do not include survey, design, marketing, master planning, land and other non-construction related cost items. Costs are presented based upon 1990 constant dollars.

The total off-site cost of the entire 765-acre project (960 acres less the 195-acre golf course) including an eight percent contingency factor is $65.3 million. Average on-site development costs range between $19,200 per multi-family unit and from $24,000 to $28,800 per single-family unit depending upon lot size. This results in a total on-site cost of approximately $81.9 million.

CHAPTER III

CHAPTER III
ALTERNATIVES CONSIDERED

1. INTRODUCTION

Planning for the Kealakehe property has been coordinated by the HFDC and was begun in 1987, shortly after its creation, in an effort to fulfill the agency's mission to develop affordable housing. A Concept Feasibility Study, prepared by Belt Collins and Associates, was published the following year detailing the potential feasibility of utilizing the Kealakehe property for the development of affordable housing. At that time, the project area included the State owned lands located makai of the Queen Kaahumanu Highway. However, the publication of the Concept Feasibility Study resulted in a negative reaction to the HFDC's proposal to promote the development of a resort on the makai lands as a mechanism for funding the development of affordable homes on the mauka property. Subsequently, the makai lands were dropped from the project area and planning was focused on the property mauka of the highway.

Thus, the HFDC's planning efforts have been focused on alternative configurations of residential development on the mauka property. Non-residential uses of the property have been considered as potential revenue generators to help underwrite the cost of affordable housing, but only as secondary uses that would enhance a residential community. Therefore, non-residential uses of the entire property have not been considered in the process of developing the project master plan.

2. DESCRIPTION OF ALTERNATIVES

2.1 Smaller Scale Alternatives

Development of the project at a small scale, that is to say, development of only a portion of the property area was considered in the course of master plan preparation. It was determined that off-site infrastructure costs including water transmission lines, sewer lines and the mauka-makai arterial roadway would render a small scale project infeasible from a cost perspective. The cost of some of this infrastructure, particularly potable water wells for example, can be timed so that infrastructure development will be coordinated with housing construction, supply can equal demand, and the cost can be proportionately distributed. However, in the case of water and sewer lines and the mauka-makai roadway, the infrastructure must be oversized to accommodate the entire project and implemented in the first phase, regardless of how many actual units may be built. These costs must be borne by the project regardless of size. Thus, the smaller the project, the less feasible it is to cover necessary off-site infrastructure costs.

The Kealakehe Planned Community is based upon the concept of providing affordable housing opportunities in the West Hawaii region in response to existing and projected demand for affordable housing units. To a certain degree, development of the proposed project may require direct and indirect government subsidies. While scaling down the project may help to lower development costs of the housing units, it would not reduce the need for off-site infrastructure. Many of these costs might be borne by the State regardless of the size of the project, and be passed on to the prospective owners of the housing units. Reducing the number of units in the development may therefore result in increasing the costs to the units and decreasing the affordability to the target group.

2.2 "No-Action" Alternative

An alternative to the proposed project is to leave the land undeveloped (the 'no-action' alternative). While this alternative would maintain open space in an area where significant urban expansion is projected, it is not compatible with the Governor's policy promoting the utilization of State property for the development of affordable housing.

Retaining the land in open space may help to preserve the habitat for the endangered plant species, uhi uhi, which has been identified on the subject property. However, the preservation of a portion of the property may be sufficient to protect the uhi uhi habitat rather than designate the entire parcel as a preserve. Preservation of the remaining property for open space may not be warranted given the crucial need for affordable housing in the area.

In addition, the proposed development of the property by the State will include a new mauka-makai roadway which will transect a portion of the property and provide much needed relief to existing traffic congestion on Palani Road. Retaining the property in open space and prohibiting the construction of a region-serving roadway across it may seriously limit options for short-term and long-term transportation improvements in the area.

2.3 Agricultural Development

A total of approximately 148 acres within the project area are identified as Other Important Agricultural Land under the State's ALISH system (Agricultural Land of Importance to the State of Hawaii). These lands are located generally in the northern portion of the property adjacent to the existing urban area. About 100 acres are located within the project area presently designated as Urban. The remaining 48 acres are located with land designated as Agriculture. The remainder of the property has no agricultural value as determined by the State's ALISH system.

Agricultural development such as crop cultivation on the property may not be economically feasible due to poor soil conditions, topography, and the lack of irrigation water and access roadways. The cost of developing the infrastructure necessary to support large scale crop cultivation may be prohibitive because the development costs would greatly exceed the income received from cash crops. Archaeological field work indicates that during prehistoric and historic times crop cultivation was limited to the planting of individual plants within cracks or open blisters in the lava.

Portions of the upper project area have been leased to the neighboring Palani Ranch for livestock grazing. However, the use of the property for extensive grazing of livestock may be incompatible with existing and proposed uses of neighboring properties due to primarily to odors and insects associated with large herds of cattle.

2.4 Recreational Development

Limiting the development of the subject property to recreational purposes such as public playing fields and parks may not be economically feasible given the cost of infrastructure needed to service the site, including roadways, sewer and drainage lines, potable water, and electrical lines versus the income derived from recreational activities. However, it should be recognized that the proposed public golf course will be implemented separate from the residential component of the project. Since the golf course irrigation system will utilize effluent from the Kealakehe Sewage Treatment Plant, potable water needs will be limited to those of the club house. Vehicular access to the golf course from Queen Kaahumanu Highway will not require substantial new roadway development. Therefore, regardless of the outcome of the proposed Kealakehe Planned Community, it is possible that a substantial portion of the subject property will be used for recreational activity.

2.5 Resource Extraction

An existing quarry is located north of the subject property and an abandoned quarry is located south of the property. No quarrying activities have occurred on the Kealakehe property to the extent of the State's knowledge. There is no evidence that the subject property would yield quarry material of sufficient quantity or quality to warrant such activity. However, the use of the property for resource extraction is not compatible with the projected uses of the neighboring Queen Liliuokalani Trust property.

2.6 Resort Development

The use of the property above Queen Kaahumanu Highway as a possible resort is not considered to be practical from a marketing point of view; it would simply not be competitive with ocean-oriented resorts.

2.7 Industrial and Commercial Development

Development of the subject property for commercial and/or industrial uses may be an appropriate use of the property, especially in those areas of relatively level topography. However, these land uses would reduce lands available for housing and therefore are not consistent with the Governor's policy to provide affordable housing through the use of State owned property.

2.8 Public Facilities

A variety of public facilities are being considered for development within the Kailua area. These include a West Hawaii university campus, a regional sports center, a regional hospital, a corrections facility, schools, and a civic center which would contain county, state and federal office buildings. It has been suggested that if would be in the best interest of the community if these types of activities were developed on government owned land. To this end, the Kealakehe site offers an excellent location for many of these facilities. In fact, the master plan contains a proposal for a 30 acre Civic Center to be located on County owned land adjacent to the subject property, as well as a high school and an elementary school. However, development of the entire project area for public purposes would not contribute to the provision of affordable housing in the region, a goal clearly established by the Governor of Hawaii.

2.9 Residential Alternatives

In 1986, three separate parcels of State-owned land were evaluated for their potential as residential developments; Kealakehe, Lalamilo, and Kalaoa. The Kealakehe project site was selected based upon County projections of population growth in the area and its close proximity to the planned Kealakehe STP. Following is a description of the residential alternatives developed during the past three and a half years for the Kealakehe property. The first five alternatives, which were included in the Concept Feasibility Study discussed earlier, included the makai lands of Kealakehe. They are presented here for the sake of documenting the actual alternatives considered. However, it should be understood that the development of the makai lands is not included in the current master plan and the makai area is not analyzed in this environmental impact statement.

Concept Feasibility Study Alternatives

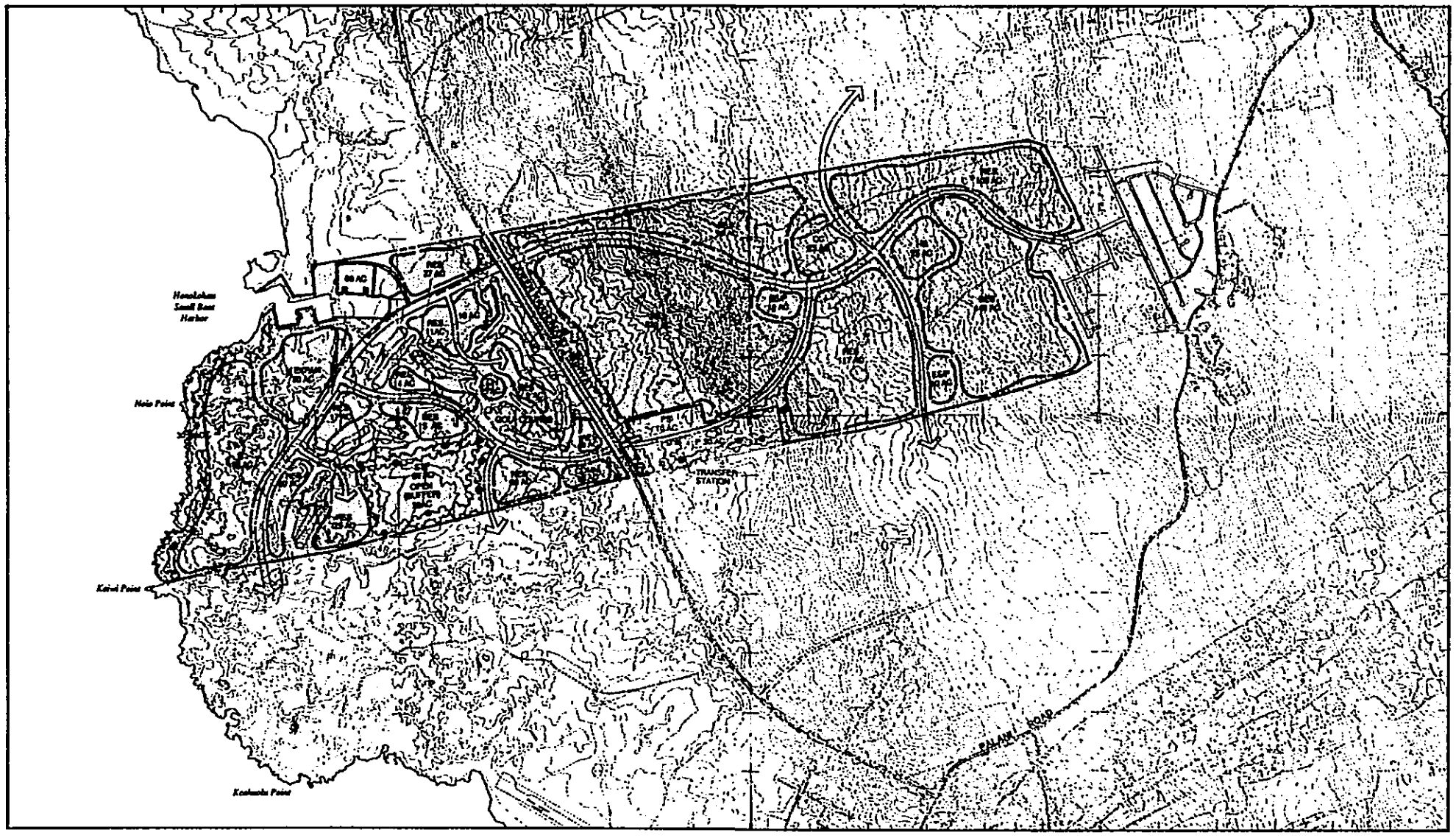
Alternative Concept One: This concept consists of resort, harbor expansion and an 18 hole championship County golf course with market priced residential uses on the makai side of Queen Kaahumanu Highway. This project shows the proposed County Sewage Treatment Plant occupying approximately 50 acres of the site along the southern boundary of the project. A buffer area of approximately 20 acres surrounds the STP. The ocean frontage in the conservation district is dedicated to a public ocean side park. The area adjacent to the Honokohau Small Boat Harbor is shown for harbor expansion as indicated on the State of Hawaii Department of Transportation Harbor's Division master plan. However, the area adjacent to the entry road and the highway is shown as future residential rather than industrial as shown on the Harbor Division's plan.

The concept shows an integrated plan of community uses on the area mauka of Queen Kaahumanu Highway. The area is predominantly shown as residential use. No differentiation is shown between housing types. However, the master plan will delineate both affordable and market priced housing for this area. A range of densities as well as housing types will be planned for this area including traditional single family units, alternative single family type projects, duplexes, patio homes, quadraplexes, townhouses, garden and walk-up apartments.

Community uses, parks, schools and neighborhood commercial areas are also shown on this portion of the project. The landfill area is shown as a reclamation area to be used for future community park site. Pedestrian walkways and bicycle paths providing safe places for residents and students to travel between various community uses, parks and schools are planned as a part of the total community. The area adjoining Queen Kaahumanu Highway is shown as an open space, landscaped buffer on the mauka side of the road and with the golf course front the majority of the highway on the makai side of the highway.

MAKAI AREA

USE	SYMBOL	AREA	UNITS	POP.
RESORT	R	100	1,500	2,850
RESIDENTIAL (Market)	RES	183	549	1,647
GOLF COURSE		170		
GOLF CLUB HOUSE	CH	5		
COMMERCIAL	C	10		
SEWAGE TREATMENT PLANT	STP	50		
HARBOR (EXISTING/EXPANSION)	H	110		
PARK/OPEN SPACE	P/O	50.5		
ROADS		18		
SUB TOTAL (Makai Area)		696.5	2,049	4,497



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Prepared by: BELT COLLINS & ASSOCIATES

KEALAKEHE PLANNED COMMUNITY

FIGURE 3-1
ALTERNATIVE CONCEPT ONE

MAUKA AREA

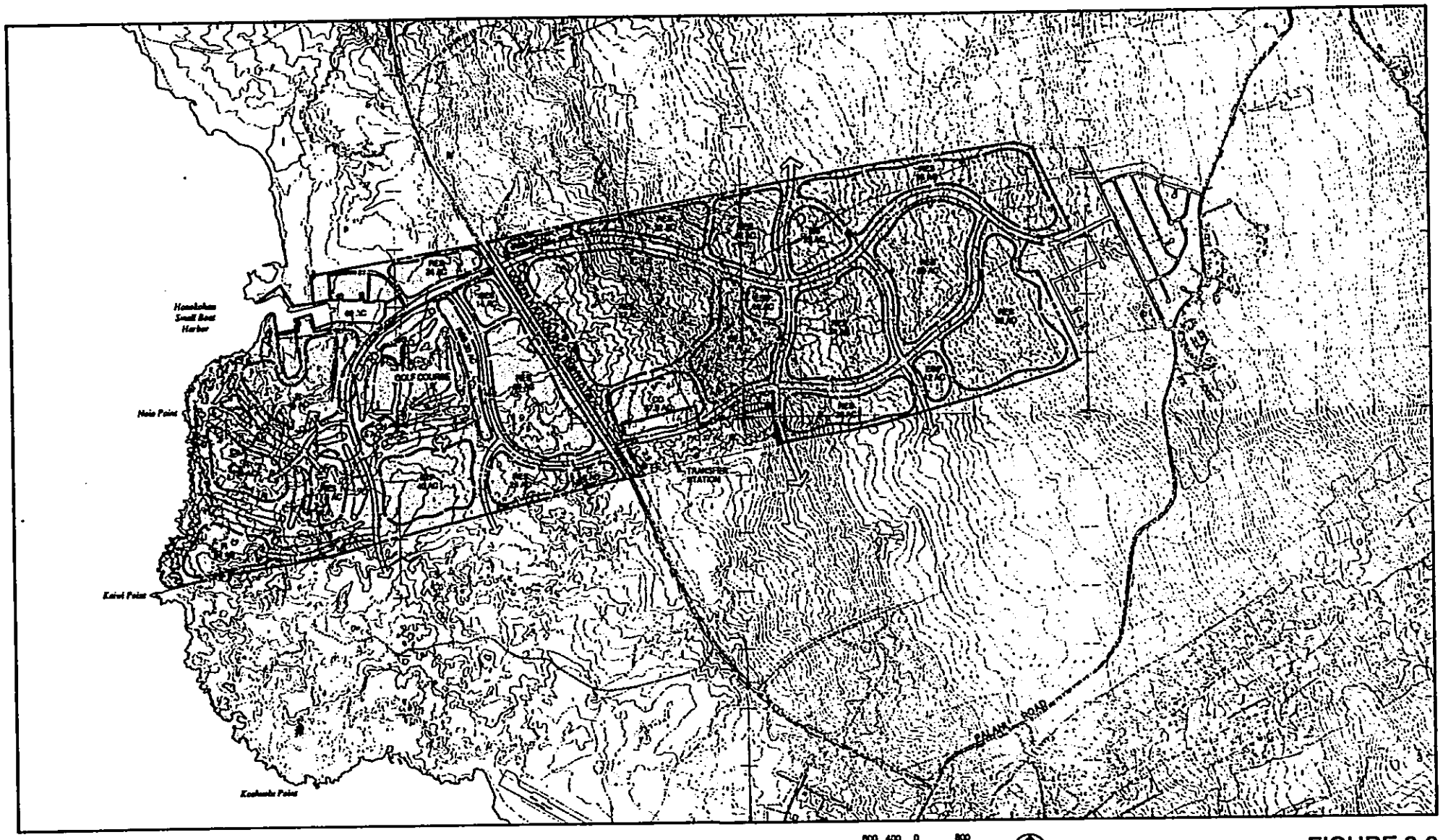
USE	SYMBOL	AREA	UNITS	POP.
RESIDENTIAL (Affordable & Market)	R	684	3,420	10,260
COMMUNITY CENTER	CC	25		
HIGH SCHOOL	HS	25		
ELEMENTARY SCHOOL/PARK	ES/P	20		
PARK/OPEN SPACE	P/O	46		
ROADS		30		
POLICE STATION		10		
SUB TOTAL (Mauka Area)		840	3,420	10,260
GRAND TOTAL		1,536.5	6,469	14,757

Alternative Concept Two: This concept consists of resort uses including proposed resort use in conjunction with harbor expansion and an 18 hole championship golf course with market priced residential uses on the makai side of Queen Kaahumanu Highway. A neighborhood commercial area/parcel is located at the southern intersection with Queen Kaahumanu Highway. This project shows the proposed County Sewage Treatment Plant occupying approximately 50 acres of the site along the southern boundary of the project. A buffer area of approximately 20 acres surrounds the STP. The ocean frontage in the conservation district is dedicated to a public (County or State) ocean side park. The area adjacent to the entry road and the highway is shown as future residential rather than industrial as shown on the Harbor Division's plan.

The concept shows an integrated plan of community uses on the area mauka of Queen Kaahumanu Highway. The area is predominantly shown as residential use. No differentiation is shown between housing types. However, the master plan will delineate both affordable and market priced housing for this area. A range of densities as well as housing types will be planned for this area including traditional single family units, alternative single family type product, duplexes, patio homes, quadraplexes, townhouses, garden and walk-up apartments.

Community uses, parks, schools and neighborhood commercial areas are also shown on this portion of the project. The proposed community center is sited adjacent to the police substation now under construction mauka of Queen Kaahumanu Highway. The landfill area is shown as a reclamation area to be used for future community park site.

Pedestrian walkways and bicycle paths providing safe places for residents and students to travel between various community uses, parks and schools are planned as a part of the total community. The area adjoining Queen Kaahumanu Highway is shown as an open space, landscaped buffer on both the makai and the mauka side of the road.



KEALAKEHE PLANNED COMMUNITY

FIGURE 3-2
ALTERNATIVE CONCEPT TWO

MAKAI AREA

USE	SYMBOL	AREA	UNITS	POP.
RESORT	R	100	1,500	2,850
RESIDENTIAL (Market)	RES	165	825	2,475
COMMERCIAL	C	6		
GOLF COURSE		176		
GOLF CLUB HOUSE	CH	5		
SEWAGE TREATMENT PLANT	STP	50		
HARBOR (EXISTING/EXPANSION)	H	60		
PARK/OPEN SPACE	P/O	116.5		
ROADS		18		
SUB TOTAL (Makai Area)		696.5	2,325	5,325

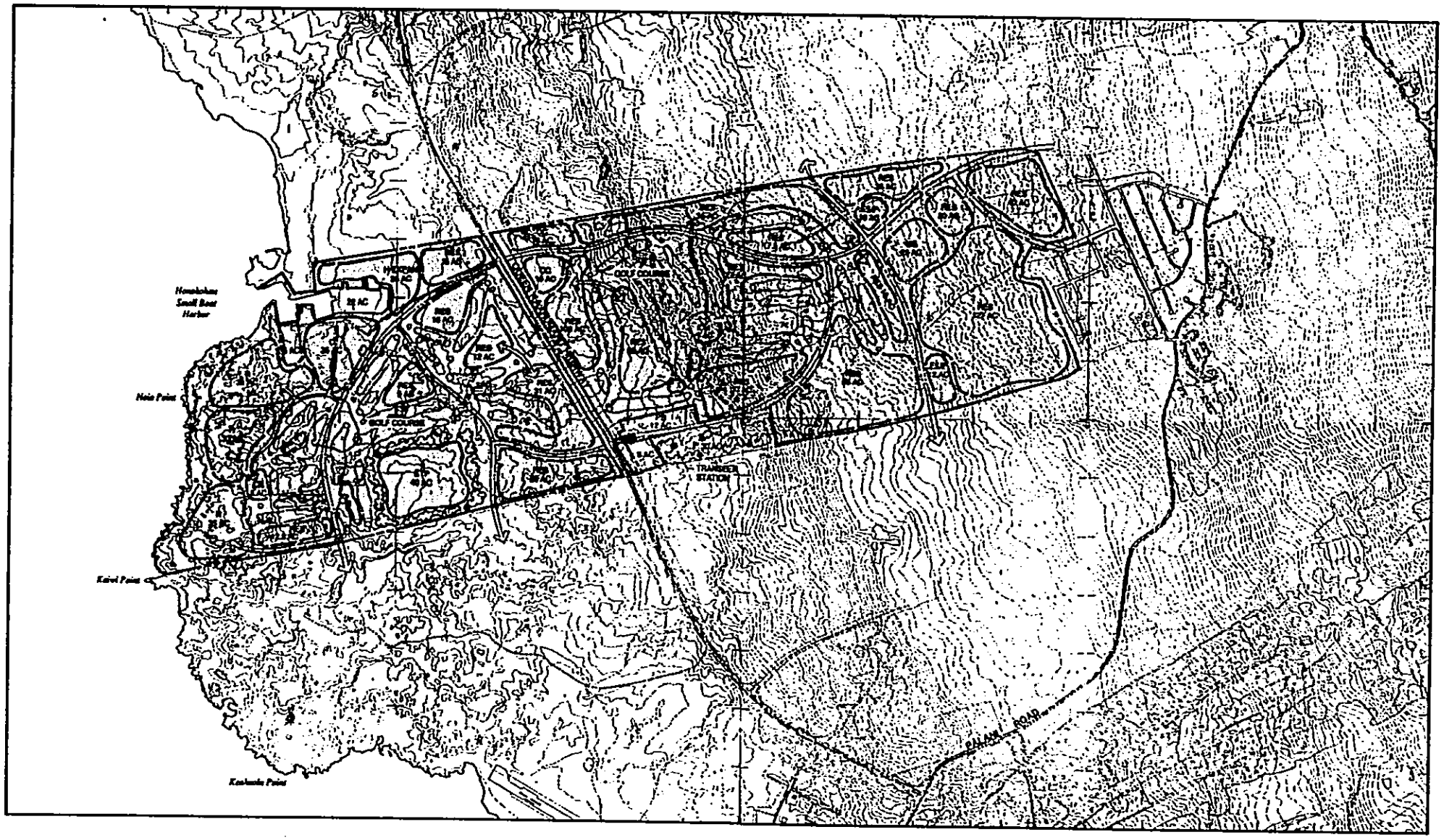
MAUKA AREA

USE	SYMBOL	AREA	UNITS	POP.
RESIDENTIAL (Affordable & Market)	R	651	3,255	9,665
COMMUNITY CENTER	CC	35		
HIGH SCHOOL	HS	25		
ELEMENTARY SCHOOL/PARK	ES/P	22		
PARK/OPEN SPACE	P/O	69		
ROADS		38		
SUB TOTAL (Mauka Area)		840	3,255	9,665
GRAND TOTAL		1,536.5	5,580	14,990

Alternative Concept Three: This concept consists of higher priced "market" residential/second homes on the ocean frontage, harbor expansion includes commercial expansion with residential above the harbor adjacent to the intersection on the highway with the harbor access road. A private 18 hole championship golf course is sited with market priced residential uses on the makai side of Queen Kaahumanu Highway. This project shows the proposed County Sewage Treatment Plant occupying approximately 50 acres of the site along the southern boundary of the project. A buffer area of approximately 20 acres surrounds the STP. The ocean frontage in the conservation district is dedicated to a public sea side park. The area adjacent to the entry road and the highway is shown as future residential rather than industrial as shown on the Harbor Division's plan.

The concept shows an integrated plan of community uses on the area mauka of Queen Kaahumanu Highway. An 18 hole championship public golf course is sited on the mauka side of Queen Kaahumanu Highway. The majority of the area is predominantly shown as residential use. No differentiation is shown between housing types. The master plan will delineate both affordable and market priced housing for this area. A range of densities as well as housing types will be planned for this area.

Community uses, parks, schools and neighborhood commercial areas are also shown on



KEALAKEHE PLANNED COMMUNITY

FIGURE 3-3
ALTERNATIVE CONCEPT THREE

this portion of the project. The landfill area is shown as a reclamation area to be used for future community park site. Pedestrian walkways and bicycle paths providing safe places for residents and students to travel between various community uses, parks and schools are planned as a part of the total community. The community center is sited mauka of the highway opposite the harbor entry road. The area adjoining Queen Kaahumanu Highway is shown as an open space, landscaped buffer with portions of the golf course fronting both sides of the highway.

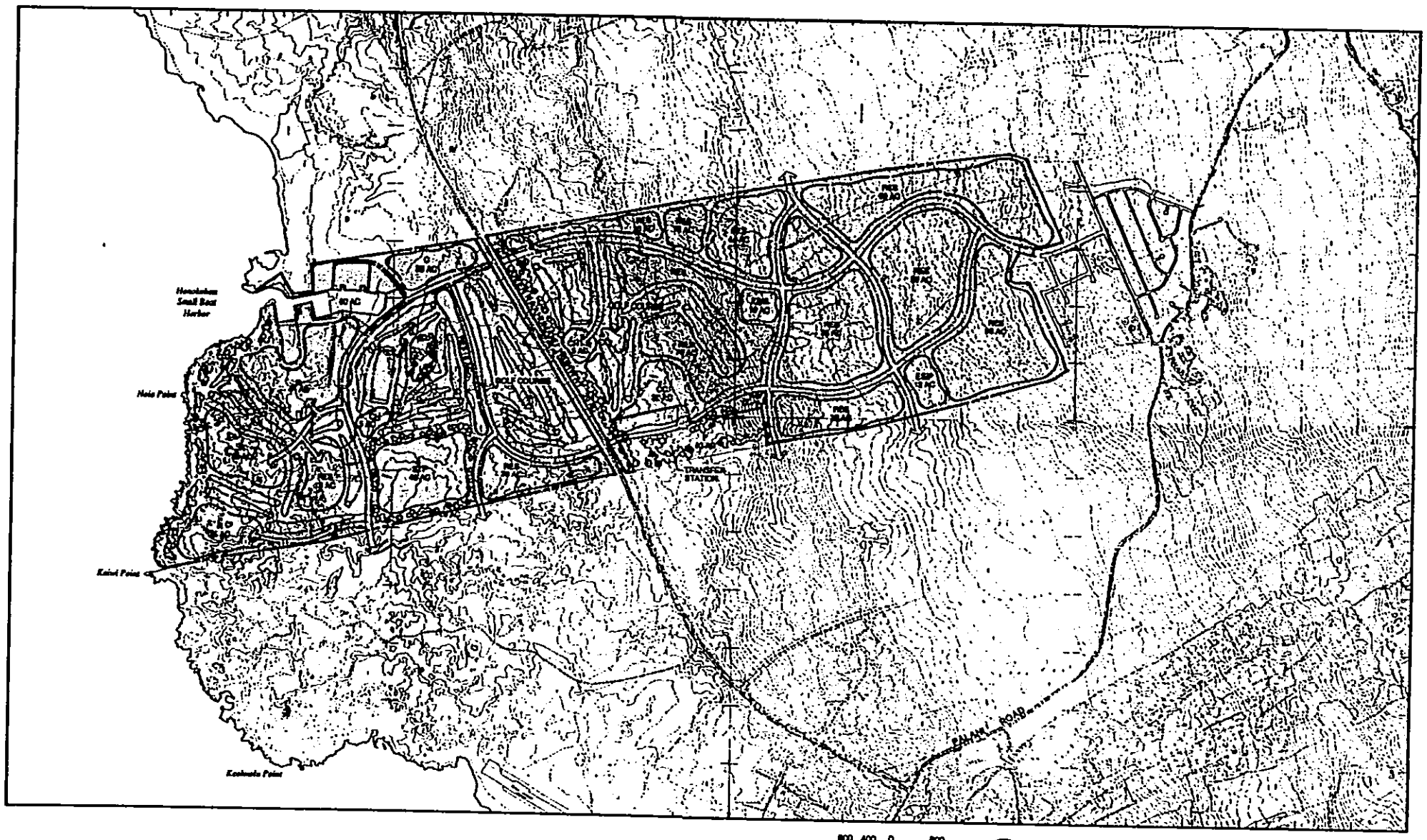
MAKAI AREA

USE	SYMBOL	AREA	UNITS	POP.
RESORT	R	100	1,500	2,850
RESIDENTIAL (Market)	RES	120.5	528	1,584
COMMERCIAL	C	15		
GOLF COURSE		175		
GOLF CLUBHOUSE	CH	5		
SEWAGE TREATMENT PLANT	STP	50		
HARBOR (EXISTING/EXPANSION)	H	81		
PARK/OPEN SPACE	P/O	132		
ROADS		18		
SUB TOTAL (Makai Area)		696.5	2,028	4,434

MAUKA AREA

RESIDENTIAL (Affordable & Market)	R	458	2,292	6,878
COMMUNITY CENTER	CC	36		
GOLF COURSE		220		
GOLF CLUBHOUSE		5		
HIGH SCHOOL	HS	25		
ELEMENTARY SCHOOL/PARK	ES/P	22		
PARK/OPEN SPACE	P/O	36		
ROADS		38		
SUB TOTAL (Mauka Area)		840	2,292	6,878
GRAND TOTAL		1,536.5	4,320	11,312

Alternative Concept Four: This concept consists of resort development along the ocean frontage with a private 18 hole championship golf course between three bulk resort parcels. One of the resort parcels is shown developed as a part of the Honokohau harbor expansion. Market priced residential uses are sited around the remainder of the private golf course. Nine holes of a public golf course are sited on the makai side of the highway. This alternate shows the proposed County Sewage Treatment Plant occupying approximately 50 acres of the site along the southern boundary of the project. A buffer area of approximately 20 acres surrounds the STP. The ocean frontage in the conservation district is dedicated to a public sea side park. The area adjacent to the entry road and the highway is shown as future commercial rather than industrial as shown on the Harbor Division's plan.



KEALAKEHE PLANNED COMMUNITY

FIGURE 3-4
ALTERNATIVE CONCEPT FOUR

The concept shows an integrated plan of community uses on the area mauka of Queen Kaahumanu Highway. The area is predominantly shown as residential use. No differentiation is shown between housing types. However, the master plan will delineate both affordable and market priced housing for this area. A range of densities as well as housing types will be planned for this area including traditional single family units, alternative single family type product, duplexes, patio homes, quadraplexes, townhouses, garden and walk-up apartments.

Community uses, parks, schools and neighborhood commercial areas are also shown on this portion of the project. The landfill area is shown as a reclamation area to be used for future community park site. Pedestrian walkways and bicycle paths providing safe places for residents and students to travel between various community uses, parks and schools are planned as a part of the total community. The community center is sited adjacent to the police substation now under construction. The remaining nine holes of the public golf course are sited on the mauka side of Queen Kaahumanu Highway. The public golf clubhouse is also sited on the mauka side of the highway. The area adjoining Queen Kaahumanu Highway is shown as an open space with the golf course fronting the majority of the highway on both the makai and mauka side.

MAKAI AREA

USE	SYMBOL	AREA	UNITS	POP.
RESORT	R	100	1,500	2,850
RESIDENTIAL (Market)	RES	82	410	1,230
COMMERCIAL	C	25		
GOLF COURSE		250		
GOLF CLUB HOUSE	CH	5		
SEWAGE TREATMENT PLANT	STP	50		
HARBOR (EXISTING/EXPANSION)	H	60		
PARK/OPEN SPACE	P/O	106.5		
ROADS		18		
SUB TOTAL		696.5	1,910	4,080

MAUKA AREA

RESIDENTIAL (Affordable & Market)	R	552	2,760	8,280
COMMUNITY CENTER	CC	32		
GOLF COURSE		80		
GOLF CLUB HOUSE		5		
HIGH SCHOOL	HS	25		
ELEMENTARY SCHOOL/PARK	ES/P	22		
PARK/OPEN SPACE	P/O	86		
ROADS		38		
SUB TOTAL		840	2,760	8,280
GRAND TOTAL		1,536.5	4,670	12,360

Alternative Concept Five: This concept shows the proposed 100 acre Kealakehe Sports Facility mauka of Queen Kaahumanu Highway as well as resort, harbor expansion and an 18 hole championship golf course with market priced residential uses on the makai side of Queen Kaahumanu Highway. This project shows the proposed County Sewage Treatment Plant occupying approximately 50 acres of the site along the southern boundary of the project. A buffer area of approximately 20 acres surrounds the STP. The ocean frontage in the conservation district is dedicated to a public ocean side park. The area immediately adjacent to the Honokohau Small Boat Harbor is shown for harbor expansion as indicated on the State of Hawaii Department of Transportation Harbor's Division master plan. However, the area adjacent to the entry road and the highway is shown as future residential rather than industrial as shown on the Harbor Division's plan.

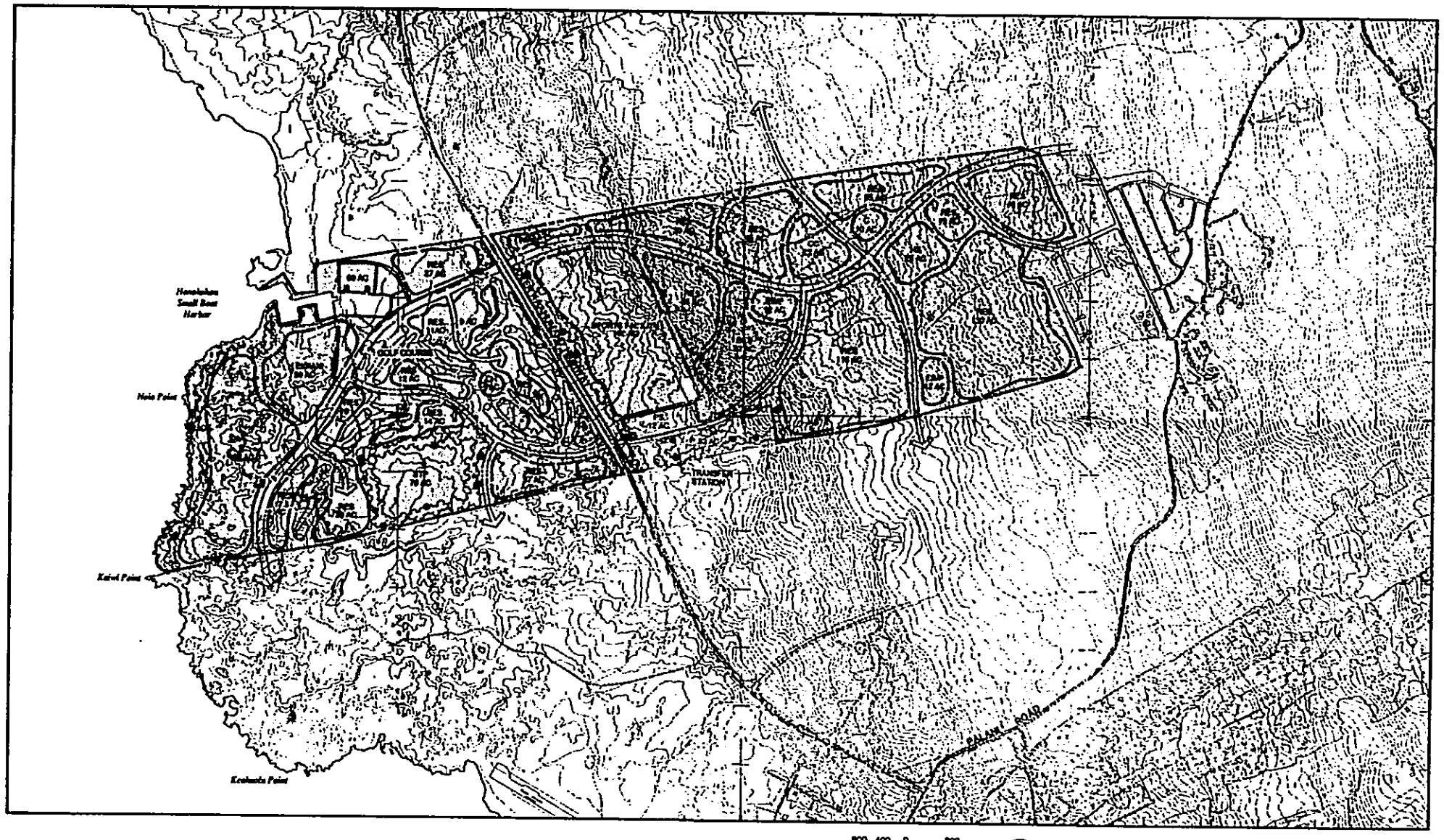
The concept shows an integrated plan of community uses on the area mauka of Queen Kaahumanu Highway. The area is predominantly shown as residential use. No differentiation is shown between housing types. However, the master plan will delineate both affordable and market priced housing for this area. A range of densities as well as housing types will be planned for this area including traditional single family units, alternative single family type product, duplexes, patio homes, quadraplexes, townhouses, garden and walk-up apartments.

MAKAI AREA

USE	SYMBOL	AREA	UNITS	POP.
RESORT	R	100	1,500	2,850
RESIDENTIAL (Market)	RES	175	800	2,400
GOLF COURSE		135		
GOLF CLUB HOUSE	CH	5		
SEWAGE TREATMENT PLANT	STP	50		
HARBOR (EXISTING/EXPANSION)	H	110		
PARK/OPEN SPACE	P/O	103.5		
ROADS		18		
SUB TOTAL (Makai Area)		696.5	2,300	5,250

MAUKA AREA

USE	SYMBOL	AREA	UNITS	POP.
RESIDENTIAL (Affordable & Market)	R	527	2,635	7,905
KEALAKEHE SPORTS FACILITY		100		
COMMUNITY CENTER (w POLICE)	CC	35		
COMMERCIAL	C	10		
HIGH SCHOOL	HS	25		
ELEMENTARY SCHOOL/PARK	ES/P	24		
PARK/OPEN SPACE	P/O	81		
ROADS		38		
SUB TOTAL (Mauka Area)		840	2,635	7,905
GRAND TOTAL		1,536.5	4,935	13,155



KEALAKEHE PLANNED COMMUNITY

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Prepared by: BELT COLLINS & ASSOCIATES

FIGURE 3-5
ALTERNATIVE CONCEPT FIVE

Community uses, parks, schools and neighborhood commercial areas are also shown on this portion of the project. The landfill area is shown as a reclamation area to be used for future community park site. Pedestrian walkways and bicycle paths providing safe places for residents and students to travel between various community uses, parks and schools are planned as a part of the total community.

The area adjoining Queen Kaahumanu Highway is shown as an open space, landscaped buffer on the mauka side of the road and with the golf course front the majority of the highway on the makai side of the highway.

Conclusion

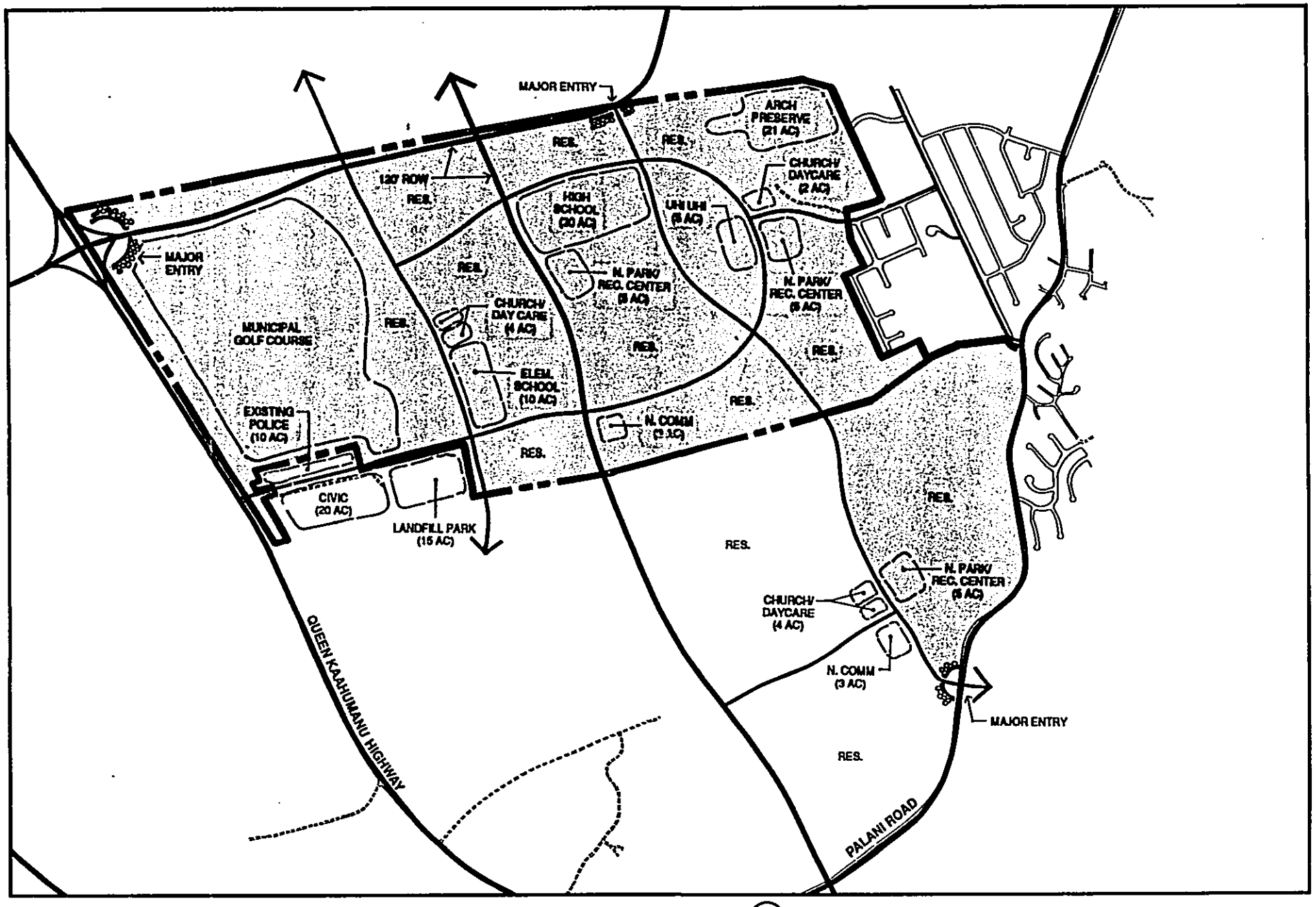
Upon review of the Concept Feasibility Analysis, the HFDC determined that development of the mauka portion of the Kealakehe property for affordable housing was possible and directed Belt Collins to begin preparation of a Master Plan for the Kealakehe project.

Kealakehe Planned Community Master Plan

Begun in July, 1989, the Master Plan has now been completed and represents the basis for this environmental impact statement. Following are the alternative plans considered during the master plan development process. Unlike the previous alternatives, these do not include the makai portion of the Kealakehe property. (Note the numbering of the alternatives in Master Plan analysis was #1 through 6, but has now been changed to #6 though 11 to avoid confusion with the first five alternatives discussed above.)

Alternative Concept 6: This alternative utilizes a series of mid-level roadways, aligned parallel to Queen Kaahumanu Highway, to establish a "terraced" development within the Kealakehe parcel.

Land Use:	840 acres of Kealakehe mauka of the Queen Kaahumanu Highway including a 160 acre golf course, and 450 acres of land proposed for purchase from the Queen Liliuokalani Trust.
Traffic:	A strong lateral orientation is defined by two north-south roadways (60 foot r.o.w.) linking Palani Road to two mauka-makai roadways; one, a 120 foot r.o.w. thoroughfare situated along the northern boundary of the property, and the second, a 60 foot r.o.w. extending mauka from Queen Kaahumanu Highway at the southern boundary of the property in a grand loop around the Kealakehe property and ending at the lowest mid-level roadway.
Residential:	Market housing borders the golf course on the north and east sides and is dispersed along the prime view corridors at the various terrace levels. Multi-



KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

Prepared by: BELT COLLINS & ASSOCIATES
Date: JUNE 1990

FIGURE 3-6
ALTERNATIVE CONCEPT SIX

family units are situated within the grand roadway loop near an elementary and high school. Residential villages between the midlevel roadways consist primarily of single-family unit developments.

Public Facilities: An elementary school is located along the lower mid-level roadway, with a high school situated between the middle and upper roadways. Three church and day care center sites are distributed throughout the project, one adjacent to the elementary school, the second between the archaeological park and plant preserve, and the third situated near Palani Road. The existing police facility is preserved and the landfill area is designated for development as a park, immediately mauka of a civic center.

Special Areas: An archaeological preserve is situated in the north eastern corner of the project area. An endangered plant park, which could be developed as an arboretum for endangered plants indigenous to the region, is located at the top of the grand loop.

Alternate Densities:

	Total Residential Acreage	@ 5 units per acre	@ 5.5 units per acre	@ 6 units per acre
Kealakehe (840 acres)	461	2,305	2,535	2,766
With 150 ac QLT land	606	3,030	3,333	3,636
With 450 ac QLT land	901	4,505	4,955	5,406

Alternative Concept 7: This alternative maximizes residential frontage along the proposed municipal golf course by segmenting the course and extending it mauka to a mid-level roadway.

Land Use: 840 acres of Kealakehe mauka of the Queen Kaahumanu Highway including a 190 acre golf course, and 450 acres of land proposed for purchase from the Queen Liliuokalani Trust.

Traffic: The mauka-makai thoroughfare (120 foot r.o.w.) is transformed into a residential boulevard by shifting it's alignment south and creating three elongated residential parcels between it and the northern property boundary. The boulevard is bisected at mid-level by a north-south roadway (60 foot r.o.w.) connecting to Palani Road. A second mid-level roadway is situated upslope linking Palani Road to a core area of public facilities.

Residential: Market housing borders the golf course on the north and east and south sides. Multi-family units are situated directly mauka and makai of an elementary and high school. Affordable single-family unit developments are concentrated in the QLT portion of the project area.

Public Facilities: An elementary school adjoining a church and day care complex is situated at the mauka intersection of the residential boulevard and the upper mid-level roadway. A high school is located south of the elementary school across the arboretum. A small neighborhood commercial center is situated near the high school just mauka of the mid-level roadway. The existing police facility is preserved and the landfill area is designated for development as a park, just mauka of a civic center.

CORRECTION

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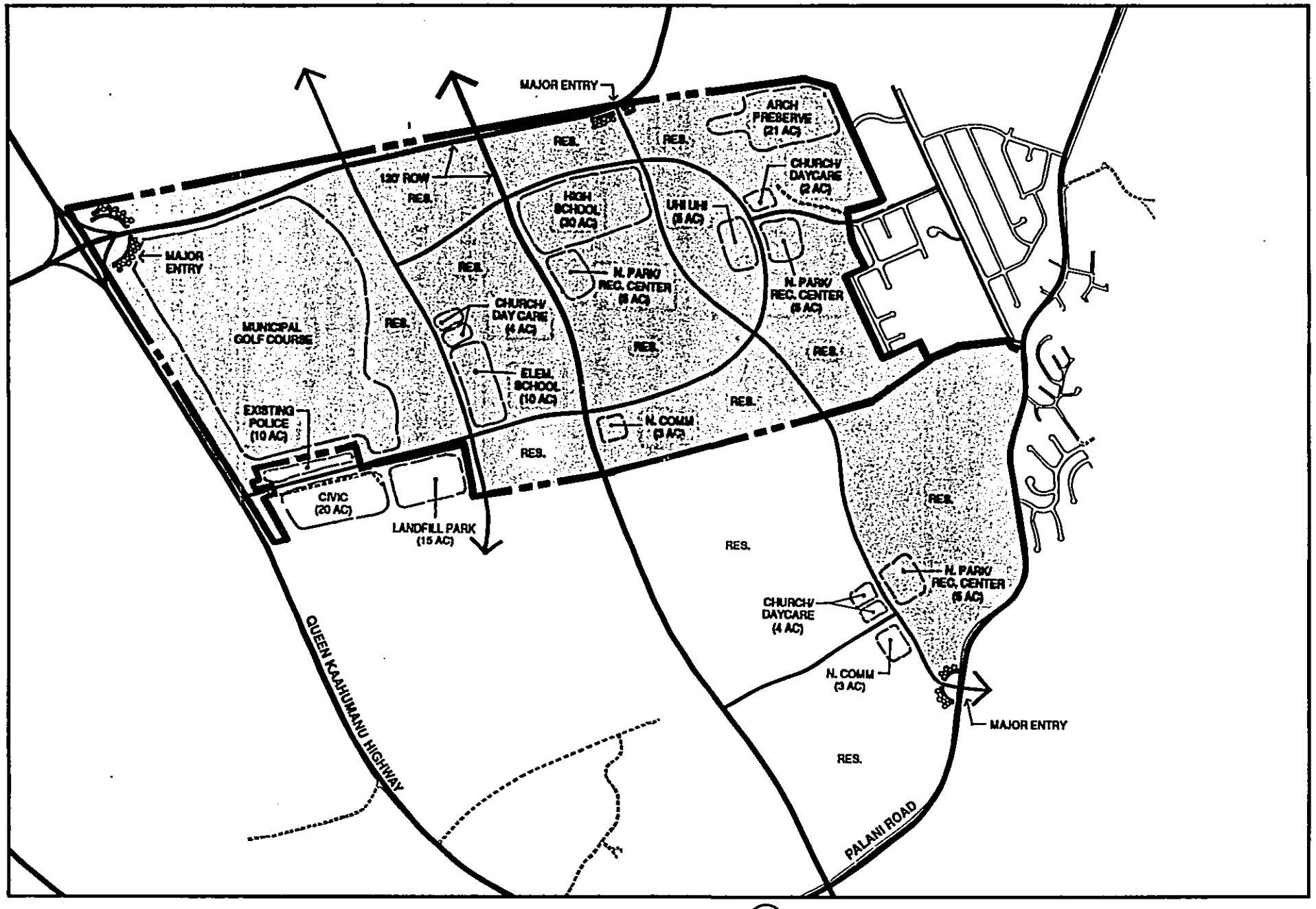

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KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

Prepared by: BELT COLLINS & ASSOCIATES
Date: JUNE 1990

FIGURE 3-6
ALTERNATIVE CONCEPT SIX

family units are situated within the grand roadway loop near an elementary and high school. Residential villages between the midlevel roadways consist primarily of single-family unit developments.

Public Facilities: An elementary school is located along the lower mid-level roadway, with a high school situated between the middle and upper roadways. Three church and day care center sites are distributed throughout the project, one adjacent to the elementary school, the second between the archaeological park and plant preserve, and the third situated near Palani Road. The existing police facility is preserved and the landfill area is designated for development as a park, immediately mauka of a civic center.

Special Areas: An archaeological preserve is situated in the north eastern corner of the project area. An endangered plant park, which could be developed as an arboretum for endangered plants indigenous to the region, is located at the top of the grand loop.

Alternate Densities:

	Total Residential Acreage	@ 5 units per acre	@ 5.5 units per acre	@ 6 units per acre
Kealakehe (840 acres)	461	2,305	2,535	2,766
With 150 ac QLT land	606	3,030	3,333	3,636
With 450 ac QLT land	901	4,505	4,955	5,406

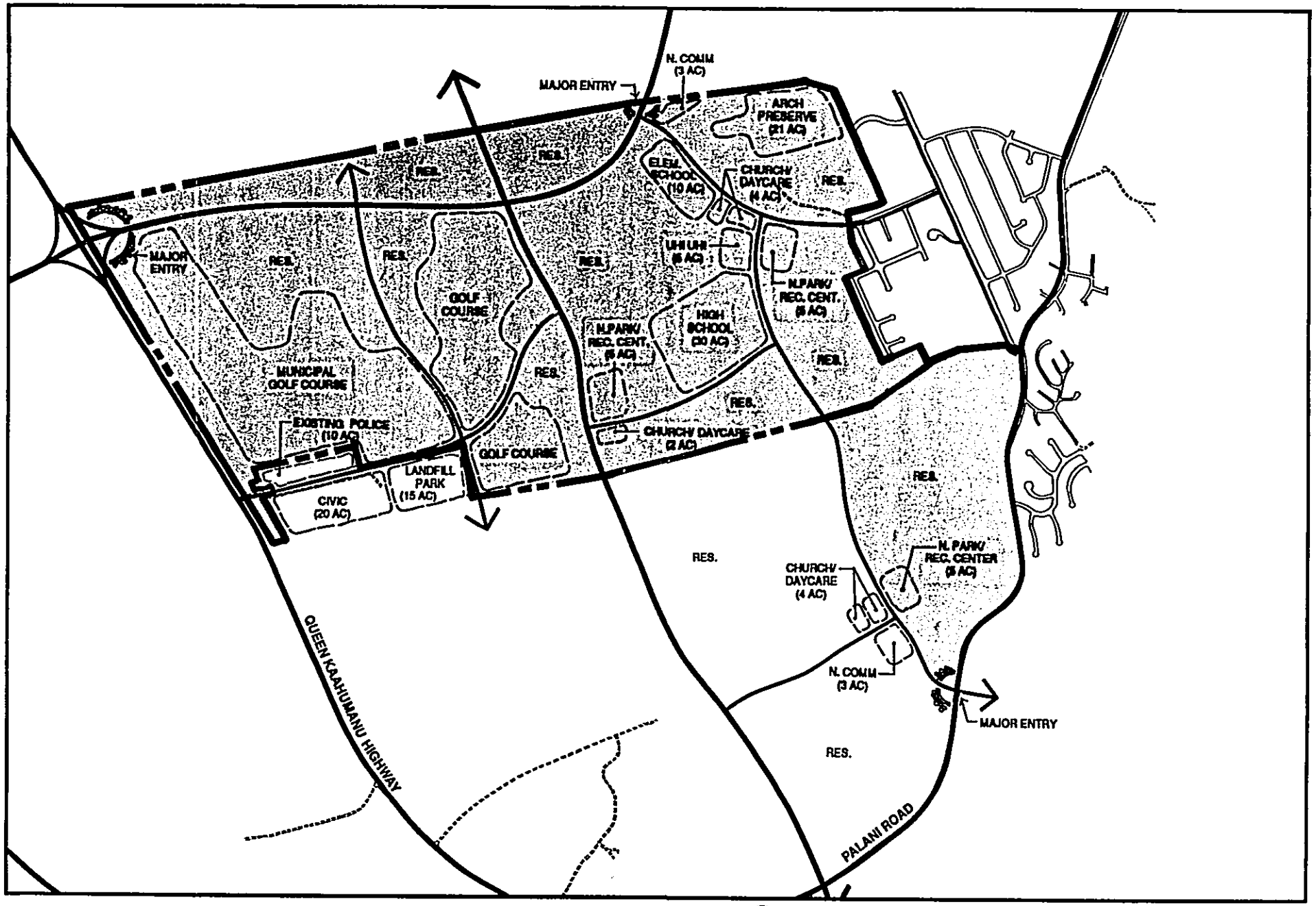
Alternative Concept 7: This alternative maximizes residential frontage along the proposed municipal golf course by segmenting the course and extending it mauka to a mid-level roadway.

Land Use: 840 acres of Kealakehe mauka of the Queen Kaahumanu Highway including a 190 acre golf course, and 450 acres of land proposed for purchase from the Queen Liliuokalani Trust.

Traffic: The mauka-makai thoroughfare (120 foot r.o.w.) is transformed into a residential boulevard by shifting it's alignment south and creating three elongated residential parcels between it and the northern property boundary. The boulevard is bisected at mid-level by a north-south roadway (60 foot r.o.w.) connecting to Palani Road. A second mid-level roadway is situated upslope linking Palani Road to a core area of public facilities.

Residential: Market housing borders the golf course on the north and east and south sides. Multi-family units are situated directly mauka and makai of an elementary and high school. Affordable single-family unit developments are concentrated in the QLT portion of the project area.

Public Facilities: An elementary school adjoining a church and day care complex is situated at the mauka intersection of the residential boulevard and the upper mid-level roadway. A high school is located south of the elementary school across the arboretum. A small neighborhood commercial center is situated near the high school just mauka of the mid-level roadway. The existing police facility is preserved and the landfill area is designated for development as a park, just mauka of a civic center.



KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

Prepared by: BELT COLLINS & ASSOCIATES
Date: JUNE 1990

FIGURE 3-7
ALTERNATIVE CONCEPT SEVEN

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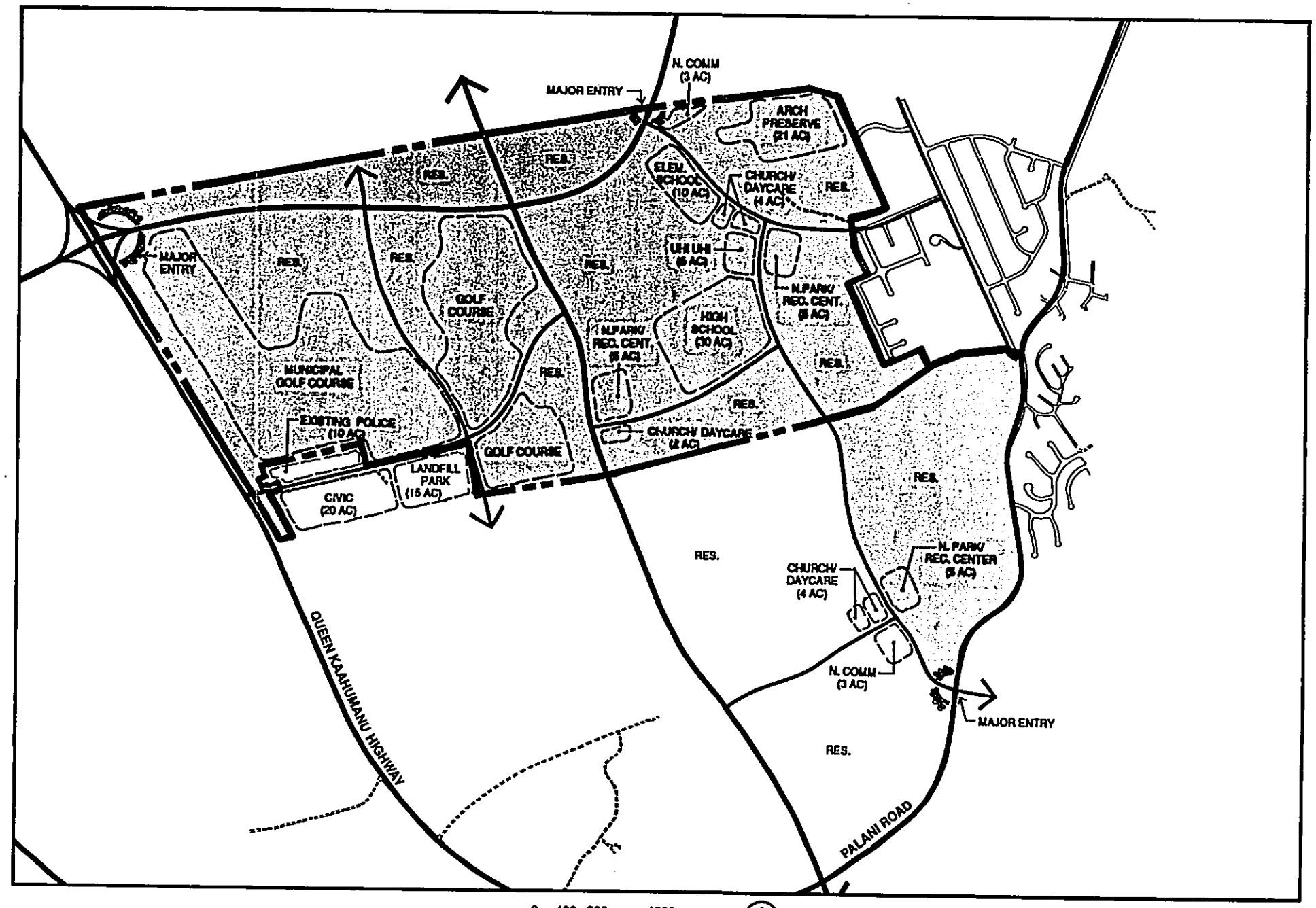


KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

Prepared by: BELT COLLINS & ASSOCIATES
Date: JUNE 1990

FIGURE 3-7
ALTERNATIVE CONCEPT SEVEN

Special Areas: An archaeological preserve is situated in the north eastern corner of the project area. An endangered plant park, which could be developed as an arboretum for endangered plants indigenous to the region, is located between the elementary school and high school.

Alternate Densities:

	Total Residential Acreage	@ 5 units per acre	@ 5.5 units per acre	@ 6 units per acre
Kealakehe (840 acres)	460	2,300	2,530	2,760
With 150 ac QLT land	605	3,025	3,327	3,630
With 450 ac QLT land	880	4,400	4,840	5,280

Alternative Concept 8: This alternative utilizes a loop road to establish a village core within the Kealakehe parcel. The circular village core is divided between a mix of public facilities including schools, a church/day care complex, an endangered plant preserve/park, with a neighborhood serving commercial area on the east side; and residential areas to the west. Additional residential neighborhoods surround the village core.

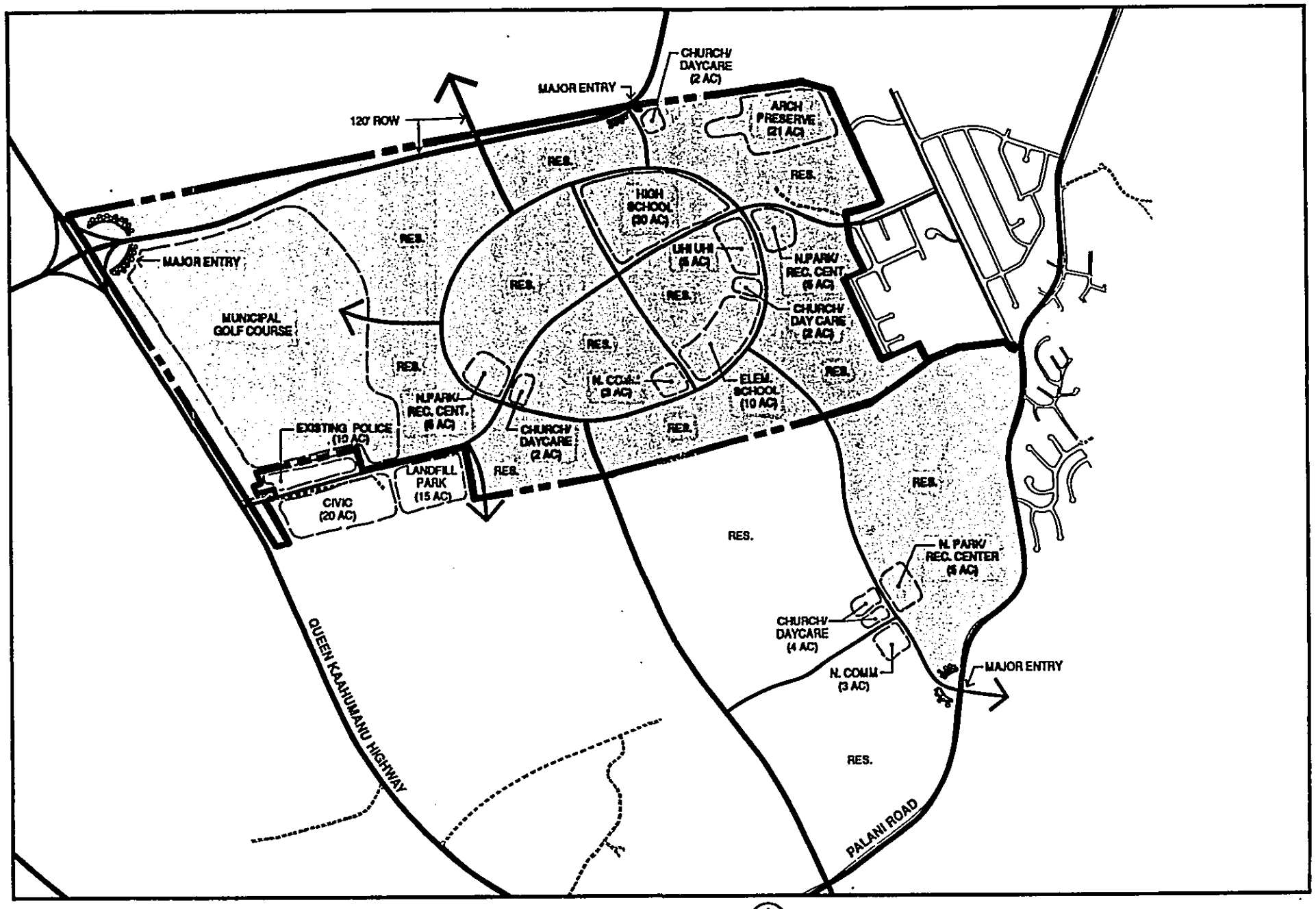
Land Use: 840 acres of Kealakehe mauka of the Queen Kaahumanu Highway including a 160 acre golf course, and 450 acres of land proposed for purchase from the Queen Liliuokalani Trust, situated between Kealakehe and Palani Road.

Traffic: A strong mauka-makai orientation is defined by two east-west roadways, one linking the mauka area to Queen Kaahumanu Highway and bisecting the village core (60 foot r.o.w.), and the second hugging the northern boundary of the property to create an unobstructed thoroughfare (120 foot r.o.w.) downslope to the highway. North-south traffic across the property is interrupted by the loop road (60 foot r.o.w.) surrounding the village core.

Residential: Market housing borders the golf course on the north and east sides. Moderate density multi-family units are situated within the central village core surrounded by single-family units developments. Residential areas outside of the village center consist primarily of single-family unit developments.

Public Facilities: Within the village core, an elementary school and a high school are separated by a large park which includes the arboretum. Additional public facilities include a church and day care center. A second church and day care center complex is situated at the southern end of the QLT property proposed for purchase by the State. The existing police facility is preserved as part of a civic center complex and the landfill area is designated for development as a park.

Special Areas: An archaeological preserve is situated in the north eastern corner of the project area. An endangered plant park, which could be developed as an arboretum is located on the eastern side of the village core.



KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

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Date: JUNE 1990

FIGURE 3-8
ALTERNATIVE CONCEPT EIGHT

Alternate Densities:

	Total Residential Acreage	@ 5 units per acre	@ 5.5 units per acre	@ 6 units per acre
Kealakehe (840 acres)	485	2,425	2,667	2,910
With 150 ac QLT land	630	3,025	3,327	3,630
With 450 ac QLT land	905	4,525	4,977	5,430

Alternative Concept 9: This alternative utilizes a network of roadways to establish a grid pattern of development with a traditional character.

Land Use: 840 acres of Kealakehe mauka of the Queen Kaahumanu Highway including a 160 acre golf course and 450 acres of land proposed for purchase from the Queen Liliuokalani Trust.

Traffic: This alternative emphasizes a series of mid-level roadways (60 foot r.o.w.) within the property, aligned parallel to Queen Kaahumanu Highway and two mauka-makai roadways (one 120 foot r.o.w, and one 60 foot r.o.w.) linking Queen Kaahumanu Highway to the upper mid-level roadway. With the exception of a small loop roadway with the 150 acre QLT parcel, the road network is characterized by a basic grid with traditional four-corner intersections.

Residential: Market housing borders the golf course on the north and east sides. Multi-family units are centrally located in the Kealakehe parcel just mauka of the middle north-south (mid-level) roadway. Residential areas between the mid-level roadways and within the QLT parcel consist primarily of single-family unit developments.

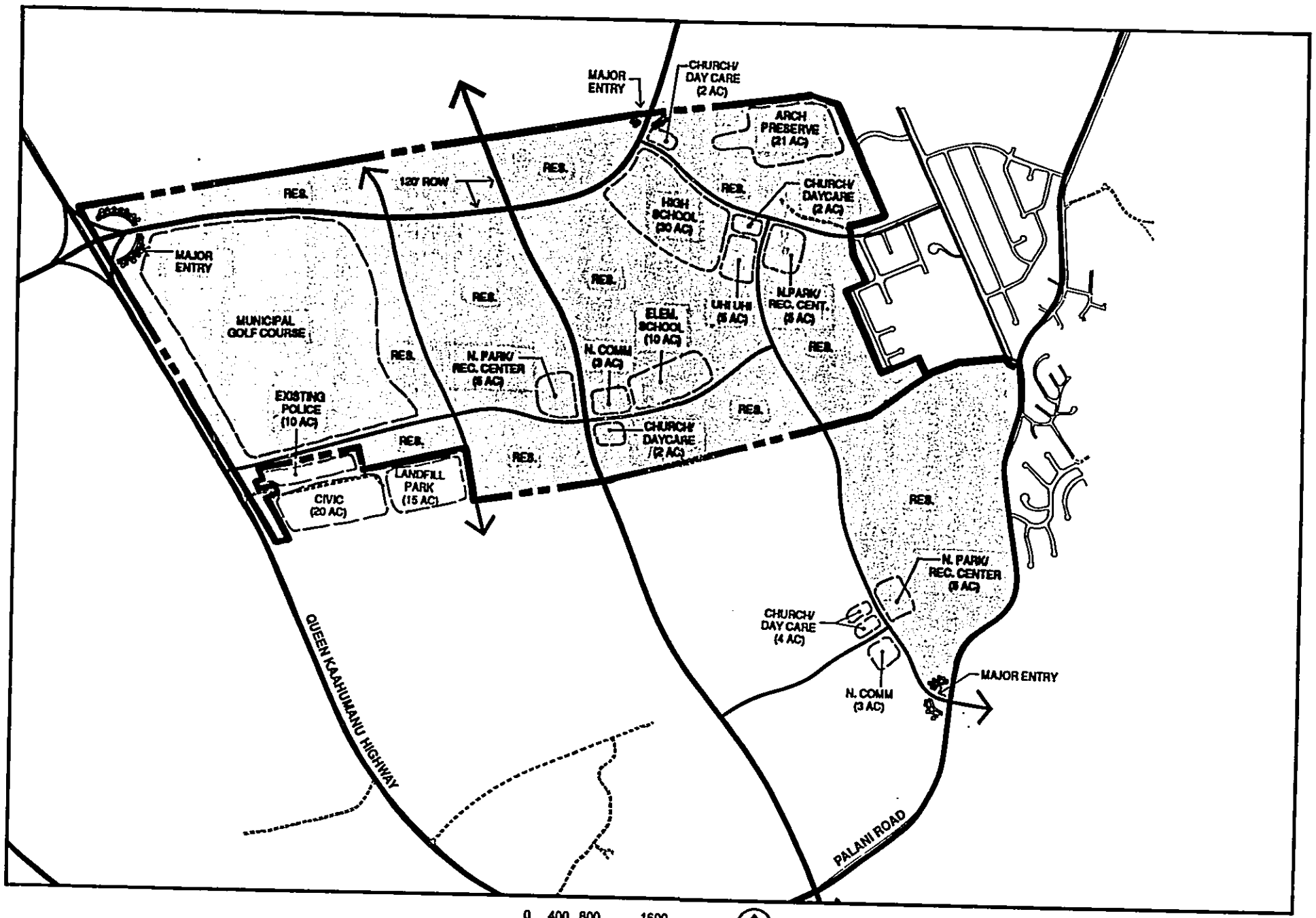
Public Facilities: An elementary school and high school are situated on either side of the plant preserve park. A neighborhood commercial area is located just makai of the elementary school. A single church and day care center site lies mauka of the high school between it and the archaeological park. The existing police facility is preserved and the landfill area is designated for development as a park, just mauka of a proposed civic center.

Special Areas: An archaeological preserve is situated in the north eastern corner of the project area. An endangered plant park, which could be developed as an arboretum for endangered plants indigenous to the region, is located below the upper north-south roadway.

Alternate Densities:

	Total Residential Acreage	@ 5 units per acre	@ 5.5 units per acre	@ 6 units per acre
Kealakehe (840 acres)	489	2,445	2,689	2,934
With 150 ac QLT land	634	3,170	3,487	3,804
With 450 ac QLT land	909	4,545	4,999	5,454

Alternative Concept 10: This alternative utilizes two mauka-makai roadways to link a series of six residential villages. A moderate density village is centrally located with the Kealakehe parcel



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ENVIRONMENTAL IMPACT STATEMENT

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Date: JUNE 1990

FIGURE 3-9
ALTERNATIVE CONCEPT NINE

with open space on either end in the form of a golf course on the makai side and a park preserve on the mauka end.

Land Use: 840 acres of Kealakehe mauka of the Queen Kaahumanu Highway including a 160 acre golf course, and 450 acres of land proposed for purchase from QLT.

Traffic: This alternative emphasizes two mid-level roadways (60 foot r.o.w.) aligned parallel to Queen Kaahumanu Highway and two mauka-makai boulevards (one 120 foot r.o.w, and one 60 foot r.o.w.) linking Queen Kaahumanu Highway to Palani Road and Mamalahoa Highway. Both mauka-makai roadways extend through the length of the property, well within the Kealakehe boundaries, rather than hugging the property borders, with one extending to Mamalahoa, and the other ending in a T-intersection with the upper mid-level roadway.

Residential: Full development consists of six separate villages. Market housing borders the elongated golf course extended in a mauka direction. Multi-family units are centrally located in the Kealakehe parcel on the south side of the mauka-makai roadway connecting Palani Road. Four additional residential villages are aligned across the mauka portion of the property.

Public Facilities: Three village cores are created, each containing a church/day care center, a neighborhood commercial area, and a small park. A high school site lies mauka of the lower mid-level roadway along the project's northern border. The police facility is preserved as part of a civic center area and the landfill is converted to a golf course driving range. A commercial area is situated at the intersection of Queen Kaahumanu Highway and the northern mauka-makai roadway.

Special Areas: An archaeological preserve is situated in the north eastern corner of the project area. An endangered plant park is located below the upper north-south roadway, defining the eastern end of the central village core.

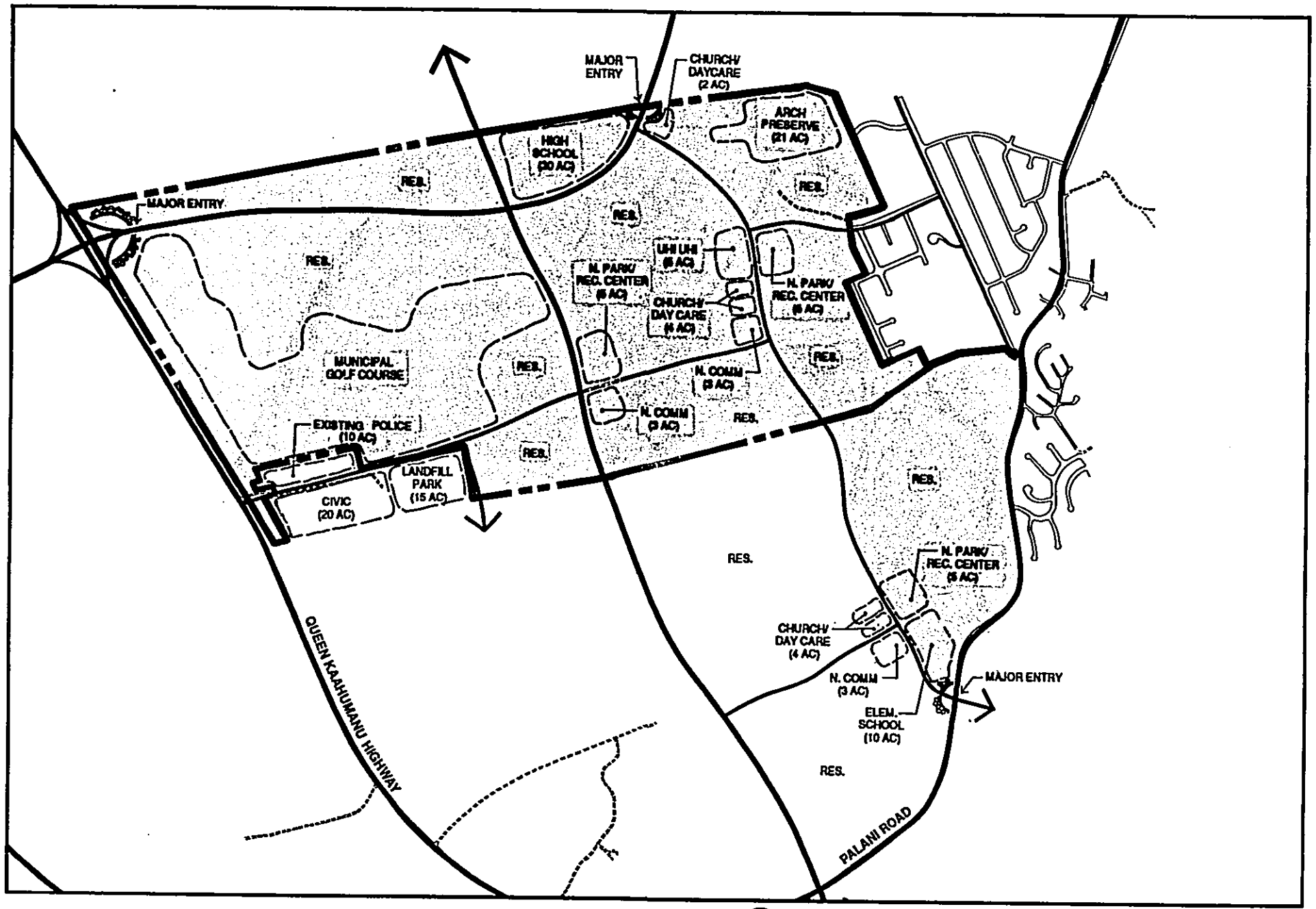
Alternate Densities:

	Total Residential Acreage	@ 5 units per acre	@ 5.5 units per acre	@ 6 units per acre
Kealakehe (840 acres)	508	2,540	2,794	3,048
With 150 ac QLT land	643	3,215	3,536	3,858
With 450 ac QLT land	918	4,590	5,049	5,508

Alternative Concept 11: This alternative maximizes residential uses along the golf course by simplifying the roadway pattern. Two moderate density villages are created; one centrally located along the mid-level roadway, and a second upslope near Palani Road.

Land Use: 840 acres of Kealakehe, mauka of the Queen Kaahumanu Highway including a 166 acre golf course, and 450 acres of land proposed for purchase from QLT.

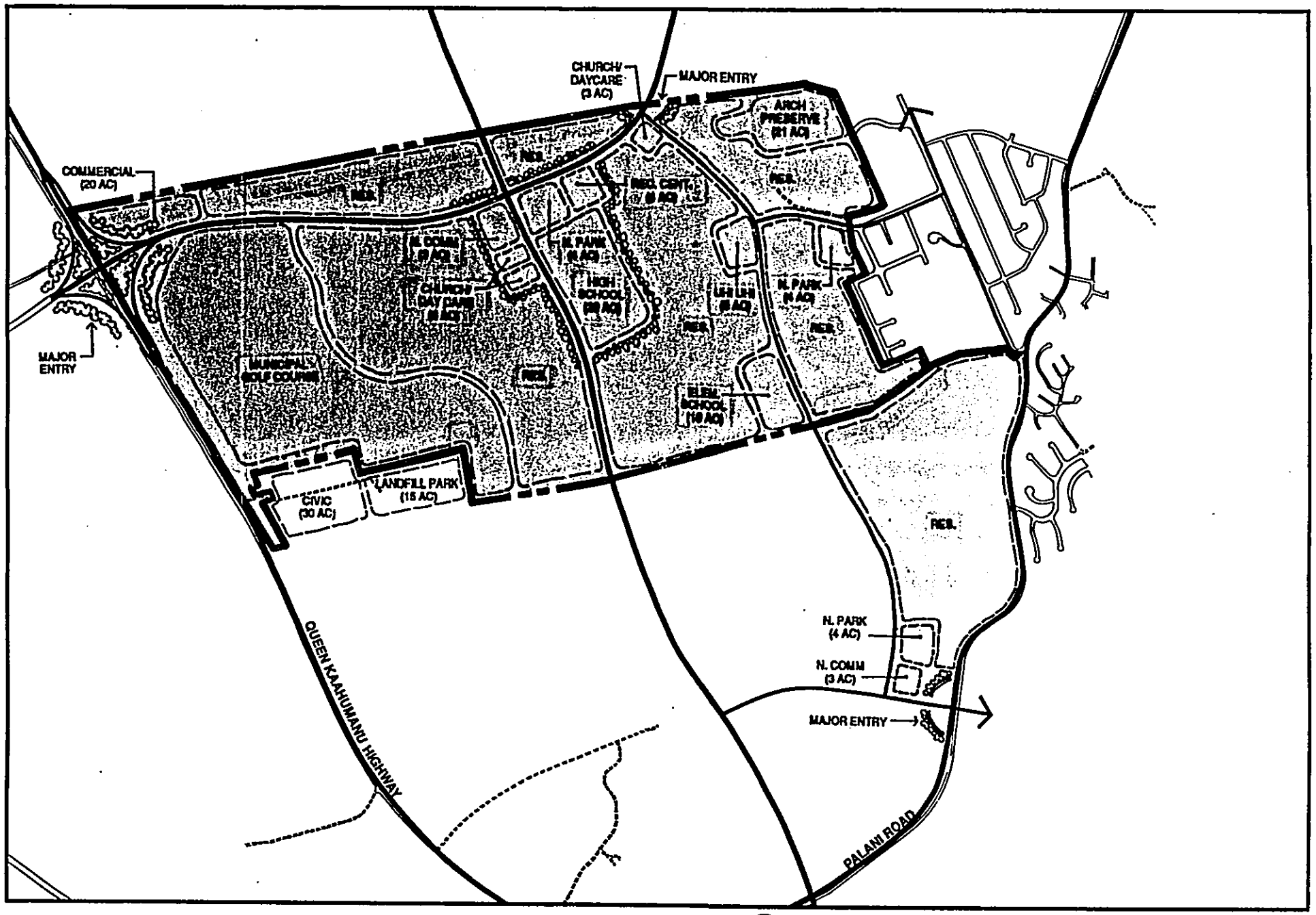
Traffic: This alternative emphasizes two mid-level roadways (one 120 foot r.o.w, and one 60 foot r.o.w.) aligned parallel to Queen Kaahumanu Highway and one mauka-makai boulevard (120 foot r.o.w.) linking Queen Kaahumanu Highway to



KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

Prepared by: BELT COLLINS & ASSOCIATES
Date: JUNE 1990

FIGURE 3-10
ALTERNATIVE CONCEPT TEN



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ENVIRONMENTAL IMPACT STATEMENT

Prepared by: BELT COLLINS & ASSOCIATES
Date: JUNE 1990

FIGURE 3-11
ALTERNATIVE CONCEPT ELEVEN

Kealakehe Street and eventually to Mamalahoa Highway. The mauka-makai roadway extends well into the property rather than hugging the property boundary, establishing a village core at its intersection with the mid-level highway.

Residential: Full development consists of six separate villages. Market housing borders the elongated golf course extended in a mauka direction. Multi-family units are centrally located in the Kealakehe parcel at the intersection of the mid-level highway and the mauka-makai roadway. Four additional residential villages are aligned across the mauka portion of the property.

Public Facilities: Two village cores are created, each containing a church/day care center, a neighborhood commercial area, and a small park. A high school site lies mauka of the lower mid-level roadway in the village core. The police facility is preserved as part of a civic center area and the landfill is converted to a public park. A 20 acre commercial area is situated at the intersection of Queen Kaahumanu Highway and the northern mauka-makai roadway.

Special Areas: An archaeological preserve is situated in the north eastern corner of the project area. An endangered plant park is located below the upper north-south roadway, defining the eastern end of the central village core.

Alternate Densities:

	Total Residential Acreage	@ 5 units per acre	@ 5.5 units per acre	@ 6 units per acre
Kealakehe (840 acres)	496	2,480	2,728	2,976
With 150 ac QLT land	629	3,145	3,459	3,774
With 450 ac QLT land	905	4,525	4,977	5,430

2.10 Development of the Project as Proposed

Based upon a careful review of all the alternatives, Concept 11 was selected by the HFDC as its Preferred Concept. Subsequently, the design of the golf course was altered to maximize residential frontage along the fairways. In addition, desired levels of density were established in order to guide infrastructure planning. It was determined that single family units would be developed at six units to the acre with multi-family units at twelve units to the acre. These refinements of Concept Plan 11 eventually led to the Master Land Use Plan upon which this document is based.

3. COMPARATIVE EVALUATION

The following table presents a comparative evaluation of major alternative actions to the proposed development. The table demonstrates the benefits, costs and general impacts associated with each alternative action.

TABLE 3-1: COMPARATIVE ANALYSIS OF DEVELOPMENT ALTERNATIVES

BENEFITS:	PROPOSED DEVELOPMENT	REDUCED SCALE	NO ACTION ALTERNATIVE	AGRICULTURAL DEVELOPMENT	RECREATIONAL DEVELOPMENT	RESOURCE EXTRACTION	RESORT DEVELOPMENT	INDUSTRIAL/ COMMERCIAL	PUBLIC FACILITIES
affordable housing	2	1	0	0	0	0	0	0	0
recreation facilities	2	1	0	0	1	0	2	0	1
improved access	2	1	0	0	1	0	2	1	1
economic growth	2	1	0	1	1	1	2	1	1
(2 = positive impact) (1 = minimal impact) (0 = possible negative impact)									
COSTS:									
public infrastructure	0	0	1	1	0	1	0	0	0
government expenditures	0	0	1	2	0	1	0	0	0
(2 = low) (1 = medium) (0= high)									
IMPACTS:									
endangered plants	1	1	2	0	1	0	1	0	1
archaeological sites	1	1	2	0	1	0	1	0	1
population growth	0	1	2	1	2	1	0	1	1
views	1	1	2	1	2	1	0	1	1
(2 = low) (1 = medium) (0 = high)									
TOTAL SCORE:	11	8	10	6	9	5	8	4	7

CHAPTER IV

CHAPTER IV
PHYSICAL AND NATURAL ENVIRONMENT

1. INTRODUCTION

This chapter presents a description of the environment affected by the proposed development. Following a description of each category of concern, a discussion of potential impacts is presented. The discussion is based upon the assumption of full development of the proposed project. Should the project be reduced in scale, it is presumed that potential impacts would be proportionately less for most of the categories discussed. Each section is concluded with a review of mitigation measures that would be required to minimize potential adverse impacts.

The information contained in this chapter is based upon three sources of information. The first source is detailed studies, including field studies, conducted by staff planners and engineers as well as consultants contracted specifically for this environmental impact statement. All subconsultant studies are included in their complete and final form as appendices to this document. The second source is comments received from public agencies, private groups, organizations and residents from the affected region, and elected and appointed officials, based upon their review of the environmental assessment and the concept plans for the project. The third source is comparisons and evaluations made by consultants relative to similar planned or existing projects.

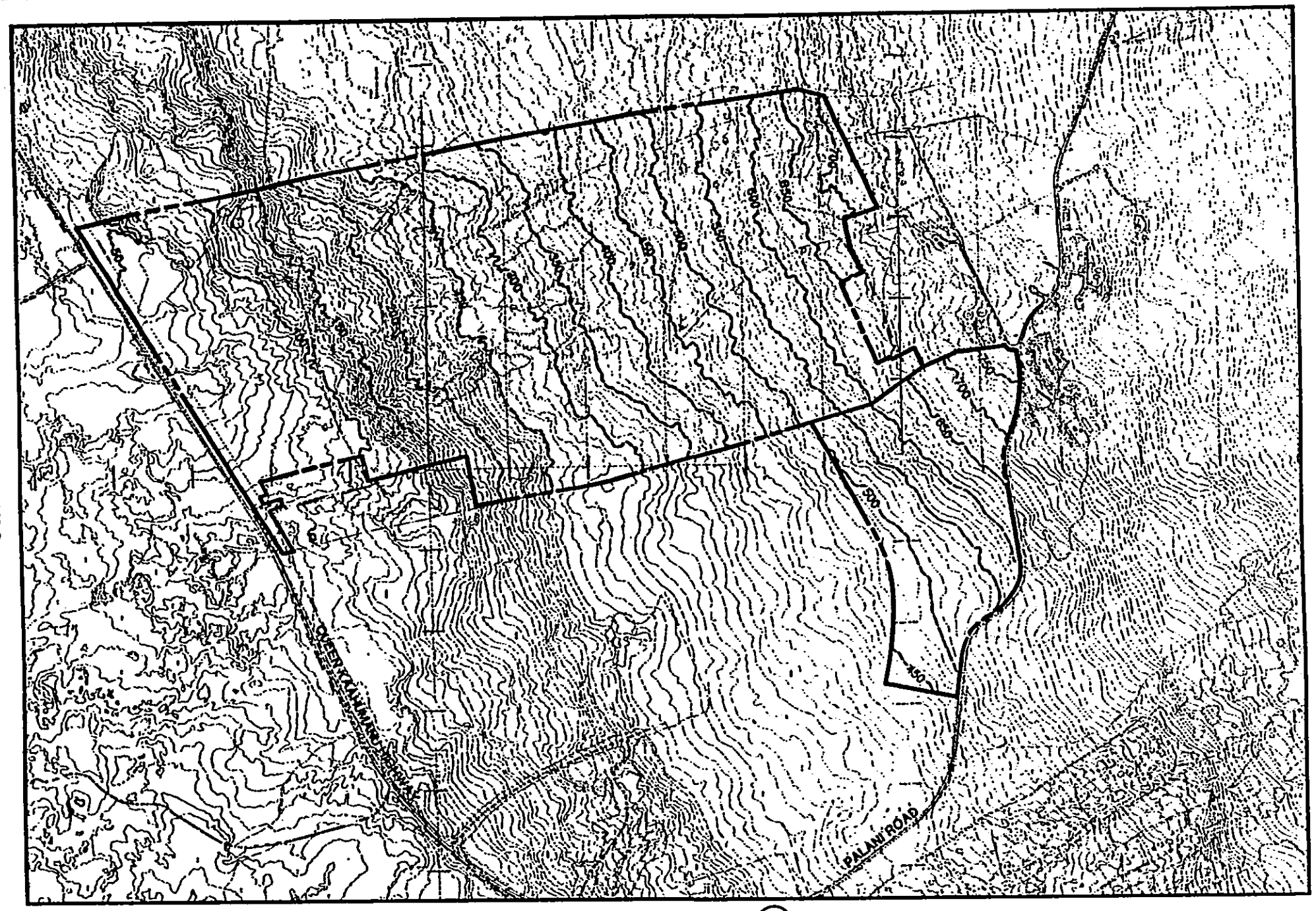
2. PHYSICAL ENVIRONMENT

2.1 Geology, Physiography, Soils, and Agricultural Potential

2.1.1 Existing Conditions

2.1.1.1 Geology and Physiography

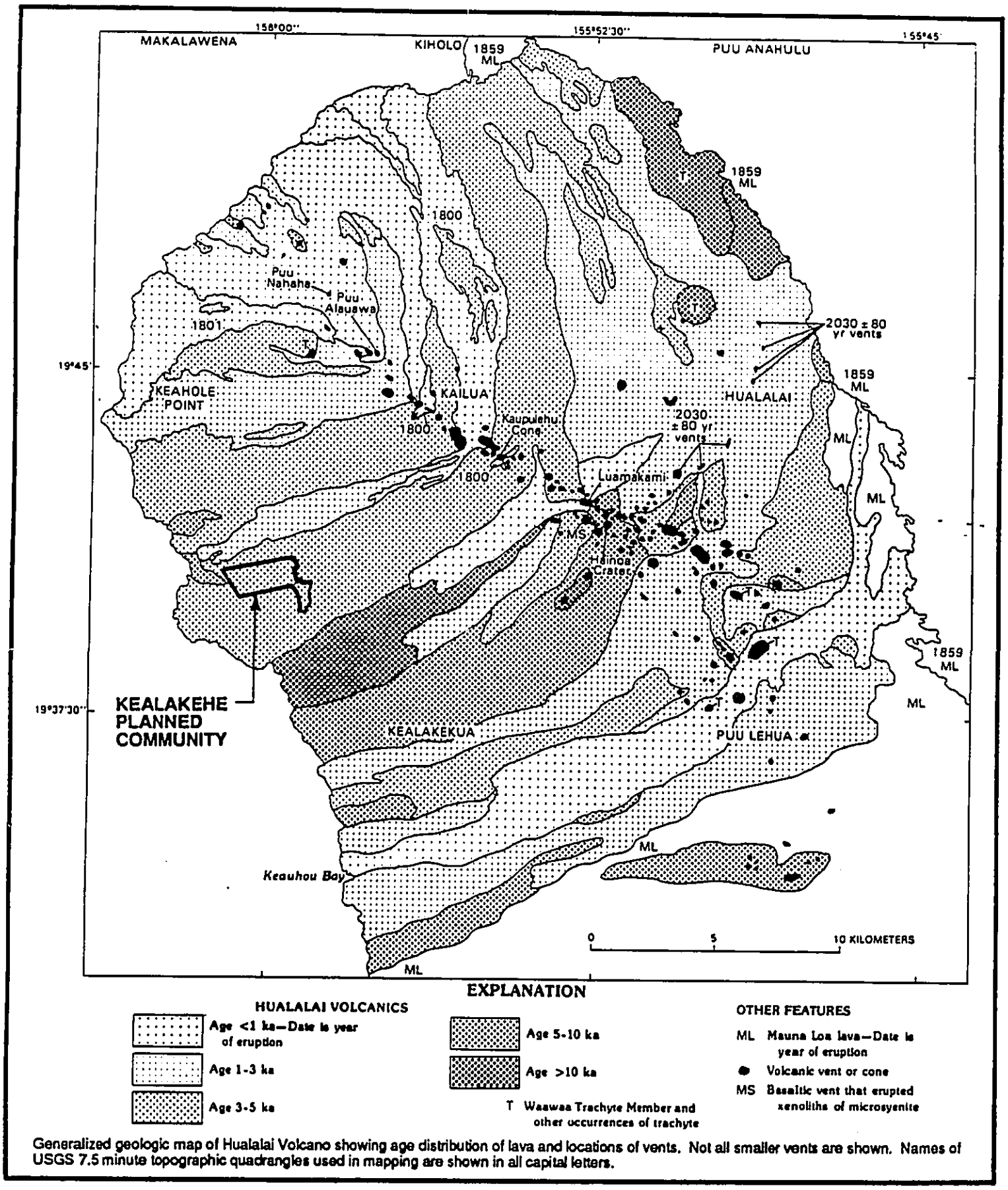
The project area consists of approximately 960 acres of land situated between the Queen Kaahumanu Highway and the existing Kealakehe community and Queen Liliuokalani Village. The property's topography is characterized by a continuous slope from an elevation of 50 feet at the highway to an elevation of 750 foot at the upper most portion of the project area (see Figure 4-1). The site area tends to be relatively flat from the highway to a point about 1,600 feet inland with a slope of just over three percent, before the property starts to rise in a relatively consistent manner with a slope of about twelve percent. Over the length of the entire property (a 9,600 foot linear distance), the elevation increases 700 feet resulting in an average slope of just over seven percent. However, the topography of the site is best characterized as a rough, uneven surface composed of a'a and pahoehoe lava flows which have formed rubble piles, mounds and gullies.



KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

Prepared by: BELT COLLINS & ASSOCIATES
Date: JUNE 1990

Figure 4-1
TOPOGRAPHY



Generalized geologic map of Hualalai Volcano showing age distribution of lava and locations of vents. Not all smaller vents are shown. Names of USGS 7.5 minute topographic quadrangles used in mapping are shown in all capital letters.

NORTH

Source: VOLCANISM IN HAWAII, U.S.G.S. PROFESSIONAL PAPER 1350
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Figure 4-2
GEOLOGY

As shown in Figure 4-2, the project area is located on the western slope of Hualalai volcano. The entire site is composed of lava estimated to be from three to five thousand years old.

2.1.1.2 Soils and Agricultural Potential

The project area consists of four soil types as classified by the United States Department of Agriculture Soil Conservation Service (December, 1973). Following is a description of the four soils types as presented in the Soil Conservation Services 1973 publication. The distribution of these soil types is presented in Figure 4-3.

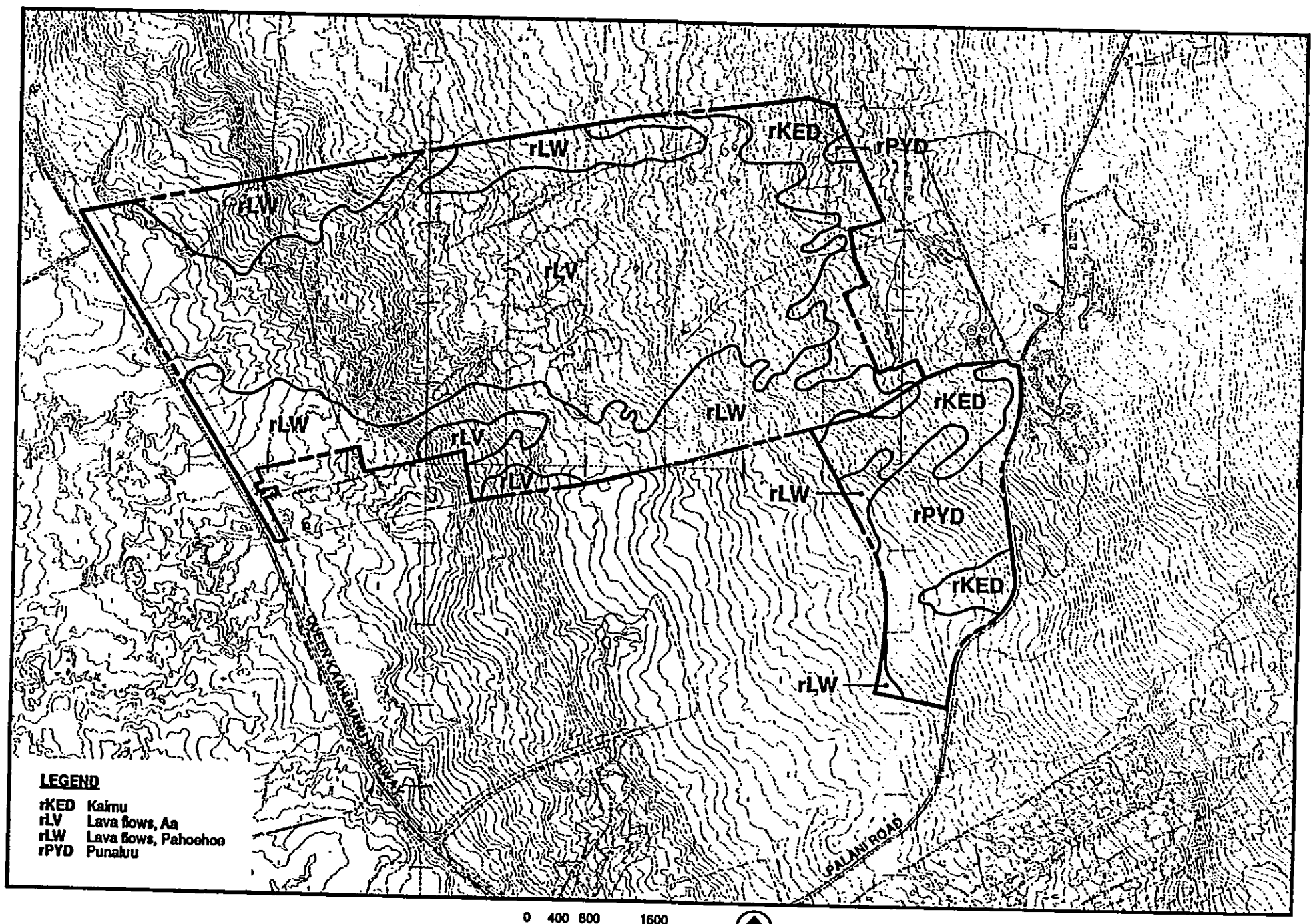
rLV A'a Lava Flows. This lava has practically no soil covering and is bare of vegetation, except for mosses, lichens, ferns, and a few small ohia trees. It is at an elevation ranging from near sea level to 13,000 feet and receives from 10 to 250 inches of rainfall annually. It is associated with pahoehoe lava flows and many soils. This lava is rough and broken. It is a mass of clinkery, hard, glassy, sharp pieces piled in tumbled heaps. In areas of high rainfall, it contributes substantially to the underground water supply and is used for watershed.

rLW Pahoehoe Lava Flows. This lava has a billowy, glassy surface that is relatively smooth. In some areas, however, the surface is rough and broken, and there are hummocks and pressure domes. Pahoehoe lava has no soil covering and is typically bare of vegetation except for mosses and lichens. In the areas of higher rainfall, however, scattered ohia trees, ohelo berry, and aalii have gained a foothold in cracks and crevices. This miscellaneous land type is at an elevation from sea level to 13,000 feet. The annual rainfall ranges from 10 inches to more than 140 inches. Some flat slabs of pahoehoe lava are used as facing on buildings and fireplaces. In areas of higher rainfall, this lava contributes to the groundwater supply.

rKED Kaimu extremely stony peat, 6 to 20 percent slopes. This soil is at low elevations on Mauna Loa. In a representative profile the surface layer is very dark brown extremely stony peat about 3 inches thick. It is underlain by fragmental A'a lava. This soil is neutral in reaction. Permeability is rapid, runoff is slow, and the erosion hazard is slight. This soil is not suitable for cultivation. Most of it is in native woodland. Small areas are used for pasture, macadamia nuts, papaya, and citrus fruits.

rPYD Punaluu extremely rocky peat, 6 to 20 percent slopes. This soil is low on the leeward side of Mauna Loa. Rock outcrops occupy 40 to 50 percent of the surface. In a representative profile the surface layer is black peat about 4 inches thick. It is underlain by pahoehoe lava bedrock. This soil is medium acid. The peat is rapidly permeable. The pahoehoe lava is very slowly permeable, although water moves rapidly through the cracks. Runoff is slow, and the erosion hazard is slight. Roots are matted over the pahoehoe lava. This soil is used for pasture.

According to the Detailed Land Classification, Island of Hawaii, a soil analysis published by the University of Hawaii's Land Study Bureau in 1972, the entire project area is classified as "E", or very poorly suited for agricultural productivity. This study presents a detailed analysis of



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ENVIRONMENTAL IMPACT STATEMENT

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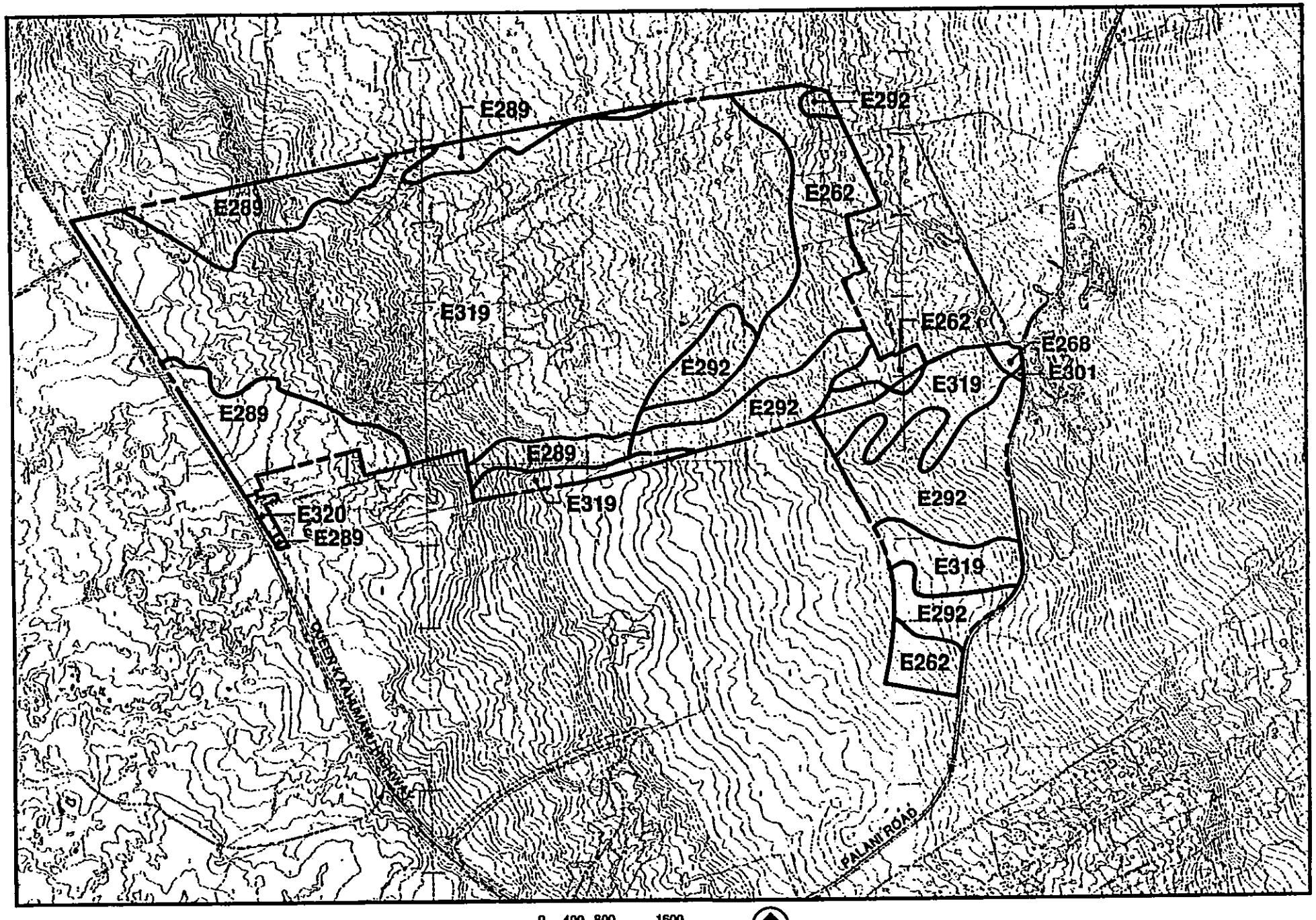
Date: JUNE 1990

Figure 4-3
SOIL STUDY



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NORTH

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ENVIRONMENTAL IMPACT STATEMENT

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Date: JUNE 1990

Figure 4-4
DETAILED LAND CLASSIFICATION

soil types identifying a total of seven variations of soil in the project area. The soil types (identifed by a numbering system) are presented in Figure 4-4. Following is a summary of the analysis.

TABLE 4-1: DETAILED LAND CLASSIFICATION

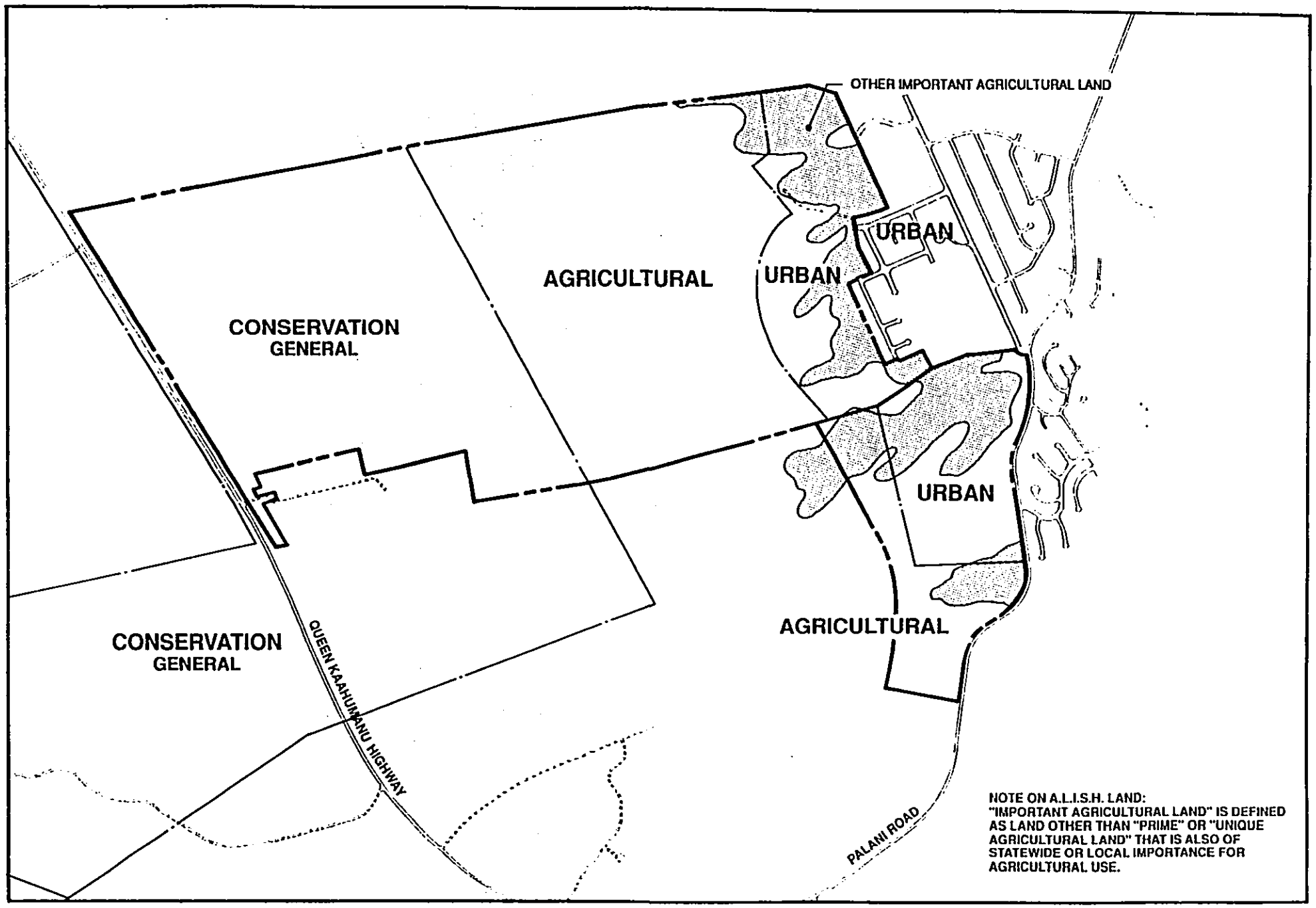
Soil	Parent Material	Stoniness	Drainage	% Slope	Machine Tillability
E262	A'a	Sharp lava clinkers	Excessively drained	0 to 35	Unsuited
E268	A'a pumice	Sharp lava clinkers	Excessively drained	0 to 35	Unsuited
E289	Pahoehoe	----------	Well drained	generally under 15	Unsuited
E292	Pahoehoe	----------	Well drained	generally under 20	Very poorly suited
E301	Volcanic Ash & pahoehoe	Slightly Stony	Moderately drained	0 to 35	Poorly suited
E319	A'a	Sharp A'a clinkers	Excessively drained	0 to 20	Unsuited
E320	Pahoehoe	----------	Well drained	0 to 20	Unsuited

A total of approximately 148 acres within the project area are identified as Other Important Agricultural Land under the State's ALISH system (Agricultural Land of Importance to the State of Hawaii). These lands are located generally in the northern portion of the property adjacent to the existing urban area and are identified in Figure 4-5. About 100 acres are located within the project area presently designated as Urban. The remaining 48 acres are designated as Agriculture. The remainder of the property has no agricultural value as determined by the State's ALISH system.

None of the land identified as Other Important Agricultural is utilized for the cultivation of crops due to its poor soil quality. Some areas within the upper region of the project site have been leased to Palani Ranch for cattle grazing.

2.1.2 Probable Impacts

Excavation, reshaping, grading and filling of the project area in preparation for the development of homesites, roadways, utilities and related land uses will impact the geology and



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ENVIRONMENTAL IMPACT STATEMENT

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Date: JUNE 1990

Figure 4-5
HAWAII STATE LAND USE DISTRICT BOUNDARIES/ALISH

physiography of the project area. While development of the project is intended to adhere to existing contours as much as possible, cut and fill will be required to meet county, state and federal design requirements for the various project elements.

The project will impact the limited agricultural activity (cattle grazing) existing on the property. Development of the property for residential purposes will preclude its use for cattle grazing. However, given the relatively poor quality of the soil and the scrub nature of its vegetation, the loss of these grazing lands is not considered to be a significant adverse impact. The soils of the project site are relatively thin and will be used on site for grading and project landscaping. It is likely that additional soils would be needed to be imported from other areas of the island to augment the available soil on-site. Overall, the potential impacts to soil and agricultural potential of the project site would be insignificant.

2.1.3 Mitigation Measures

Impacts to the geology and physiography of the project site can be mitigated to some degree through careful design of the project in an attempt to preserve existing contours. However, the natural formations of lava must be altered to allow construction of roadways and homesites. Construction activities will be conducted in accordance with applicable air and noise quality regulations to minimize potential fugitive dust and noise impacts on adjacent developed areas.

Due to the fact that agricultural activity on the project site is limited to cattle grazing, mitigation measures to minimize impacts on agriculture are not necessary.

2.2 Groundwater, Hydrology, Surface Water and Drainage

2.2.1 Existing Conditions

2.2.1.1 Groundwater and Hydrology

Kona's regional water resources can be classified in three categories; basal groundwater reserves, brackish basal groundwater, and dike-impounded perched groundwater. The basal aquifer extends from the upper slopes of Hualalai volcano to the shoreline and is recharged by regional rainfall. Seawater intrusion into the aquifer along the shoreline creates a brackish water reserve. The location and size of this brackish water aquifer extending inland from the shoreline is unknown due to the lack of a systematic survey to determine its extent. General assumptions about its size cannot be easily made because of the character of rainfall in the region and geologic formations which impact its distribution. Based on limited knowledge gained from existing wells, dike-impounded perched groundwater may exist at higher elevations on Hualalai. This has been

demonstrated by the success of previous well drilling efforts. However, given the size of the area and the varying geologic conditions, no specific predictions can be made about the exact location of potable water resources. Thus, beyond the knowledge of three general zones in the Kailua region, the specific character of groundwater resources under the project area is unknown. However, information gained from historical records would indicate that it is unlikely that the project lands are suitable for potable or non-potable water development, due to the project area's relatively low elevation and the probability that the brackish water aquifer could extend under at least a portion of the property (see Figure 4-6).

2.2.1.2 Surface Water and Drainage

As discussed earlier in this chapter, the subject property is covered with ancient a'a and pahoehoe lava flows. Due to the porous character of these flows and their rapid permeability, there are no known defined drainage ways or perennial streams within the project area. Consequently, no floodways or floodzones have been identified or recorded.

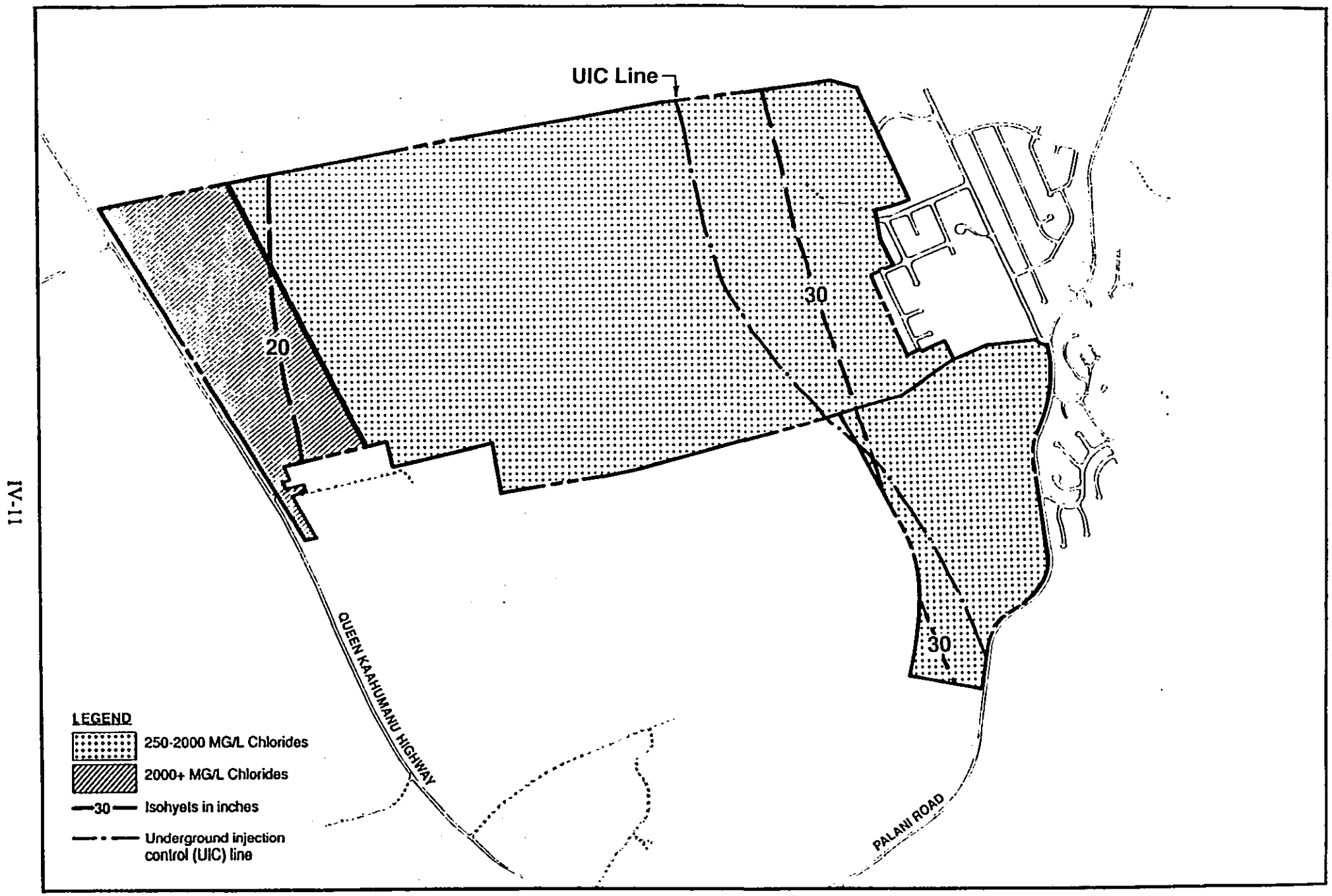
2.2.2 Probable Impacts

Immediate impacts to the groundwater, hydrology and drainage characteristics of the property could result from alterations to the existing land forms due to grading, cut and fill associated with site development and a subsequent change in percolation and drainage patterns. The importation of topsoil for landscaping purposes could result in substantial increases in soil runoff before ground cover on residential lots has been firmly established. Long term impacts could result from the introduction of pollutants associated with urbanization; most specifically biocides and fertilizers associated with landscaping and household and automotive-related chemical spills associated with the proposed residential and non-residential land uses.

Surface runoff and drainage from the property will increase due to an increase in impermeable surfaces such as rooftops, roadways, parking lots, playgrounds and sidewalks. Runoff from the roadways and parking lots could introduce petrochemicals associated with automobiles into the groundwater if allowed to percolate through underlying lava formations.

2.2.3 Mitigation Measures

Potential adverse impacts to the groundwater resources and drainage characteristics of the project site would be mitigated through the design and construction of a drainage infrastructure



KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

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Date: JUNE 1990

Figure 4-6
GROUND WATER

system in full compliance with Hawaii County Department of Public Works and State Department of Health standards. Soil runoff during the construction and pre-landscaping phases would be mitigated through careful design of residential areas, management controls established during construction, and a comprehensive landscaping program to be implemented with each phase of development. Potential adverse impacts from pollutants would be mitigated through the use of slow time release or rapid uptake fertilizers, and the United States Environmental Protection Agency and State Department of Health approved biocides that are applied by or under the direction of certified applicators. Petrochemical pollutants from street runoff can not be easily controlled.

2.3 Natural Hazards

2.3.1 Existing Conditions

Aside from storms and strong winds, the natural hazards which could have the greatest potential impact upon the physical character of the subject property are volcanic eruptions and earthquakes. Tsunamis are not considered to be a potential threat to the property because of its distance from the coastline and its elevation.

The proposed project is located on the western slope of Hualalai volcano, which rises to a height of 8,271 feet above sea level. As indicated in Figure 4-2, the project site is located between 7 and 8 miles west of Hainoa Crater, the volcano's summit, on a prehistoric lava flow estimated to be from three to five thousand years old. During the past 10,000 years (Holocene time), Hualalai has experienced about 200 eruptions with a general eruptive recurrence interval of about 50 years. However data indicates that eruptions have occurred in clusters (groups of several eruptions over a few hundred years, separated by several centuries of inactivity). Hualalai last erupted in 1800-01. Lava emerged at about the 1,600 feet elevation north of the project site and created a flow which reached the ocean north of Keahole Point. The intervals between the latest Holocene eruptions, including the 189 years since the last one, have lead geologists to suggest that a Hualalai eruption is highly probable within the next 200 years and could occur during the next few decades (Moore, Clague et. al., 1987).

Hazards associated with eruptions can be categorized in four types; lava flows, tephra falls, pyroclastic surges and volcanic gases. Volcanic hazard zones have been established for the entire island of Hawaii, including the Kailua region (Mullèneaux, et.al., 1987). The area surrounding Hualalai is designated as lava flow Hazard Zone 4 (with zone 1 being the highest and zone 9 being the lowest risk), and is characterized by lava coverage of less than fifteen percent in the past 750 years. Unlike the younger volcanoes, Mauna Loa and Kiluaea, the rift zones of Hualalai do not seem to have a distinctively higher degree of hazard than do its flanks.

Tephra, which consists of volcanic ash and coarser fragments produced by lava fountaining or explosive eruptions, is not considered to be a significant hazard at Hualalai. The entire volcano is contained in Tephra Hazard Zone 2 (on a scale of 1 to 3 with 1 representing the greatest risk), where tephra from lava fountains could be frequent but thin. A separate zone (2A) is designated for the summit and northwest rift zone of Hualalai, indicating a hazard from tephra falls more than ten centimeters thick in an area up to four kilometers on each side of the rift zone. The project area is approximately five miles outside of this zone.

Hazard zones for volcanic gases are the same as for tephra. All of Hualalai is located in Volcanic Gas Hazard Zone 2. Although the hazard is less than areas in zone 1, historical events indicate that gas effects could be significant far from a source vent. In 1977, gases from eruptions at Kilauea killed vegetation as far as 18 miles from their source (J.P.Lockwood, 1978).

No threat from pyroclastic surges, which are clouds of ash, rock fragments and gas which move at high speed outward from a source vent, has been identified for Hualalai. Pyroclastic surges are presently associated only adjacent to Kilauea caldera, although they could conceivably be initiated at other places where ground water or sea water can interact with magma.

The island of Hawaii experiences thousands of earthquakes every year, usually associated with volcanic activity or the movement of magma at shallow depths. Earthquakes endanger people and property by shaking structures and generating ground fractures, settling and landslides. Sudden subsidence along the shoreline associated with an earthquake can also generate a tsunami. The two most severe earthquakes during historical times occurred in 1868 and 1975. The magnitudes of both quakes exceeded 7 on the open-ended Richter scale and resulted in locally major damage in the Kau and Kilauea areas respectively. Both events generated a tsunami.

Although earthquakes associated with magmatic movement below Hualalai have been recorded, they are relatively infrequent when compared to earthquake activity at Mauna Loa and Kilauea. The most likely threat would, therefore, result from a large earthquake (magnitude 6 or greater) occurring at Mauna Loa or Kilauea and impacting the Kailua region. In 1983, landslides at Kealakekua Bay occurred shortly after a magnitude 6.6 earthquake occurred at a depth of seven miles, approximately mid-way between Mauna Loa and Kilauea.

2.3.2 Probable Impacts

The proposed project is not likely to have any impact on natural hazards to which the land might be subjected. However, natural hazards such as lava flows and earthquakes could have a

direct impact upon the proposed project. Based upon information developed by the United States Geological Survey (USGS) and published in its Professional Paper 1350 (1987), the likelihood of volcanic eruption at Hualalai is small relative to activity at Mauna Loa and Kilauea. Nevertheless, Hualalai is considered to be an active volcano and could erupt within the next few decades based upon its eruptive pattern over the past 10,000 years. An eruption of Hualalai could result in a lava flow inundating the project site. Due to the general slope of the property, such a flow could be expected to reach the ocean in a few hours. An eruption at Hualalai could also result in thin layers of tephra impacting the project site. Volcanic gases from an eruption might also impact the project site. However, both of these latter occurrences would depend in great part upon the size of the eruption, associated fountaining of lava, and wind direction.

Buildings, including residential structures, as well as roadways, sewer and water lines could be damaged by an earthquake of sufficient magnitude. Due to the general character of the project site, landslides resulting from an earthquake are unlikely. However, construction upon areas of substantial fill could be expected to be impacted at a higher degree than areas with no fill.

2.3.3 Mitigation Measures

The impact of lava flows upon the project site can only be mitigated with the intention of protecting life. The protection of property from lava inundation has proven to be relatively ineffective on a regional scale. Therefore, mitigation of lava flow hazards is limited to the provision of adequate evacuation routes and a civil defense warning system designed to provide area residents with as much advance notice of a threatening lava flow as possible.

Mitigation of hazards associated with earthquakes include adherence to County building codes and standards in order to minimize potential damage to structures. It is recommended that all building and structures within the proposed project be designed and constructed in compliance with applicable building codes and standards. It is further recommended that the use of large volumes of fill to establish level development sites be discouraged.

2.4 Visual Attributes

2.4.1 Existing Conditions

The existing visual character of the project site can be discussed from two vantage points; the first from the existing community of Kealakehe in the vicinity of Kealakehe Elementary and Intermediate School and the neighboring residences looking makai toward the ocean, and the second from Queen Kaahumanu Highway looking mauka toward the existing community.

The view makai is to some degree obscured by existing vegetation. Views of the ocean and coastline can be seen from some parts of the existing community. Views of the subject property are generally limited to the those areas abutting existing residential lots. The makai view of the project site can be best described as areas of pahoehoe and a'a rubble with vegetation cover ranging from sparse grasses to dense thickets of kiawe (*Prosopis pallida*). Kailua town and the coastline to the south cannot generally be seen. The dominant view is of the coastline west of the property, Honokohau Harbor, and the coastline extending to the north. The Kealakehe landfill is visible from portions of the existing community and wisps of smoke and fugitive dust associated with the landfill are clearly visible.

The mauka view is characterized by gently sloping land extending from the highway up to the existing community. The view of the land within the project site is much improved over the view makai from the existing community. The project site appears to consist of areas of barren lava, offset by large patches of grass and dense stands of kiawe. The existing residences of Kealakehe, as well as Kealakehe school are visible from the highway. The summit of Hualalai is visible on clear days.

2.4.2 Probable Impacts

The proposed project will result in changes to the existing views. The land will be converted from open area to a series of residential subdivisions, a community commercial area, and public golf course. The general character and density of the development will be similar to the existing community. Initial development of the area will result in a clearing of the vegetation which will improve views of the property. However, once development is completed and landscaping has taken hold, the project will appear to be an extension of the existing community and will be characterized by low residential profiles of not more than two stories, and yard and street trees. The proposed commercial center near Queen Kaahumanu Highway will be visible from the highway, but due to the relatively flat topography, will not obstruct mauka views. The proposed Civic Center in the vicinity of the Kealakehe landfill may include buildings from two to four stories or more in height. The lower portion of the project will be developed as a public golf course and will appear to be a spacious open area with tree lined fairways clearly visible from the highway and portions of the existing community. The proposed mauka-makai roadway (Kealakehe Parkway) will be visible from both the mauka and makai vantage points.

2.4.3 Mitigation Measures

Views of the ocean and coastline will be preserved wherever practicable. Residences will be sited to take advantage of makai views. Mauka views of Hualalai will also be preserved. Potential impacts to views will be mitigated through the creation of view corridors and the use of landscaping. General views will be preserved by limiting the height of residential structures. The location of the proposed golf course in the lower portion of the project area will ensure that views of the ocean from the proposed community are not obstructed. The visual impact of the commercial area and Civic Center will be mitigated through the limiting of building heights, the use of landscaping and the creation of view corridors.

3. NATURAL ENVIRONMENT

3.1 Terrestrial Flora

Following is a summary of the botanical survey conducted for the proposed project by Char and Associates. The survey is included in its entirety in the appendix to this environmental impact statement.

3.1.1 Existing Conditions

A botanical survey of the subject property was conducted in July, 1989 to assess the botanical resources present. The objectives of the survey were to (1) provide a general description of the major vegetation types; (2) inventory the terrestrial, vascular flora; and (3) search for threatened and endangered plants on the project site. A walk-through survey method was employed. Areas most likely to harbor native plant communities or rare species, such as the open, mixed shrubland and rougher a'a lava flows, were more intensively examined. Species identification was made in the field; plants which could not be positively determined were collected for later identification in the herbarium and for comparison with taxonomic literature.

A total of 145 plant species were inventoried on the project site during the field survey. Of these, 110 (76% are introduced or alien species, 31 (21%) are native, and 4 (3%) are of Polynesian origin. Among the 31 species of native plants, 16 species are indigenous (native to the Hawaiian islands and also elsewhere) while 15 are endemic (native only to the Hawaiian islands).

Four major vegetation types were identified on the project site. The distribution of the four vegetation types corresponds roughly with substrate type, rainfall, and elevation. Rainfall varies from 20 inches annually near Queen Kaahumanu Highway to nearly 50 inches annually at the

upper boundary of the project area. A'a lava flows run the length of the property, while more weathered pahoehoe flows are found along the peripheries of the property; with one small section of Punalu'u extremely rocky peat overlying pahoehoe bedrock in the northeastern corner of the project site (Sato et al. 1973).

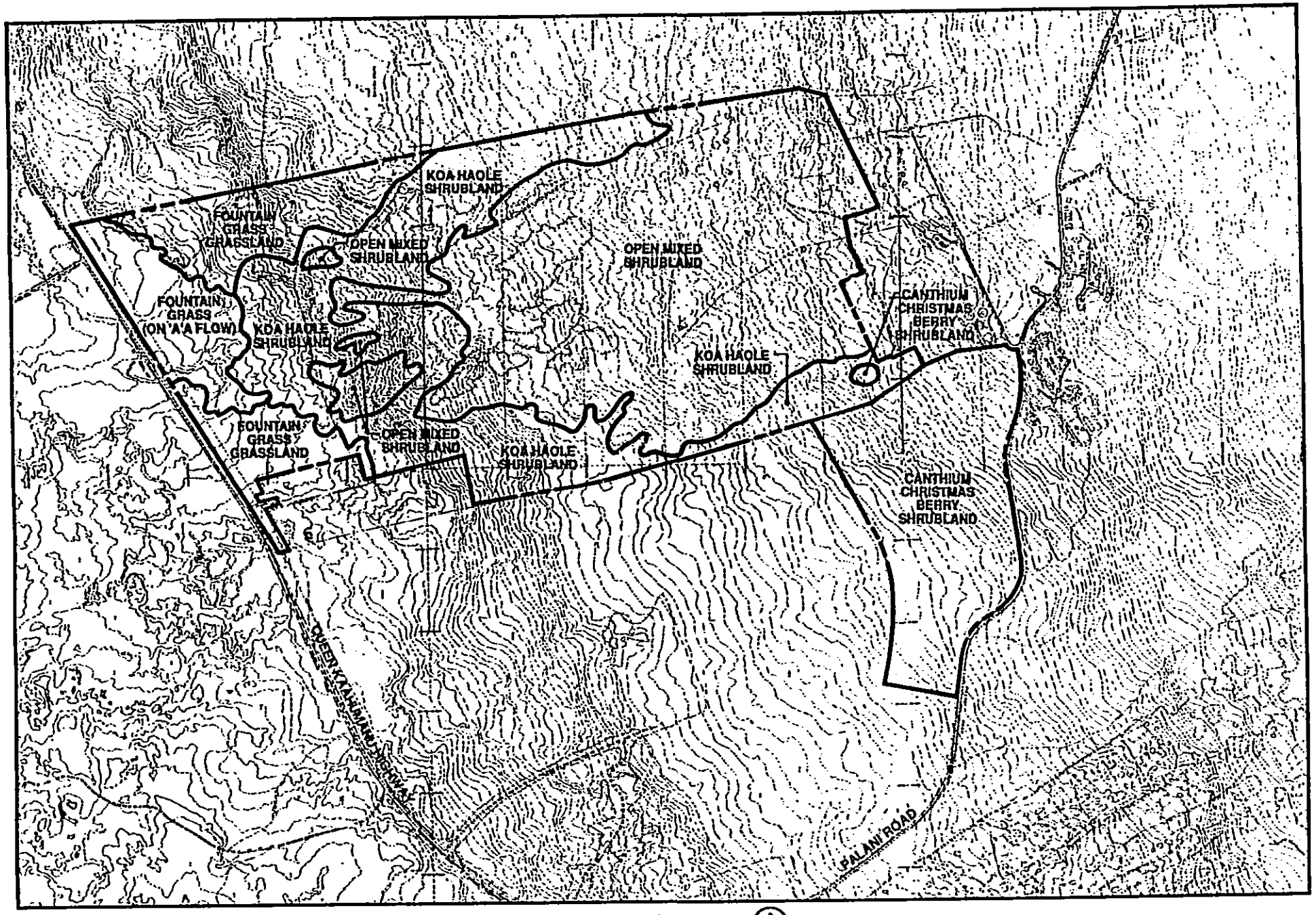
Following is a description of the four vegetation types identified. Figure 4-7 presents the distribution of these vegetation types.

Open Mixed Shrubland. This vegetation is generally distributed above the 400 foot contour interval on a'a lava. It may extend to lower elevations on some flows with many of the native elements quickly attenuating. The physiognomy is of an open scrub with scattered trees, although in depressions with small gullies shrubs and trees may form dense thickets. Native and introduced shrubs occur in about equal numbers, although among the natives alahe'e (Canthium odoratum) and al'ali'i (Dodonaea viscosa) are locally abundant in places, while among the introduced plants koa-haole (Leucaena leucocephala), klu (Acacia farnesiana), and Christmas berry (Schinus terebinthifolius) are locally abundant. Trees occur as scattered individuals or small, scattered stands. Native shrubs and trees include mamane (Sophora chrysophylla), lama (Diospyros sandwicensis), alahe'e, maiapilo (Capparis sandwichiana), a'ali'i, Bidens micrantha ssp. ctenophylla, kalamona, (Senna gaudichaudii), naio (Myoporum sandwicense), uhi uhi (Caesalpinia kavaiensis), wiliwili (Erythrina sandwicensis), and 'ohe (Reynoldsia sandwicensis). The more commonly occurring introduced shrubs include koa'haole, Christmas berry, klu, lantana (Lantana camara), guava (Psidium guajava), senna (Senna septemtrionalis), and pluchea (Pluchea symphytifolia). Introduced trees include kukui (Aleurites moluccana), jacaranda (Jacaranda mimosifolia), silk oak (Grevillea robusta), and monkeypod (Samanea saman).

Ground cover is usually a mixture of grasses, smaller shrubs or subshrubs, and young koa-haole plants less than a foot high. These include Natal redtop (Rhynchelytrum repens), fountain grass (Pennisetum setaceum), Guinea grass (Panicum maximum), love grass (Eragrostis tenella), molassesgrass (Melinis minutiflora), Bermuda grass (Cynodon dactylon), 'uhaloa (Waltheria indica), 'ilima (Sida fallax), coffee senna (Senna occidentalis), false mallow (Malvastrum coromandelianum), nettle-leaved vervain (Stachytarpheta urticifolia), indigo (Indigofera suffruticosa), bur bush (Triumfetta rhomboidea), and air plant (Kalanchoe pinnata).

Cattle grazing on this part of the property tends to keep most of the open mixed shrubland low and there are numerous cattle paths through the shrubland. Where cattle congregate, usually under trees and where there is some soil, plants of acute-leaved sida (Sida acuta), bur bush, hairy honohono (Commelina benghalensis), false mallow, amaranth (Amaranthus viridus), and coffee senna are more numerous.

There are minor variants of this shrubland. For example, along the upper boundary, adjacent to the residential area and public housing, the property has been more disturbed as evidenced by the large piles of boulders, a number of dozer



KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

Prepared by: BELT COLLINS & ASSOCIATES
Date: JUNE 1990

Figure 4-7
VEGETATION

walks, and piles of rubbish. In this area, weedy species such as Spanish needle (Bidens pilosa), Florida beggarweed (Desmodium tortuosum), hyptis (Hyptis suaveolens), etc., are abundant, and California grass (Brachiaria mutica) forms extensive mats. Where the substrate is weathered pahoehoe, fountain grass becomes more numerous.

Canthium/Christmas Berry Shrubland. This vegetation type occurs on the 150-acre parcel which is included in the proposed community. The Canthium/Christmas berry shrubland continues across the slope and extends onto the adjacent Queen Liliuokalani Trust Keahuolu lands where a recent flora survey was conducted (Char, 1989).

The substrata is a'a with blocky chunks generally 4 to 6 inches in diameter. Both alahe'e (Canthium odoratum) and Christmas berry occur in almost equal numbers, though one or the other may be more abundant in places. The shrubs form dense thickets, 10 to 15 feet tall. Scattered through the shrubland are clusters of mamane, 18 to 20 feet tall; other native shrubs and trees including wiliwili, a'ali'i 'ohe, Bidens micrantha ssp. ctenophylla, lama, and 'ohi'a (Metrosideros polymorpha). Introduced trees and shrubs, which also generally occur as scattered individuals, include jacaranda, silk oak, autograph tree (Clusia rosea), guava, kukui, and monkeypod. Koa-haole forms small clumps in places but is not abundant. Near the school boundary, large plants of sisal (Agave sisalana) are found.

Ground cover varies from 40 to 50% and is composed of seedlings of the tree and shrub species mentioned above plus a mixture of grasses and weedy herbs, though litter and barren a'a predominate. Low-lying, open areas are often filled with Natal redtop, molassesgrass, lantana, fountain grass, 'ilima, and air plant. Locally abundant, twining and sprawling over shrubs, are vines of huehue (Cocculus triloba).

Koa-haole Shrubland. This vegetation type is generally found associated with pahoehoe substrate. Dense to open koa-haole shrublands are found adjacent to the Kealakehe residential area, the County landfill, and above the quarry and cement batching plant. The koa-haole plants vary in height from 8 to 12 feet tall, although, in places, they may be somewhat taller. Scattered trees of kiawe (Prosopis pallida) and 'opiuma (Pithecellobium dulce) are usually found associated with this shrubland. Other trees and shrubs occasionally found here include alahe'e, Christmas berry, monkeypod, lantana, maiapilo, and naio. Locally abundant are 'ilima and 'uhaloa.

Lower elevation koa-haole shrubland usually supports a dense ground cover of fountain grass, while upper elevation shrubland has a ground cover composed of Natal redtop, fountain grass, and various weedy species as nettle-leaved vervain (Stachytarpheta urticifolia), beggar's tick (Bidens pilosa, Bidens cynapifolia), hairy abutilon (Abutilon grandifolium), and air plant.

Where this vegetation type occurs on a'a substrate, there is very little ground cover and the koa-haole shrubs tend to occur in scattered patches usually in shallow depressions.

Fountain Grass Grassland. Along the northern boundary of the subject property, where it abuts Palani Ranch, fountain grass forms a rather extensive and dense grassland. Koa-haole shrubs occur as scattered individuals, although, in low-lying areas they may sometimes form small-sized thickets. Other shrubs and subshrubs occasionally found in the grassland include 'ilima, indigo (Indigofera suffruticosa), alahe'e, 'uhaloa, and maiapilo. A few trees of kiawe and 'ohe can be observed scattered through the grassland; one rather large tree of maua (Xylosma hawaiiense), about 20 feet tall, is found on a rocky knoll near the jeep trail that begins behind the quarry.

On the a'a flow adjacent to Queen Kaahumanu Highway, fountain grass occurs in scattered clumps. In these areas, 'uhaloa and 'ilima are abundant.

In general, these grasslands tend to be species poor as the aggressive fountain grass forms a dense cover which crowds out other plants. Fountain grass is considered a serious pest in dry areas of the Big Island as it outcompetes most native species for establishment. It is also a fire-adapted species. The grass burns swiftly and hot causing extensive damage to native dry forest. After fires it is able to quickly reestablish itself (Wagner et al. in press).

3.1.2 Threatened and Endangered Plants

One officially listed endangered species, the uhi uhi (Caesalpinia kavaiensis; formerly known as Mezoneuron kavaiense), and one candidate endangered species, Bidens micrantha *subspecies (ssp.)* ctenophylla (no common name), occur on the Kealakehe site. An officially listed endangered species is protected by the Federal Endangered Species Act of 1973 (16USC 1531-1543), as amended, and by the State's threatened and endangered wildlife and plants law (Chapter 124, Hawaii Revised Statutes, Title 13, Subtitle 5, Part 2). Bidens micrantha ssp. ctenophylla is considered a Category 1 candidate endangered species by the United States Fish and Wildlife Service (1985). Plants considered Category 1 material should be regarded as candidates for addition to the Endangered and Threatened Species List and, as such, consideration should be given them in environmental planning.

The uhi uhi is a large shrub to medium-sized tree (up to 30 feet tall) with thick, rough, dark gray bark and very dark blackish-brown heartwood. The leaves are twice divided into smaller leaflets with 4 to 8 pairs of pale green leaflets per pinnae. The flowers are borne in clusters at branch tips and are pinkish-purple to brick red. The seed pods are flat and thin; bluish-glaucous when young, pale pinkish-tan to gray when older. The Hawaiians used the strong, dark, heavy wood for spears and fishing implements called la'au melomelo or la'au makalei (Rock 1913, 1920).

Uhi uhi was first described from the island of Kauai in 1867. Later specimens were

collected on O'ahu and Maui. Uhi uhi plants were discovered in the North Kona area in 1909. Today the populations have been greatly reduced. Only a single tree is known from the Kaua'i plantation, a few plants occur in the Wai'anae mountains on O'ahu, and about two dozen plants have been recorded on the slopes of Hualalai in the Pu'uwaawaa-Ka'upulehu ahupua'a on the island of Hawaii. Cattle, goats, and other feral herbivores were probably responsible for most of the population decline, but in recent years exotic plants, such as fountain grass, have become so abundant as to inhibit regeneration and to increase the chances of wildfire (Lamoureux 1982).

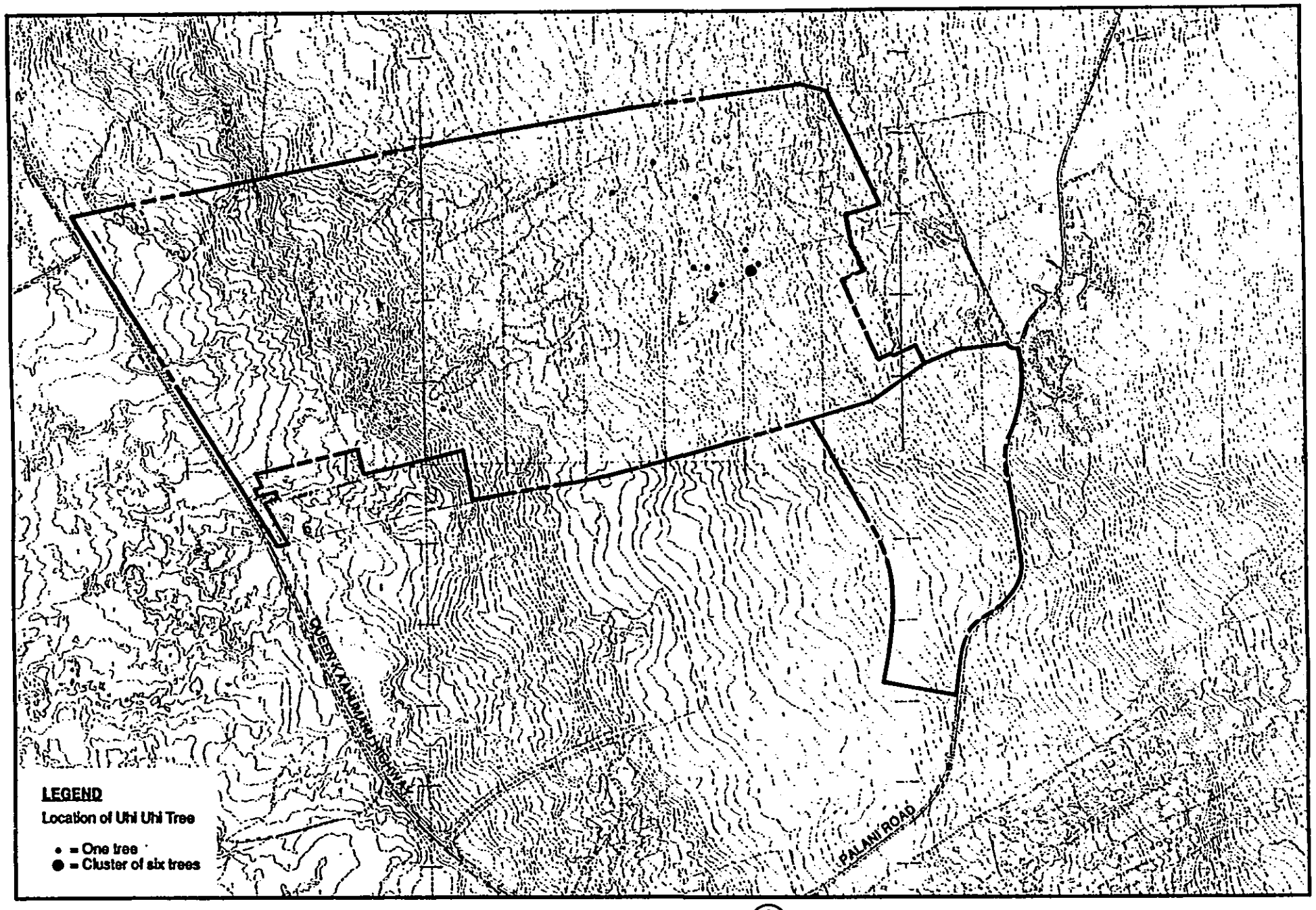
Nineteen uhi uhi plants were located on the Kealakehe project site. This represents a significant increase in the number of known plants and also extends the range of distribution of the species from Pu'uwaawaa-Ka'upulehu across to the Kailua-Kona area. On the project site, the majority of the plants are found between the 500 and 550 foot elevation contours in open mixed shrubland. A few plants occur in koa-haole shrubland on a'a flows. The location of the 19 plants is presented in Figure 4-8. The plants vary in height from 8 feet to about 25 feet tall, with the majority of them from 12 to 15 feet tall. Most are multi-branched and, at the time of the field survey, had flowers and many seed pods. Although an intensive search around the plants was made, no seedlings or saplings of uhi uhi were located.

Bidens micrantha ssp. ctenophylla occurs in shrubland and dry forests on the leeward slopes of Hualalai. In addition to being a candidate endangered species, it is also considered vulnerable or threatened by extensive habitat destruction or modification or by other environmental disturbances (Wagner et al in press). It is an attractive plant with dense clusters of yellow, daisy-like flowers. The dense inflorescences may contain 15 to 75 or more flowers per cluster. Bidens is an erect, much-branched, perennial herb from 2 to 5 feet tall. Under optimum growing conditions, it may reach 7 to 8 feet in height.

On the Kealakehe project site, Bidens is found scattered through-out the open mixed shrubland and Canthium/Christmas berry shrubland in fairly large numbers.

3.1.3 Probable Impacts

Impacts to the existing flora would result from preparation of the project site for the development of residential units and supporting infrastructure. Grading, cut and fill work, and similar construction activities will destroy existing plant cover. Impacts would also occur from the introduction of alien or exotic plant species which might outcompete existing species. The significance of potential impact has been evaluated on the basis of the extent of loss of existing vegetation, the potential for introduction of competitive exotic species, and the potential for loss of



KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

Prepared by: BELT COLLINS & ASSOCIATES
Date: JUNE 1990

Figure 4-8
ENDANGERED FLORA SPECIES LOCATION

endangered or threatened species.

The impact to existing vegetation is considered to be significant due to the need for extensive grading and clearing associated with site preparation. However, the loss of existing vegetation will be offset, to some degree, by the introduction of extensive landscaping. Virtually all of the areas designated for residential development will need to be cleared. The remaining property will also be cleared for the development of infrastructure and non-residential uses, including school sites and parks. Approximately 80% of the land cleared will be landscaped as residential yards, neighborhood parks, school play fields and golf course fairways.

Because they are a federally designated endangered species, the 19 uhi uhi plants identified on the project site must be preserved. As part of the analysis of environmental impacts conducted for the proposed project, an opinion was sought from the State Attorney General concerning the ability to move or relocate uhi uhi plants from areas designated for development. The Department of the Attorney General responded, in part, "...because it does not seem the uhi uhi trees can be successfully transplanted, and because it cannot be said that destruction of any of the species would help propagate the species as a whole, under existing statutes the uhi uhi trees must be preserved in place." (letter to William W. Paty, Chairman of the Board of Land and Natural Resources, December 20, 1989). Therefore, while impact upon the habitat of the uhi uhi plants may be significant due to grading and site preparation, there will be no significant impact upon the uhi uhi plants because they will be preserved.

Impacts upon the Bidens, a candidate endangered species, may be significant because of the need for removal of existing vegetation in the course of site preparation.

3.1.4 Mitigation Measures

To offset the loss of native plants, the use of native plant material for landscaping is recommended. Native plants adapted to the low rainfall and lava substrates of the Kealakehe site are recommended for inclusion into the overall landscaping of residential and non-residential areas, including parks and school sites and similar common areas. While the golf course fairways and greens must be recultivated using exotic grasses, much of the area designated as rough can be left undisturbed or recultivated with native plants. In addition, homeowners may also be interested in planting native plants if they were made available to them. Many of the native plants are attractive and of ornamental value; these include the uhi uhi, wiliwili, 'ohe, naio, alahe'e, mamane, kalomona, and Bidens micrantha ssp. ctenophylla.

In order to mitigate the potential impact of the proposed project upon the habitat of the uhi uhi plants and upon the Bidens, it is proposed that a five-acre endangered plant preserve be established around a cluster of eight uhi uhi trees located in the upper portion of the project area. This preserve would also help to preserve a number of other native species in the area including the candidate Bidens species. Propagation material from other native plants not found within the 5 acre preserve, such as maua, wiliwili, halapepe (Pleomele hawaiiensis), olopua (Nestegis sandwicensis), and pua-kala (Argemone glauca) as well as from the separate uhi uhi plants, should be collected for inclusion onto the site. The preserve should be an actively used nature study park with trails, jogging paths, picnic shelters, etc. Descriptive signs should be provided for the plants. Pamphlets for a self-guided tour could be provided and would highlight the native species, describe how the Hawaiians used the plants, and present ways these plants could be used in landscaping to conserve water. In addition to the five-acre preserve, it is recommended that a one-half acre preserve should be established around each of the remaining eleven uhi uhi plants. Long-term management of these separate one-half acre lots and the five-acre preserve would include an active management program for the eradication of introducted plants, especially fountain grass, koa-haole, and Christmas berry.

Additional mitigation measures will include the following: 1) the preparation of a mitigation plan for the uhi uhi plants in the Kealakehe area, which will include a plan for the propagation of the uhi uhi plants and Bidens plants with seeds and cuttings from the mature trees and plants on site; 2) the initiation of State legislation to bring Hawaii State law into conformance with Federal law concerning the relocation of endangered plant species; and 3) the establishment of an escrow fund for the long-term preservation of endangered and candidate endangered species with start-up funds not to exceed $100,000. Conducted in tandem, these three mitigation measures will provide the means to cultivate seedlings and cutting from the existing plants in a funded preserve, monitor the impacts of development upon the endangered and candidate endangered species, and eventually relocate the endangered plants to a more secure area once their genetic line is secured through the cultivation of seeds and cuttings from each adult plant.

Finally, the United States Fish and Wildlife Service has been contacted and advised of the existence of the endangered plants. Because two of the uhi uhi plants are located within the golf course area (to be transferred by Executive Order of the Governor to the County of Hawaii) which is to serve as the effluent disposal area for the Kealakehe Sewage Treatment Plant, the County of Hawaii's Public Works Department has formally requested a "biology opinion" from the FWS. While the biology opinion, which amounts to a recommendation, will not be completed before publication of this environmental impact statement, it is expected to provide additional guidelines and recommendations for mitigation measures applicable to both the HFDC and County of Hawaii.

3.2 Terrestrial Fauna

Following is a summary of the survey of avifauna and feral mammals conducted for the proposed project by Phillip L. Bruner. The survey is included in its entirety in the appendix to this environmental impact statement.

3.2.1 Existing Conditions

A survey of terrestrial fauna was conducted in August, 1989 to assess the biological resources present at the project site. The objectives of the survey were to: 1) document what bird and mammal species occur on the property or may likely occur given the type of habitats available; 2) provide some baseline data on the relative abundance of each species as well as general habitat preferences; 3) determine the presence or likely occurrence of any native fauna particularly any that are considered "Endangered" or "Threatened". If such occur or may likely be found on the property, identify what features of the habitat may be essential for these species and suggest how those resources may best be protected; and, 4) determine if the property contains any special hatitats that if lost or altered by development might result in a significant impact on the fauna in this region of the island. Field observations for birds were made with the aid of binoculars and by listening for vocalizations. Attention was also paid to the presence of tracks and scats as indicators of bird and mammal activity. A trail was cut and marked in the dense upper section of the property. At various locations along the trail, as well as in all types of habitat elsewhere on the property, eight minute counts were made of all birds seen or heard. Between count stations observations of birds seen or heard were also noted. Observations of feral mammals were limited to visual sightings and evidence in the form of skeletal remains, scats and tracks. No attempts were made to trap mammals in order to obtain data on their relative abundance and distribution. Three evenings were devoted to searching for the presence of owls and the Hawaiian Hoary Bat (Lasiurus cinerus semotus).

3.2.1.1 Avifauna

No endemic (native) species of land or water birds were recorded during the course of the field survey. The Short-eared Owl o Pueo (Asio flammeus sandwichensis) is the only species which might occur at this site because it is relatively common on Hawaii particularly at higher elevations. No other endemic birds would be expected at the site given the elevation and location of the site and nature of the habitats available to the birds.

Of all migratory indigenous (native) shorebirds that winter in Hawaii, the Pacific Golden Plover (Pluvialis fulva) is the most abundant. However, no plover were recorded during the field survey. This result was not unexpected due to the time of year of the survey and the type of habitat present at the site. It is likely that during the time of year when plover are present in Hawaii (August to May) very few actually utilize the property. In its present state the property is unsuitable for migrating shorebirds because they prefer open areas such as mud flats, lawns, pastures and plowed fields.

No indigenous species of resident native birds were recorded nor would any be expected at the site. No seabirds were observed on the property. Some seabirds nest and roost on barren lava flows in Hawaii but at much higher elevations.

A total of 18 species of exotic birds were recorded during the field survey. The most abundant species at Kealakehe is Japanese White-eye (Zosterops japonicus), Common Myna (Acridotheres tristis), House Finch (Carpodacus mexicanus), and Zebra Dove (Geopelia striata). Given the range of habitats found on the property as well as from survey elsewhere in West Hawaii, the following exotic bird species might also be expected to occur on or near the property: Erckel's Francolin (Francolinus erkelii), California Quail (Callipepla californica), and Japanese Quail (Coturnix japonica). The most unexpected sightings were: Lavender Waxbill (Estrilda caerulescens), Yellow-fronted Canary (Serinus mozamibicus), and Saffron Finch (Sicalis flaveola). These popular cage birds have become increasingly more common in this region over the past few years. The Yellow-billed Cardinal (Paroaria capitata) has likewise expanded its range along the Kona coast. This species does not at present occur elsewhere in the State. A close relative, the Red-crested Cardinal (Paroaria coronata), is common on Oahu. Like its relative, the Yellow-billed Cardinal prefers coastal habitat and does not range into dense middle and upper elevation forests.

3.2.1.2 Mammals

A total of 7 Small Indian Mongoose (Herpestes auropunctatus) were seen or heard during the survey. Three feral cats were observed as well as the skeletal remains of pigs and cows. Cattle were also heard along the north boundary of the property. Evidence of rats and mice were also found in the area of the sanitary landfill. The presence of the landfill provides a concentrated food source for birds as well as rats, mice, mongooses and cats.

Records of the endemic and endangered Hawaiian Hoary Bat (Lasiurus cinerus semotus) are sketchy, but the species has been reported on the island of Hawaii. Bats have been found on

the Sheraton Waikoloa Beach Resort property (Bruner, 1984). However, none were observed during the field survey at Kealakehe despite three nights of observations. This species roosts primarily in trees. Much remains to be known about the natural history of this bat and its ecological requirements in Hawaii.

3.2.1.3 Endangered and Threatened Species

No endangered or threatened species of birds or mammals were observed during the field survey.

3.2.1.4 General Conclusions

General conclusions regarding bird populations include the following: 1) the dense forested mauka section of the property contained many more species of birds than the open habitat located on the lower slope; and 2) the present habitats provide a limited range of living spaces which are utilized by the typical array of exotic species of birds one would expect at this elevation and in this type of environment in Hawaii. However, it should be noted that the number of species and the relative abundance of each species may vary throughout the year due to available resources and reproductive success. While, only long-term studies can provide a comprehensive view of bird populations in a particular area, when brief field studies are coupled with data gathered from other similar habitats the value of the conclusions drawn are significantly increased.

With regard to the mammal populations, it is concluded that the existence of the landfill provides an unnatural concentration of food resources for mammals (as well as birds). In order to obtain more definitive data on mammals, a trapping program would be required. Census data obtained by trapping would likely show a greater than normal number of rats, mice, mongoose and cats than would be expected without this resource.

3.2.2 Probable Impacts

The proposed development will create an urban environment which will result in a significant change over the existing conditions. The present habitat provides a limited range of living spaces that are utilized by exotic species of birds expected to occur at the project site. The residential character of the project will probably result in an increase in the variety of bird species and their relative abundance. It is likely that the Pacific Golden Plover would be attracted to the open spaces created by proposed parks and lawn areas. Some species of birds (particularly the Common Myna and House Sparrow) presently concentrated around the landfill will likely be more

widespread on the property following development. This increase is not expected to positively or adversely affect population levels of other species or the nature of the proposed project. Other species such as the Japanese White-eye, House Finch and game birds like the Black Francolin will decline in abundance once the forested area is eliminated. This can be interpreted as an adverse impact. However, given the vast amounts of undeveloped land around the project site, it is evident that other habitat opportunities are available and that development will not threaten the existence of these birds. Thus, the impact is not viewed as significant.

Changes resulting from the proposed development will impact the habitat of mammals identified on site. However, the impact is viewed as insignificant because there are abundant alternative habitats for the mammals around the project site, and the species identified, particularly rats, mice, mongooses and feral cats can easily adapt to more urban settings.

3.2.3 Mitigation Measures

As stated above, no endangered or threatened avifauna or mammal species have been identified on the project site. The majority of bird and mammal species identified on site area exotic. The value of these species is somewhat subjective, in that birds such as the Common Myna and House Sparrow, as well as rats and mice, are considered to be pests and nuisances by some. However, in general impacts to existing exotic species are considered to be insignificant. Therefore, no mitigation measures are necessary.

3.3 Historical and Archaeological Resources

Following is a summary of the archaeological inventory survey conducted for the proposed project by Paul H. Rosendhal, Ph.D., Inc. (PHRI) in September 1989. The scope of work for the survey was determined to be adequate by the staff of the Historic Sites Office of the State's Department of Land and Natural Resources. The significance of all archaeological remains identified within the project area was assessed in terms of the National Register criteria contained in the Code of Federal Regulations (36 CFR Part 60) and the criteria for evaluation of traditional cultural values prepared by the national Advisory Council on Historic Preservation (ACHP). These criteria are currently used by the Hawaii Department of Land and Natural Resources-Historic Sites Section/State Historic Preservation Office (DLNR-HSS/SHPO) for the evaluation of cultural resources.

The project area consists of portions of two ahupua'a's; Kealakehe and Keahuolu. The majority of the project area (approximately 840 acres) is located within Kealakehe and is identified

as 5(b) ceded land by the Office of Hawaiian Affairs. The remainder (approximately 150 acres) is located within Keahuolu, which is presently owned by the Queen Liliuokalani Trust.

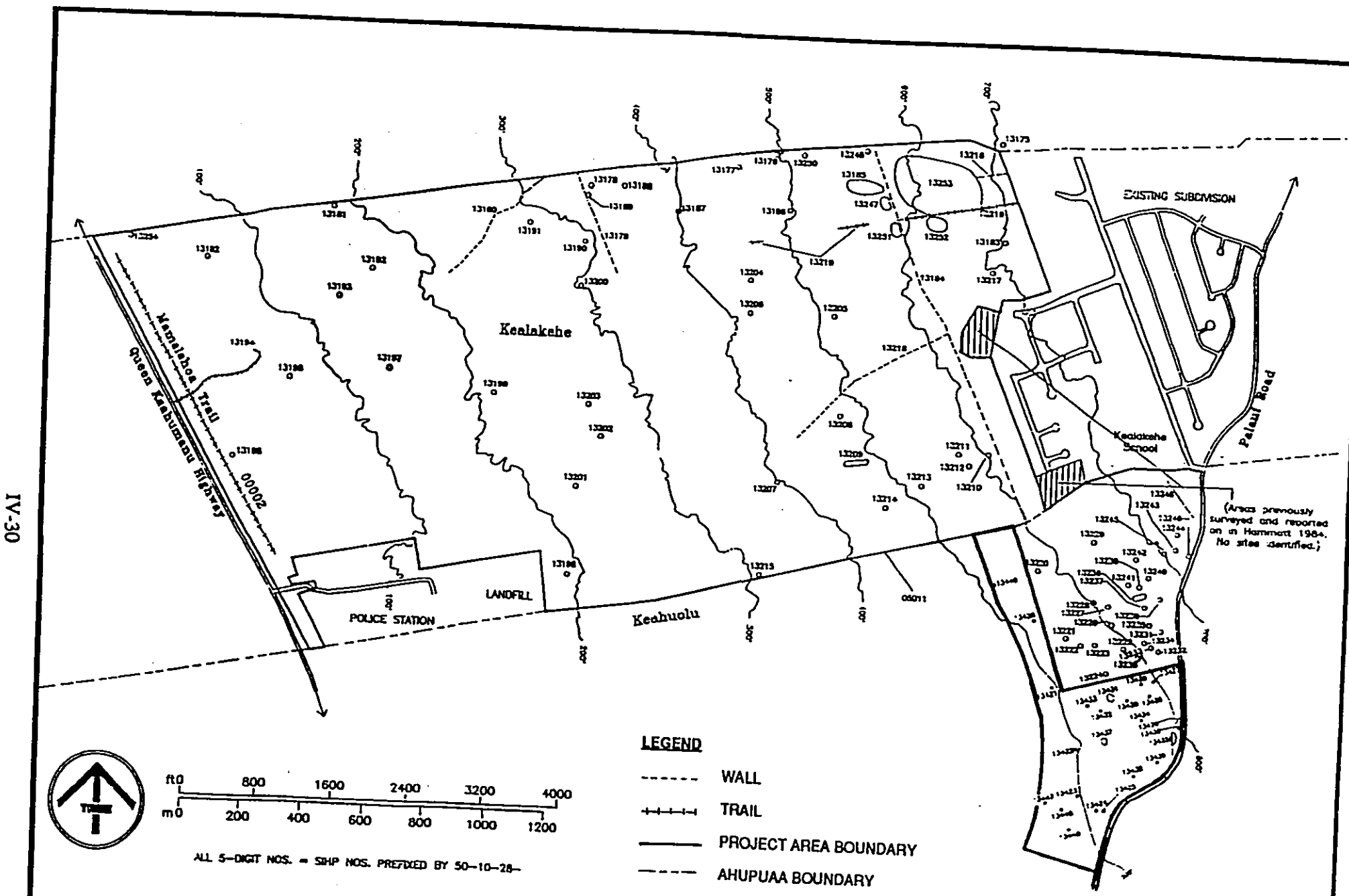
Aerial reconnaissance of the project area indicated that cultural features occurred on all lava types present, and that much of the surface was not visible from the air due to heavy vegetation. Therefore, a pedestrian survey was conducted maintaining a uniformily high-intensity level (30 foot intervals). After the initial pedestrian survey, a crew returned to all sites that were flagged for recording purposes. Sites were tagged, photographed, measured, and described. In certain cases, sites were cleared of vegetation and mapped. Generally, surface visibility was such that all or nearly all surface features could be located with persons spaced about 30 feet apart on a sweep line. However, surface visibility was limited in the Keahuolu property area and in the northern portion of the the upper Kealakehe parcel. In these areas, it is therefore likely that not all features were observed during the pedestrian sweep, or during the recording phase. There are undoubtedly additional rock mounds, pahoehoe excavations, and other minor agricultural features that have not been enumerated in the final report. Finally, subsurface testing was conducted at Site 13188.

3.3.1 Existing Conditions

A total of 106 sites consisting of 1,119 component features were identified in the project area (see Figure 4-9). Four of the sites have been previously identified. Two of those previously identified had been listed on the State Inventory of Historic Places (SIHP). These are Mamalahoa Trail (SIHP site 00002) and the Kealakehe/Keahuolu ahupua'a boundary wall (Site 5011). The remaining two previously identified sites are Site 13188, a habitation cave (Hammatt et al., 1987), and Site 13253, a terrace complex interpreted by Soehren (1975) as a burial site.

Among the 106 sites identified, 53 are in Kealakehe, 52 are in Keahuolu, and one (the ahupua'a boundary wall discussed above) is between the two lands. Overall site density is greater in the Keahuolu parcel, where 49% of the identified sites and 69% of the features occur on 16% of the total project area. Thirty-four of the identified sites consist of a single feature; usually a wall, trail, enclosure or cairn. Multiple feature sites consists of up to 120 or more individual features. Twelve complexes contain 30 or more features; eight of these complexes are in Keahuolu.

Twenty-four formal features types were identified within the subject property. These are presented in Table 4-2. Feature frequencies indicate a predominance of pahoehoe excavations and rock mounds, which together comprise nearly 71% of all features. The frequencies of these and other features such as modified outcrops, terraces, small enclosures and low mounded walls indicates relatively intense use of the area for agricultural purposes.



KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

Source: PAUL H. ROSENDAHL, PhD., INC
Date: MAY 1990
Prepared by: BELT COLLINS & ASSOCIATES
Date: JUNE 1990

Figure 4-9
ARCHAEOLOGICAL SITES

TABLE 4-2: FEATURE COUNTS BY FORMAL TYPE

Formal Type	Count	%	Formal Type	Count	%
Alignment	3	.2	Cairn	38	3.4
Cave	8	.7	C-Shape	1	.08
Enclosure	31	2.8	Faced mound	8	.7
Filled blister	9	.8	Filled crevice	1	.08
Hearth	2	.2	Kerbstone trail	5	.4
Midden scatter	1	.08	Modified pahoehoe blister	7	.6
Modified outcrop	59	5.2	Overhang	1	.08
Pahoehoe excavation	342	30.5	Paved area	4	.3
Pavement	6	.5	Platform	19	1.7
Roadbed	3	.2	Rock mound	452	40.3
Steppingstone trail	12	1.1	Terrace	84	7.5
Trail	3	.2	Wall	20	1.8
TOTAL:				1,119	99.4%

In general, the Keahuolu area exhibits a greater concentration of features than does the Kealakehe portion of the project. The Kealakehe portion contains a wider range of functional types than Keahuolu, which has a relatively specialized agricultural pattern. This pattern consists of a large number of rock mounds, pahoehoe excavations, and modified outcrops with a limited number of terraces and platform features. The difference between the two ahupua'a as they are represented within the project area appear to be most related to: 1) a more intensive use of Kealakehe for cattle ranching, resulting in a differential preservation of surface features between the two ahupua'a; 2) more intensive use of Keahuolu for agriculture, due to its more favorable location in relation to rainfall patterns; 3) a possible period of intensive agricultural activities in Keahuolu during the historic period, related to a sisal mill and plantation referred to in historical reference texts; and 4) the presence of the Great Wall of Kuakini in Keahuolu, indicating the likely presence of relatively concentrated and/or politically important residential sites associated with Kailua village.

Features that may contain human interments occur at seven sites and include faced mounds, platforms and terraces. The most concentrated occurrence of these features is at Site 13253, where seven terraces and three platforms are present. This site was described by Soehren (1975) as a burial area. A second concentration of probable graves is located at Site 13181, where four platforms occur. A third concentration of possible burials is at Site 13185, where six faced terraces occur. Additional agricultural features are present at this site and the probability of burials being present here is felt to be not as great as at the preceding two sites. Four faced mounds, three

at Site 13254 and one at Site 13193, are included in the list of possible burials. However, subsequent research conducted with regard to the siting of the Kealakehe Parkway (mauka-makai roadway) indicates that no burials are present at Site 13193. On the basis of findings during excavations of eight faced mounds in Kealakehe by Hammatt et al. (1987), the likelihood of locating skeletal remains in Site 13254 is not extremely high, but the possibility nevertheless exists. Finally, it is of interest to note that the literal translation of the name Ke-ala-kehe is "road to the burials". This may be due in part to the close proximity of Sites 13253 and 13181 to the Mamalahoa Trail or "King's Highway" which parallels Queen Kaahumanu Highway on the mauka side.

A single radiometric dating sample was collected from Site 13188 during the subsurface testing. The sample was comprised of numerous small scattered woody plant flecks. The sample was determined to have a count rate statistically indistinguishable from the modern count rates. Although the radiometric sample was determined to be indistinguishable from the modern, the presence of volcanic flakes in association with the sample indicates a likely occupation sometime before the twentieth century. However, the carbonized materials scattered in the deposit may have been derived from a brush fire, rather than from a fire inside the site (a cave). The entrance to the cave is oriented in such a manner that wind-born materials are easily accumulated inside. A date was previously derived by Hammatt et al. from a site east of the survey area and was determined to have a calendric range of AD 1645-1950.

3.3.2 Probable Impacts

Impacts to the features found within the project area would primarily be a loss of the features due to excavation and/or construction of the proposed project. For those sites identified for possible preservation, impacts could also include increased human activity around and exposure to the sites. This is especially important for sites that might be preserved with interpretive development in park-like or educational setting.

The significance of individual sites and features have been evaluated based on the definitions derived from the National Register of Historic Places criteria for evaluation (Table 4-3). The Hawaii State Historic Preservation Office also employs these criteria for evaluating cultural resources.

Of the 106 identified sites, 27 are assessed as significant solely for information content. No further work is recommended for these sites. They have been measured, mapped, described, photographed, and plotted. Data collected from them during the present survey is considered

sufficient; their preservation is not essential, although they could perhaps be considered for inclusion into development landscaping. The remaining 79 sites are recommended for further data collection. Table 4-3 summarizes the general significance assessments and recommended general treatments for all sites identified in the current survey.

TABLE 4-3:
SUMMARY OF GENERAL SIGNIFICANCE ASSESSMENTS AND RECOMMENDED GENERAL TREATMENTS

Site Number	Significance Category				Recommended Treatment			
	A	X	B	C	FDC	NFW	PID	PAI
13175	-	+	-	-	-	+	-	-
13177	-	+	-	-	-	+	-	-
13182	-	+	-	-	-	+	-	-
13188	-	+	-	-	-	+	-	-
13191	-	+	-	-	-	+	-	-
13195	-	+	-	-	-	+	-	-
13196	-	+	-	-	-	+	-	-
13198	-	+	-	-	-	+	-	-
13199	-	+	-	-	-	+	-	-
Subtotal	**0**	**9**	**0**	**0**	**0**	**9**	**0**	**0**

General Significance Categories:

- A = Important for information content, further data collection necessary (PHRI = research value)
- X = Important for information content, no further data collection necessary (PHRI = research value, SHPO = not significant)
- B = Excellent example of site type at local, regional, island, State, or National level (PHRI = interpretive value); and
- C = Culturally significant (PHRI = cultural value).

Recommended General Treatments:

- FDC = Further data collection necessary (intensive survey and testing, 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); and
- PAI = Preservation "as is", with no further work (and possible inclusion into landscaping), or minimal further data collection necessary.

(Table 4-3 continued)

Site Number	Significance Category				Recommended Tratment			
	A	X	B	C	FDC	NFW	PID	PAI
13200	-	+	-	-	-	+	-	-
13208	-	+	-	-	-	+	-	-
13215	-	+	-	-	-	+	-	-
13216	-	+	-	-	-	+	-	-
13217	-	+	-	-	-	+	-	-
13237	-	+	-	-	-	+	-	-
13243	-	+	-	-	-	+	-	-
13245	-	+	-	-	-	+	-	-
13249	-	+	-	-	-	+	-	-
13250	-	+	-	-	-	+	-	-
13251	-	+	-	-	-	+	-	-
13424	-	+	-	-	-	+	-	-
13426	-	+	-	-	-	+	-	-
13432	-	+	-	-	-	+	-	-
13433	-	+	-	-	-	+	-	-
13434	-	+	-	-	-	+	-	-
13439	-	+	-	-	-	+	-	-
Subtotal	**0**	**17**	**0**	**0**	**0**	**17**	**0**	**0**
05011	+	-	-	-	+	-	-	-
13179	+	-	-	-	+	-	-	-
13180	+	-	-	-	+	-	-	-
13183	+	-	-	-	+	-	-	-
13184	+	-	-	-	+	-	-	-
13186	+	-	-	-	+	-	-	-
13187	+	-	-	-	+	-	-	-
13189	+	-	-	-	+	-	-	-
13190	+	-	-	-	+	-	-	-
13201	+	-	-	-	+	-	-	-
13202	+	-	-	-	+	-	-	-
13203	+	-	-	-	+	-	-	-
13207	+	-	-	-	+	-	-	-
13210	+	-	-	-	+	-	-	-
13211	+	-	-	-	+	-	-	-
13212	+	-	-	-	+	-	-	-
13213	+	-	-	-	+	-	-	-
13214	+	-	-	-	+	-	-	-
13218	+	-	-	-	+	-	-	-
13220	+	-	-	-	+	-	-	-
13221	+	-	-	-	+	-	-	-
13222	+	-	-	-	+	-	-	-
13224	+	-	-	-	+	-	-	-
Subtotal	**23**	**0**	**0**	**0**	**23**	**0**	**0**	**0**

(Table 4-3 continued)

Site Number	Significance Category				Recommended Tratment			
	A	X	B	C	FDC	NFW	PID	PAI
13225	+	-	-	-	+	-	-	-
13226	+	-	-	-	+	-	-	-
13227	+	-	-	-	+	-	-	-
13229	+	-	-	-	+	-	-	-
13230	+	-	-	-	+	-	-	-
13231	+	-	-	-	+	-	-	-
13232	+	-	-	-	+	-	-	-
13233	+	-	-	-	+	-	-	-
13235	+	-	-	-	+	-	-	-
13236	+	-	-	-	+	-	-	-
13238	+	-	-	-	+	-	-	-
13239	+	-	-	-	+	-	-	-
13240	+	-	-	-	+	-	-	-
13241	+	-	-	-	+	-	-	-
13244	+	-	-	-	+	-	-	-
13246	+	-	-	-	+	-	-	-
13247	+	-	-	-	+	-	-	-
13248	+	-	-	-	+	-	-	-
13252	+	-	-	-	+	-	-	-
13420	+	-	-	-	+	-	-	-
13421	+	-	-	-	+	-	-	-
13422	+	-	-	-	+	-	-	-
13423	+	-	-	-	+	-	-	-
13425	+	-	-	-	+	-	-	-
13427	+	-	-	-	+	-	-	-
13428	+	-	-	-	+	-	-	-
13429	+	-	-	-	+	-	-	-
13430	+	-	-	-	+	-	-	-
13431	+	-	-	-	+	-	-	-
13435	+	-	-	-	+	-	-	-
13436	+	-	-	-	+	-	-	-
13437	+	-	-	-	+	-	-	-
13438	+	-	-	-	+	-	-	-
13440	+	-	-	-	+	-	-	-
13447	+	-	-	-	+	-	-	-
13448	+	-	-	-	+	-	-	-
13449	+	-	-	-	+	-	-	-
Subtotal	**37**	**0**	**0**	**0**	**37**	**0**	**0**	**0**
00002	+	-	+	+	+	-	+	-
13194	+	-	+	+	+	-	+	-
13219	+	-	+	+	+	-	+	-
Subtotal	**3**	**0**	**3**	**3**	**3**	**0**	**3**	**0**

(Table 4-3 continued)

Site Number	Significance Category A	X	B	C	Recommended Tratment FDC	NFW	PID	PAI
13178	+	-	-	*	+	-	-	*
13193	+	-	-	*	+	-	-	*
13205	+	-	-	*	+	-	-	*
13223	+	-	-	*	+	-	-	*
Subtotal	**4**	**0**	**0**	**4**	**4**	**0**	**0**	**4**
13176	+	-	+	*	+	-	+	*
13181	+	-	+	*	+	-	+	*
13185	+	-	+	*	+	-	+	*
13209	+	-	+	*	+	-	+	*
13228	+	-	+	*	+	-	+	*
13253	+	-	+	*	+	-	+	*
13254	+	-	+	*	+	-	+	*
Subtotal	**7**	**0**	**7**	**7**	**7**	**0**	**7**	**7**
13197	+	-	*	*	+	-	*	-
13204	+	-	*	*	+	-	*	-
13206	+	-	*	*	+	-	*	-
13234	+	-	*	*	+	-	*	-
13242	+	-	*	*	+	-	*	-
Subtotal	**5**	**0**	**5**	**5**	**5**	**0**	**5**	**0**
Total	**61**	**21**	**15**	**19**	**61**	**21**	**15**	**11**

* Provisional assessment; definite assessment pending further data collection (i.e., testing features for presence/absence of skeletal remains).

Note: Subsequent tests of Site 13193 reveal no skeletal remains (see Appendix).

3.3.3 Mitigation Measures

To ensure that the archaeological and historical sites identified within the project site are not adversely impacted, the treatments recommended by the consulting archaeologist and presented in Table 4-3 will be implemented subject to the concurrence of the State's Historic Preservation Office. Additional mitigation measures include the designation of an Archaeological Preserve in

the northeastern corner of the project area corresponding to Sites 13254, 13185 and 13219. Because Site 13254 is the largest single site within the project area, it represents a unique opportunity to provide an educational resource through interpretive development (signage). Trails recommended for preservation will be protected "as is" and where their alignments may be intersected by proposed roadways, surface treatment and signage will identify the alignment.

In those instances where skeletal remains are confirmed, the burial will be preserved "as is" or will be reinterred within the proposed archaeological preserve to ensure that the remains are not removed from the Kealakehe ahupua'a.

Additional sites proposed for preservation will be integrated into the proposed community through the use of landscaping or similar design treatments.

Finally, should any additional site be uncovered during construction, work will stop and the appropriate State and County officials notified. Work will resume upon approval of the State Preservation Officer and the Hawaii County Planning Department.

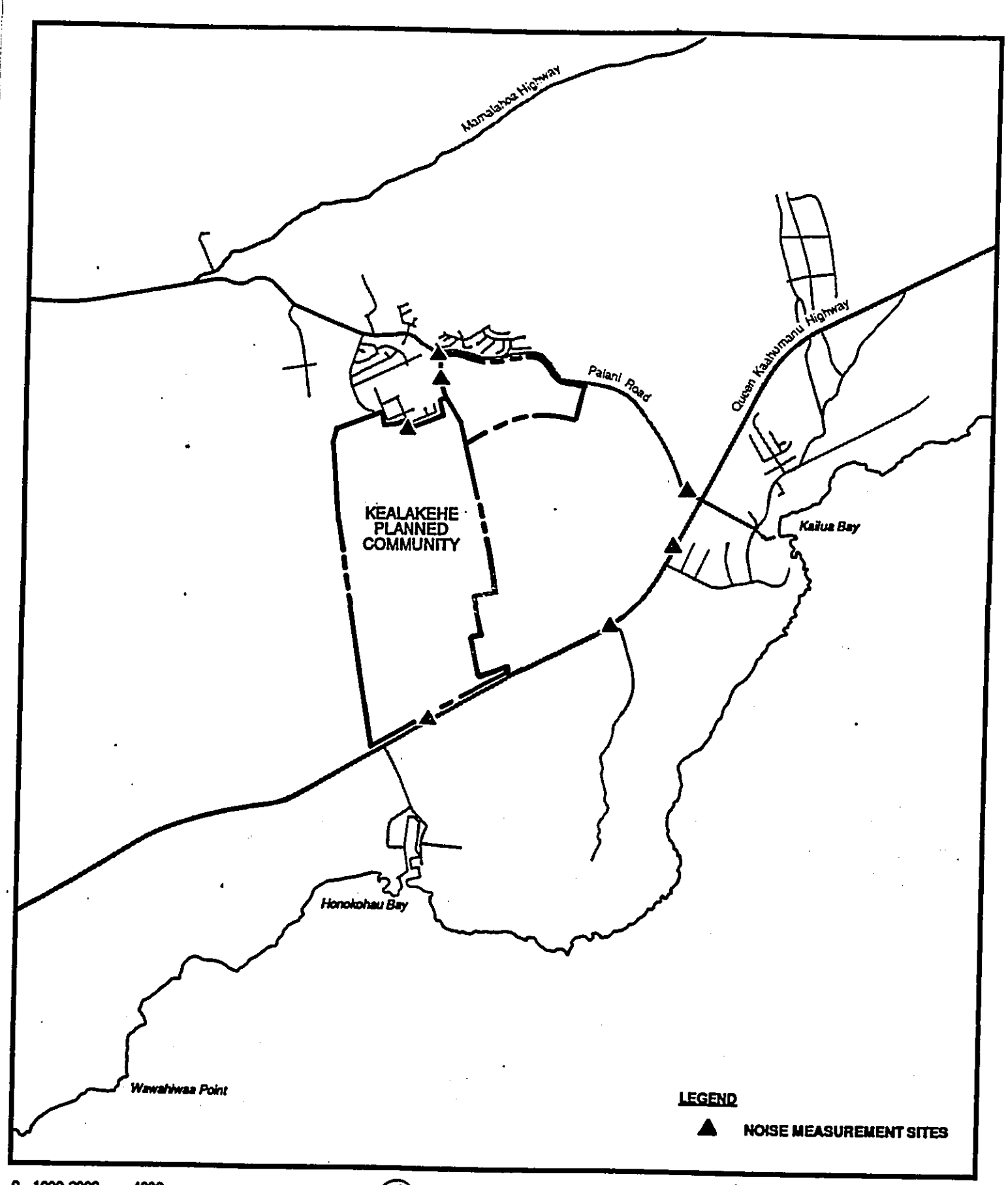
3.4 Noise Quality

Following is a summary of the noise impact study conducted for the proposed project by Y. Ebisu and Associates in June 1990. The complete study is included in the appendix of this environmental impact statement.

3.4.1 Existing Conditions

Existing traffic noise levels were measured at seven locations in the project environs to provide a basis for comparing the project's traffic noise contributions along the roadways which will service the proposed development; Queen Kaahumanu Highway, Palani Road, the Honokohau Boat Harbor Road, and the proposed Mauka-Makai Kealakehe Parkway . The locations of the measurement sites are presented in Figure 4-10.

Four basic categories are utilized in determining exterior noise exposure for residential areas; minimal exposure ($\leq 55\ L_{dn}$), moderate exposure ($56\ L_{dn}$ to $65\ L_{dn}$), significant exposure ($66\ L_{dn}$ to $75\ L_{dn}$), and severe exposure (above $75\ L_{dn}$). Minimal exposure is considered to be "unconditionally acceptable". Moderate exposure is considered to be "acceptable". Significant exposure is considered to be "normally unacceptable", while severe exposure is considered "unacceptable".



Prepared By: BELT COLLINS AND ASSOCIATES • JUNE 1990

Figure 4-10
LOCATIONS OF NOISE MEASUREMENT SITES

The existing traffic noise levels in the project area are in the "significant exposure, normally unacceptable" category at 50-foot distances from the centerlines of Queen Kaahumanu Highway and Palani Road. Traffic noise levels along the right-of-way of a roadway generally represent the worst case or highest levels due to the close proximity to noise levels. At greater setback distances of approximately 92 to 96 feet, traffic noise along Queen Kaahumanu Highway decrease to the "moderate exposure, acceptable" category. Setback distances of approximately 49 to 86 feet are required from the centerline of Palani Road to be in the "moderate exposure, acceptable" noise exposure category. Existing background ambient noise measurements obtained at sites near the existing residential community and the Kealakehe schools confirm that noise levels are very low, in the order of 45 to 50 L_{dn}. Based on this information, it was concluded that noise levels at the proposed residential portions of the project area are not expected to exceed current FHA/HUD noise standards or cause adverse noise impacts on future project residents.

3.4.2 Probable Impacts

As a result of the construction of the mauka-makai road, Kealakehe Parkway, traffic noise levels are expected to increase at the inland areas mauka of Queen Kaahumanu Highway. Following construction of this new roadway, background ambient noise levels at the phase 1 portion of the proposed project (Village 1) are expected to increase significantly from existing low levels. However, in the planned residential areas fronting the major roadways, noise levels below 65 L_{dn} are expected less than 20 feet from the centerline of the new roads. For this reason, traffic noise impacts along this roadway are not expeced following completion of phase 1.

At buildout of the project, noise attributable to both project plus non-project traffic increase significantly by 3 to 5 decibels. Setback distances along Queen Kaahumanu Highway will require 176 to 201 feet to reach normally acceptable levels (65 L_{dn}). Along Palani Road, moderately large setback distances of 100 to 144 feet will be required to reach normally acceptable levels (65 L_{dn}). Table 4-4 presents a comparison of noise impacts in 2010 with and without the project.

TABLE 4-4: PROJECT AND NON-PROJECT NOISE IMPACTS (2010)

	Noise Level Increases (Ldn) Due to:	
Roadway	Non-Project Traffic	Project Traffic
Queen Kaahumanu (north of project)	4.3	0.8
Queen Kaahumanu (fronting project)	4.1	0.2
Queen Kaahumanu (south of project)	4.1	0.2
Palani Road (near Queen Kaahumanu intersection)	3.4	-0.1
Kealakehe Parkway	N/A	73.0

As indicated in Table 4-4, the increases in traffic along Queen Kaahumanu Highway due to the project are very small when compared to those increases expected from non-project related traffic. Similar conclusions apply along Palani Road. Project traffic noise increases are expected to be greatest relative to non-project traffic along Ulua'oa and Kealakehe streets, and the two new access roadways to the project site.

As a result of the construction of the mauka portions of the Kealakehe Parkway, traffic noise levels are expected to increase in the inland areas mauka of Queen Ka'ahumanu Highway and along the northern boundary of the project. By 2010, background ambient noise levels at planned residential areas along the parkway are expected to increase significantly from existing low levels. Future traffic noise levels along the parkway's right-of-way and at the intersection with Queen Kaahumanu Highway are expected to be slightly above the 65 L_{dn} following complete project buildout. Although commercial and golf course uses are planned at the intersection, traffic noise mitigation measures may be required along the planned residential areas fronting this roadway.

Audible construction noise will probably be unavoidable during the entire project construction period. However, it is anticipated that the actual work will be moving from one location on the project site to another. Therefore, actual exposure to construction noise at any receptor location will probably be less than the project's total construction period. Analysis indicates that the general distance from construction noise necessary to reach normally acceptable levels (65 L_{dn}) will be about 450 to 550 feet. Adverse impacts from construction noise are not expected to be in the "public health and welfare" category due to the temporary nature of the work and due to the administrative controls available for its regulation. Instead, these impacts will probably be limited to the temporary degradation of the quality of the acoustic environment near the project site.

3.4.3 Mitigation Measures

The increases in traffic noise attributable to the project from the present to the year 2010 are predicted to range from 0.2 to 0.8 L_{dn} along Queen Kaahumanu Highway, where traffic noise levels are expected to remain above 65 L_{dn} along the highway right-of-way. This degree of increase in traffic noise levels attributable to the project will be difficult to perceive over a 20-year period, and is therefore, not considered to be significant. Existing and planned land uses along the highway are primarily commercial, recreational and light industrial (to become the Civic Center). Therefore, traffic noise impacts along the highway resulting from from project traffic are not considered to be serious.

Relatively large increases in traffic noise levels along the improved Palani Road are expected to occur as a result of the project plus non-project traffic. By 2010, traffic noise levels are expected to increase along Palani Road by 3.4 L_{dn}, primarily as a result of non-project traffic. Setback distances of 100 to 144 feet from Palani Road's centerline will be required to meet FHA/HUD noise standards under unobstructed line-of-sight conditions between the roadway and noise sensitive receptors. Under conditions of noise shielding by terrain features or man-made obstructions, setback distances required to meet FHA/HUD standards would be significantly less, and be probably less than 100 feet from the roadway center line.

Potential noise along the improved Palani Road are possible, both in respect to existing and planned noise sensitive receptors (such as homes) along the roadway. Existing residences located along the roadway may be impacted by the added traffic noise as well as by the future roadway improvements if noise mitigation measures are not included with the construction of the roadway improvements. Mitigation of off-site traffic noise impacts are generally performed by individual property owners fronting the roadway's right-of-way or by public agencies during roadway improvements. These mitigation measures generally take the form of increased setbacks, sound attenuating walls, total closure and air conditioning, or the use of sound attenuating windows. Severe noise impacts should not occur as a result of the proposed project as long as noise mitigation measures are incorporated into any improvement projects along Palani Road.

Mitigation of construction noise to inaudible levels will not be practical in all cases due to the intensity of construction noise sources (80 to 90+ dB at 50 feet distance), and due to the exterior nature of the work (pile driving, grading and earth moving, trenching, concrete pouring, hammering, etc.). The use of properly muffled construction equipment should be required on the job site. In addition, if soil conditions allow, the use of vibratory pile driving equipment is also recommended for minimizing construction noise impacts. However, due to the residential character of the proposed development, pile driving will typically not be necessary. The incorporation of the State Department of Health's construction noise limits and curfew times is another noise mitigation measure which can be applied to this project.

3.5 Climate, Meteorology and Air Quality

Following is a summary of an air quality impact analysis conducted for the project by Barry D. Neal and Associates in July, 1990. The complete study is included in the appendix to this environmental impact statement.

3.5.1 Existing Conditions

Nearly the entire western side of the Big Island is sheltered from the prevailing northeasterly trade winds that typify Hawaiian island weather patterns due to the shielding effect of the great volcanic masses of Mauna Kea, Mauna Loa, and Hualalai. Due to wind shadow effects caused by the Kona region's terrain, winds in the Kealakehe area are predominantly light and variable. Local winds such as land-sea breezes and/or upslope-downslope winds tend to dominate the wind pattern for the area. During the daytime, winds typically move onshore because of seabreeze and/or upslope effects. At night, winds generally are land breezes and/or 'drainage' winds that move downslope and out to sea. Calms occur about 29% of the time at nearby Keahole Point.

The project area's leeward location and low-level elevation results in a relatively moderate temperature profile compared to windward locations near sea-level. At the Old Kona Airport loated about two miles to the south west, average daily minimum and maximum temperatures are 67 degrees (F) and 83 degrees (F), respectively. The extreme minimum temperature on record at this location is 47 degrees (F) and the extreme maximum is 93 degrees (F). Temperatures at the project site are probably about 1 to 3 degrees cooler on average compared to the airport and show a slightly larger diurnal variation due to the somewhat elevated and inland location.

Atmospheric turbulence, caused by mechanical and thermal forces, is often described in terms of Stability Class. Stability class 1 is the most turbulent and class 6 the least. In suburban, coastal areas like Kealakehe, stability class 5 or 6 is generally the highest class that occurs, developing during clear, calm nighttime or early morning conditions. Stability classes 1 through 4 occur during the daytime, depending mainly on the amount of cloud cover and incoming solar radiation and the onset and extent of the seabreeze.

The Kealakehe climate is relatively dry. Average rainfall at the Old Kona Airport amounts to about 24 inches per year but may vary significantly from one year to the next. Average annual rainfall at the project site is estimated from 20 to 30 inches depending upon elevation (see Figure 4-6).

Present air quality in the project area is mostly affected by air pollutants from natural, industrial, agricultural and/or vehicular sources. Natural sources include sea spray, aero-allergens from plants, wind-blown dust, and volcanic emissions. The project region is periodically plagued by the latter, especially since the latest eruption phase of Kilauea which began in 1983. The American Lung Association is currently studying the character and concentration of volcanic air

pollution in the Kona area, but to date, no results of the study are available.

Major industrial sources of pollution include the Keahole Power Plant and the Kealakehe Landfill. Air pollution emissions from the power plant consist mostly of sulfur dioxide and oxides of nitrogen. Emissions from the landfill consist mainly of fugitive dust from heavy equipment and noxious fumes from underground fires, the latter of which has been the subject of numerous complaints from people residing and working nearby. Emissions from the landfill tend to be carried over the project site by prevailing winds mostly during the daytime.

Queen Kaahumanu Highway forms the western boundary of the project area and is the major source of vehicular pollution. While some contamination from the exhausts of motor vehicles using the highway and other roadways nearby occurs, elevated concentrations are likely confined to limited areas near intersections where and when traffic congestion occurs during poor dispersion conditions.

The only available data from air quality monitoring stations operated by the State Department of Health (DOH), consists of sulfur dioxide and particulate measurements that were made about 12 miles to the south of Kealakehe during 1985 and 1986. During that two-year period, measurements of 24-hour average sulfur dioxide concentration at this location were consistently low. No instances of levels in excess of the state/national 24-hour air quality standards were recorded.

At this time there are no reported measurements of lead, ozone, nitrogen dioxide or carbon monoxide in the project vicinity. These are primarily motor vehicle related pollutants. Lead, ozone, and nitrogen dioxide are typically regional scale problems and levels of these substances generally have not been found to exceed accepted standards elsewhere in the State. Carbon monoxide air pollution, on the other hand, typically is a microscale problem caused by congested motor vehicle traffic. To assess the impact of emissions from motor vehicles, an air quality modeling study was undertaken to estimate current ambient concentrations of carbon monoxide along the primary access routes and to predict future levels both with and without the proposed project. Present carbon monoxide concentrations were estimated to be well within the national 1-hour ambient air quality standard at all locations. However, concentrations in the vicinity of Queen Kaahumanu Highway and Palani Road may occasionally exceed the 8-hour national limit as well as the more stringent 1-hour and 8-hour state standards during adverse traffic and meteorological conditions. Predicted exceedence of the state standard is not unusual as this occurs at many locations in the state where even moderate traffic volumes are involved.

3.5.2 Probable Impacts

It is inevitable that some short- and long-term impacts on air quality will occur either directly or indirectly as a consequence of project construction and proposed land uses. Short-term impacts from fugitive dust will likely occur during the project construction phase. To a lesser extent, exhaust emissions from stationary and mobile construction equipment and from workers' vehicles also may affect air quality during the period of construction.

After construction, long-term impacts on air quality will occur primarily from emissions emanating from vehicular traffic traveling to and from the development. Primary access to the site will occur via Queen Kaahumanu Highway, Mamalahoa Highway, Palani Road and the proposed Kealakehe Parkway. In the year 2010 without the project, concentrations at most locations were predicted to decrease even though traffic is expected to increase; this is due to the effects of newer motor vehicles equipped with more efficient emission control devices and to the planned roadway improvements. Worst-cast concentration levels, however, will continue to occasionally exceed the state standards in small "hot spot" areas near congested intersections, but the national standards will probably be met.

In the year 2010 with-project scenario, the highest concentrations in the project area (at the intersection of Queen Kaahumanu Highway and Palani Road) will likely be about 10 percent higher compared to the without-project scenario but considerably lower compared to existing conditions. Concentrations at other locations for this scenario will be about the same or higher compared to the existing and without-project cases. This assumes that all mitigative measures discussed in Section 1.3 of Chapter VI, relating to traffic improvements, are implemented.

Air pollution impacts on the endangered species of trees (uhi uhi) existing on the project site due to project-related automotive emissions should be nil. This conclusion is based on the fact that estimated maximum concentrations of nitrogen dioxide that will occur will be much less than the injury threshold levels even for sensitive vegetation.

Long-term, indirect impacts are also possible due to the project's electrical power and solid waste disposal requirements. Quantitative assessments of these potential impacts were not made, but based on the estimated emission rates involved and compared to the current levels of demand, the attendant impacts are expected to be small.

The proposed project will have no measurable air quality impacts upon the Kealakehe Landfill. Potential impacts on the project from landfill emissions will be lessened but may not

eliminated with the closure of the landfill. Recurring subsurface fires could continue to persist even after landfill operations cease. The analysis of potential impacts on the project from emissions emanating from the landfill suggests further study of this problem is warranted before drawing any definitive conclusions. The little data that are available indicate the concentrations of some air contaminants may presently exceed both occupational health and safety standards within the landfill and community property lines for a distance of a few hundred feet. Nuisance odor problems may persist for several thousand feet downwind (upslope during the day and downslope at night) of the landfill.

3.5.3 Mitigation Measures

Both federal and state standards have been established to control ambient air quality. At the present time, six parameters are regulated including; particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and lead. Hawaii state air quality standards are more stringent than the comparable national limits except for the standards for sulfur dioxide. State and national standards for sulfur dioxide are the same.

State air pollution control regulations require that there be no visible fugitive dust emissions at the property line of a project. Hence, an effective dust control plan must be implemented to ensure compliance with state regulations. Fugitive dust emissions can be controlled by limiting areas disturbed, watering of active work areas, covering of open-bodied trucks and using wind screens during grading and construction. Paving and landscaping early in the construction schedule also will reduce dust emissions.

Mitigation measures to reduce the impact of carbon monoxide pollutants from increased volumes of vehicular traffic include those measures discussed in Chapter VI, Section 1.3 relating to Traffic. Additional mitigation measures could include; promoting mass transit/bus service and car pooling, adjusting local school and business hours to begin and end during off peak periods, and reducing motor vehicle emissions. However, most of these mitigative measures, and especially the latter, are beyond the control of a single developer.

The impacts of the Kealakehe Landfill on the proposed project can only be lessened by preventing or quickly extinguishing fires as they occur. Hawaii County's proposal to mine the landfill for recyclable materials, extinguish the underground fires and cover the landfill with soil is probably the most comprehensive and effective solution. The alternative of closing and capping the landfill with soil may help to reduce the frequency of underground fires, but it may still be necessary to extinguish fires periodically with boring and fire fighting equipment.

CORRECTION

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CHAPTER V

CHAPTER V
SOCIO-ECONOMIC FACTORS

1. SOCIAL IMPACTS

Following is a summary of the socio-economic impact assessment conducted for the project by Community Resources, Inc. and completed in January, 1990. The report is included in its entirety as an appendix to this environmental impact statement.

1.1 Existing Social Conditions

1.1.1 Population Trends

West Hawaii has been one of the fastest growing areas in the State of Hawaii. Its population nearly tripled from 1970 to 1988 (from 14,500 to 40,700). The growth rates have been particularly high in North Kona and South Kohala, sites of major resort development in the 1970's and 1980's.

TABLE 5-1: POPULATION TRENDS

Geopolitical Area	4-1-70	4-1-80	% Change 1970-80	7-1-88*	% Change 1980-88
North Kona District	4,832	13,748	184%	21,600	57%
South Kona District	4,004	5,914	48%	7,500	27%
South Kohala District	2,310	4,607	99%	7,900	71%
North Kohala District	3,326	3,249	-2%	3,700	14%
Total West Hawaii Area	14,472	27,518	90%	40,700	48%
County of Hawaii	63,468	92,053	45%	117,500	28%
State of Hawaii	769,913	964,691	25%	1,098,200	14%

* Estimated population

As of 1980, nearly a quarter of North Kona's population had been living on the mainland five years previously, and 40% had been mainland-born; much larger percentages than Hawaii County as a whole.

1.1.2 Housing Supply

Housing in West Hawaii (with the possible exception of North Kohala) is now considered to be in very short supply, leading to crowding and to high rentals and sales costs. During the 1980's, the West Hawaii housing inventory grew more slowly than did the resident population, meaning that more people must share living quarters. From 1980 to 1988, population increased

approximately 48% (Table 5-1). However, Hawaii County's analysis in Table 5-2 indicates that, even by March 1989, the total West Hawaii housing unit inventory had increased only 26%. In North Kona, population increased 57% while the housing unit inventory increased only about 30%. In the rest of Hawaii County, proportionate growth in housing units more closely matched population.

TABLE 5-2: HOUSING UNIT INVENTORY

Unit Type by Area	1980	1989	% Change 1980-89
North Kona			
--Single Family	4,105	5,322	29.6%
--Duplex	122	146	19.7%
--Multi-Family	2,934	4,109	40.0%
--Other	379	N/A	
--District Total, All Units	7,540	9,577	27.0%
South Kona			
--Single Family	1,631	1,974	21.0%
--Duplex	28	34	21.4%
--Multi-Family	48	88	83.3%
--Other	15	N/A	
--District Total, All Units	1,722	2,096	21.7%
North Kohala			
--Single Family	1,092	1,235	13.1%
--Duplex	12	14	16.7%
--Multi-Family	7	7	0.0%
--Other	11	N/A	
--District Total, All Units	1,122	1,256	11.9%
South Kohala			
--Single Family	8,520	10,767	26.4%
--Duplex	172	278	61.6%
--Multi-Family	3,500	4,857	38.8%
--Other	410	N/A	
--District Total, All Units	2,218	2,973	34.0%
Total West Hawaii			
--Single Family	8,520	10,767	26.4%
--Duplex	172	278	61.8%
--Multi-Family	511	653	27.8%
--Other	410	N/A	
--TOTAL, ALL UNITS	12,602	15,902	26.2%

Furthermore, Hawaii Visitors Bureau data indicate that nearly 2,000 of the 16,000 West Hawaii housing units are actually condominiums for visitor use (condominiums in resort areas may be made available for visitor use during peak travel periods, then revert to long-term residential rentals when tourism declines). An unknown number of West Hawaii single-family homes may also now be reserved for visitor rentals or as second homes.

Further indications that the supply of housing for residents in West Hawaii is severely limited are:

- West Hawaii homes in 1988 had an average resale price at least $65,000 more than the average resale price for the rest of the island. Prices throughout the island increased in 1989, but West Hawaii retained its lead (Pang, 1989).
- The average price of residential properties in all West Hawaii districts was over $200,000 in 1989 -- over twice the amount which would be affordable for a family with a median income.
- 1980 housing costs were roughly 50% higher in West Hawaii, except for North Kohala, than in East Hawaii, suggesting that West Hawaii residents have struggled with a lack of affordable housing for years.
- The supply of units for rent to residents diminished during most of the 1980's, until there were nearly no vacancies in West Hawaii in 1987. More rental housing has become available since 1987 (KPMG Peat Marwick, 1990).
- Rental prices have increased steadily by about 10% per annum since 1980 in both Hilo and Kailua.

The current shortage of affordable housing is well known to West Hawaii residents, who call the need "critical", "severe", and "drastic". In interviews conducted for the socio-economic impact study, area residents cited several telling examples:

- No houselots near Kailua are available for under $100,000.
- Recently, only three fee simple homes were listed in the greater Kailua area for less than $200,000.
- Kona area low- to moderate-income rental projects are filled, and have waiting lists.
- At one rental complex, the prospective tenants at the top of the waiting list have been there for at least six months to a year.
- According to some Kona Realtors, there are sub-unit rentals in 50% to 80% of the homes in certain neighborhoods.

- One realtor observed that 70% of all potential single family homes buyers are looking for homes with rental units.
- Some see certain neighborhoods as overcrowded because the original buyers' households now contain their grown children and grandchildren.
- Many residents know of single-family houses in which three or more families live, or one-bedroom apartments sheltering families with four or more children.
- The Hawaii Tribune Herald reported that County officials and advocates for the homeless estimate as many as 800 people in West Hawaii lack permanent shelter (Harada-Stone, 1989).

1.1.3 Economic and Labor Force Trends

West Hawaii's economy is based on the visitor industry, construction, diversified agriculture and ranching, and high technology initiatives (in ocean science and astronomy). The visitor industry has emerged as the leading industry both in terms of size and potential growth.

Construction activity has continued to increase in Hawaii County -- construction put in place in 1988 was valued at $162,750,000, an increase of 26.6% over 1987. Currently, a new major luxury hotel is under construction in West Hawaii.

Presently, West Hawaii employers report a labor shortage, particularly among skilled construction workers and entry level service workers for restaurant, retail, and resort operations. Recent available unemployment and workforce estimates from the Department of Labor and Industrial Relations show:

TABLE 5-3: LABOR FORCE & UNEMPLOYMENT RATES

	1988 Annual Average		August 1989	
Area	Civilian Labor Force	Unemployment Rate	Civilian Labor Force	Unemployment Rate
North Kona	9,776	3.7%	10,645	2.1%
South Kona	3,778	4.0%	4,108	2.4%
North Kohala	1,795	6.6%	1,929	3.9%
South Kohala	2,819	4.4%	3,060	2.6%
West Hawaii	18,168	4.3%	19,742	2.4%
Hawaii County	54,676	5.0%	59,206	2.9%

A review of occupational patterns in West Hawaii based upon the 1980 Census reveals the following:

- Compared to workers countywide and statewide, employed residents of North Kona and South Kohala were much more likely to be in tourism-related occupations or industries in 1980.

- In North Kohala, there was a dramatic 1970-80 shift from agriculture to tourism-related work, due to the phaseout of sugar operations. Many such tourism jobs were located outside of North Kohala, resulting in higher average commute times.

Continuing West Hawaii resort development would suggest even more concentration in tourism today, as well as more intensive use of available workers. Preliminary results of a 1988 survey by the Department of Business and Economic Development indicates:

- The percentage of employed workers who consider themselves "in the visitor industry" was around 40% in Kona and 35% in Kohala, compared to an islandwide figure of just 25%.

- North Kona's civilian labor force participation rate is now close to 80%, i.e., four out of every five potential workers aged 15 or above now holds a job or is actively seeking one.

1.2 Likely Future Social Trends

The following discussion is a review of future changes expected to occur with or without the proposed Kealakehe Planned Community Project.

The State of Hawaii's official "M-K Series" forecast for the period through the year 2010 indicates substantial economic and population growth for Hawaii County. Resident population is forecast to increase by 75% over the estimated 1988 figure of 117,500 to reach 180,800 persons by the year 2005 and 206,100 persons by the year 2010. The average daily visitor population is forecast to grow threefold from 11,400 in 1990 to 39,600 in 2010. Civilian jobs are forecast to increase from 50,800 in 1990 to 89,800 in 2010.

In West Hawaii, projected growth in the visitor industry is expected to produce major increases in employment and population. Population forecasts by the State of Hawaii, Hawaii County, as well as CRI and KPMG Peat Marwick (the HFDC socio-economic and market consultants, respectively) all conclude that the West Hawaii population will roughly double by the year 2005 to approximately 79,000 to 89,000 persons. (Note: population forecasts may vary due to the application of different methodologies and variables. Therefore, while specific conclusions may vary among forecasts, general consistency among them tends to validate their conclusions. Thus, a comparison of the four forecasts referred to above results in a forecast of a range of

growth rather than a commonly agreed upon number) . Table 5-4 presents a summary of key assumptions and results concerning project social and economic trends, based upon a market study conducted by KPMG Peat Marwick for the Kealakehe Planned Community project. Again, it should be noted that this discussion focuses on projected increases resulting from development and growth other than the proposed project.

TABLE 5-4: PROJECTED WEST HAWAII SOCIAL & ECONOMIC TRENDS

	1990	1995	2000	2005	2010
Resident Population:					
North Kona	31,200	35,600	40,100	45,200	51,500
South Kona	7,800	9,000	10,100	11,400	13,000
North Kohala	3,900	4,400	5,000	5,600	6,400
South Kohala	13,800	15,800	17,800	20,100	22,900
West Hawaii Total	56,700	64,800	73,000	82,300	93,800
West Hawaii Share of County Residential Population:	45.5%	45.5%	45.5%	45.5%	45.5%
Projected New Visitor Units (Cumulative):					
Hotel	0	5,700	9,085	9,085	9,785
Condominium	230	2,010	4,110	5,990	6,470
Total New Hawaii County Jobs Attributable to New Visitor Unit Development:	70	10,270	16,570	22,180	23,490
Persons per Housing Unit in Hawaii County:	2.8	2.8	2.75	2.75	2.7
Cumulative Housing Unit Demand (1):					
North Kona	800	2,920	5,800	9,130	13,680
South Kona	840	1,210	1,720	2,210	2,870
North Kohala	190	370	630	850	1,160
South Kohala	500	1,540	3,020	4,830	7,440
West Hawaii Total	2,330	6,040	11,170	17,020	25,150

(1) Baseline for estimation is 1987 Hawaii County Planning Department Inventory (14,094 units in West Hawaii)

The CRI analysis for this environmental impact statement forecasts a total project West Hawaii job count of 37,700 for the year 2005 and 45,000 for 2010. New labor supply resulting from natural population increase (excess of births over deaths) in the existing West Hawaii population would be able to fill only about 13% of the new jobs from 1990 to until 2005 and about 14% of the projected new jobs for the entire period until 2010. If there is no increase in commuting from East Hawaii, the remaining 86% of new jobs would have to be filled by net in-migration (that is, more people moving into West Hawaii than moving away) and by children born to in-migrants. (Note: the actual proportion of jobs going to net in-migrants may be somewhat lower, perhaps only 60% by 2005. This is because the analysis is based primarily upon the State's M-K assumptions for Hawaii County, and these assumptions include very low rates of labor force participation when compared to other counties. If existing residents and their children absorb more jobs, fewer in-migrants will be needed.)

The CRI analysis forecasts job growth and population growth over a twenty year period, and does not distinguish recent in-migrants from one who have lived in the area for decades. If in-migrants come to take West Hawaii jobs at a constant pace, recent in-migrants who have lived 5 years or less in West Hawaii could account for only about 12% of the 2005 workforce, and 11% of the 2010 workforce -- a lower percentage of in-migrants to West Hawaii than 1980 Census figures indicate for recent years.

Proposals for housing developments in West Hawaii, would, if all were built, yield over 21,000 new housing units, not including the Kealakehe project (KPMG Peat Marwick, 1990). Many of these developments have no permits as yet, and it is likely that fewer units will be built in the next twenty years or so.

Affordable housing commitments by resort developers would, when the resorts and the associated housing are built, yield over 3,330 employee housing units for low-income, moderate-income, and gap group families. Also, about 3,680 of the housing units in proposed residential developments are targeted as affordable units.

The total demand for new housing in West Hawaii is projected as about 25,000 units by the year 2010 (Table 5-4). This demand is higher than the supply of units proposed to be build in the projects discussed above. Also, the need for affordable housing units is great -- if housing ownership patterns continue as they have in recent years, the number of families owning their own homes in West Hawaii would be about 4,000 below that mandated by the State Housing Functional Plan, according to the market assessment for this project.

New private residential projects may well account for a much bigger part of construction spending than in recent years in West Hawaii, but these projects are not likely to meet the demand for new housing, especially affordable units.

1.3 Qualitative Changes

The social impacts of the preceding quantitative changes (that is to say, changes projected in West Hawaii not related to the proposed Kealakehe Planned Community) will depend in large part on; 1) geographical distribution of growth, 2) location and timeliness of infrastructure development (including housing), and 3) characteristics of in-migrant workers. Following is a brief discussion of current actions, conditions and plans that may affect future growth.

1.3.1 Geographic Distribution of Growth

The County's project population distributions (as well as those included in the market analysis for this environmental impact statement) indicates that West Hawaii growth will be concentrated primarily in North Kona and secondarily in South Kohala. The State of Hawaii's West Hawaii Regional Plan calls for development of a major new support community in Kealakehe as well as South Kohala development at Waikoloa, Lalamilo, and Kawaihae. The Hawaii County's draft development plan for the North Kona area from Palani Road to Keahole Airport (the Keahole to Kailua Development Plan, or "K to K" plan) identifies major residential development extending north of Palani Road, and including the Kealakehe property. The draft K to K plan also indicates a new regional Civic Center of up to 100 acres to be located in the vicinity of the Kealakehe property.

1.3.2 Infrastructure Development

The location and timeliness of infrastructure development is the second major qualitative determinant of West Hawaii's future. The magnitude of growth being planned for West Hawaii could intensify social impacts unless solutions are found. Both the State and County governments are currently in the process of exploring various mechanisms (impact fees, taxing authority, etc.) to assure that physical and social infrastructure development no longer lags far behind population growth in the future.

State and County planners are currently addressing new North Kona road alignments. The draft K to K Plan includes a new shoreline road from Honokohau Harbor to Kailua, a new mauka-makai road extending from Mamalahoa Highway across Palani Ranch and through Kealakehe to

Queen Kaahumanu Highway, major grade separated interchanges at Kealakehe and near the Keahole Airport, and a new regional roadway paralleling Queen Kaahumanu Highway on its mauka side, and the widening of Queen Kaahumanu Highway to at least six lanes.

Both State and County agencies are presently drilling for new potable water resources and the County plans to develop three new wells in 1990. A new reservoir is also planned.

The Kealakehe Landfill is proposed to be closed by the County in 1991 and a new landfill opened near Puuanahulu after about a year's construction work. However, a lawsuit challenging the new landfill project's EIS could affect scheduling drastically.

The Kealakehe Sewage Treatment Plant is presently under construction and is projected for completion by September 1991. Connections to the plant could be finished in another year. The facility is proposed to serve primarily Kailua and areas to the south.

1.3.3 Characteristics of New In-Migrant Population

The third determinant of social impacts resulting from future West Hawaii growth is the characteristics of new in-migrants. The distribution of in-migrants among two principal categories, retirees and workers, will guide the nature of future impacts.

Relatively affluent retirees and second-home owners could tend to widen the gap between "have's" and "have-nots" in West Hawaii. The State of Hawaii in its West Hawaii Regional Plan estimates that under ten percent of resort-induced population growth will be on-site resort residents, whose isolation from the general community would probably reduce any impacts, positive or negative. Undetermined, however, is the likely future number or geographic distribution of off-resort wealthy in-migrants, who would have more direct impacts on residential real estate values and the fabric of community life.

In-migrant workers and their children (who may be West Hawaii born), as earlier noted, will be required to fill anywhere from 60% to 90% of new West Hawaii jobs. The question remains as to where these in-migrant workers will come from. They will, most likely, come from a variety of locations, including East Hawaii, neighbor islands, Pacific Islands, and the continental United States. The degree to which the cultural values and lifestyles of the in-migrants differ from those of existing West Hawaii residents will determine, in great part, the extent of social impacts. While the exact composition of the in-migrant workers cannot be predicted at present, it may, however, be safely predicted that the projected growth levels imply some types of very major shifts

in the Big Island's overall population composition over the next 15 to 30 years.

1.4 Community Concerns

Community concerns are presented in two parts; those concerns independent of the proposed project, and those concerns raised in response to direct questions about the perceived impact of the proposed project.

1.4.1 Independent Concerns

The most recent community survey shedding light on major issues in West Hawaii was the State Tourism Impact Management System (TIMS) study conducted in late 1988. Results of the survey indicated the following:

- Lack of affordable housing was the top issue throughout the island, but was ranked even more highly in West Hawaii, and particularly in North Kona where 76% said it was a "big problem" for that part of the island (as opposed to 48% islandwide).

- Cost of food/clothing and existing traffic congestion were the next most important North Kona issues, rated as "big problems" by nearly 60% (as opposed to 44% and 28% respectively islandwide). For virtually all issues, North Kona residents were more likely than people elsewhere on the island to feel there was a serious problem. However, the gap was particularly wide for traffic congestion. The proportion of North Kona residents saying this was a "big problem" was twice as much as the rate for the island as a whole.

- Lack of sports/recreation facilities was also counted as a major problem by more than 50% of both North Kona and South Kona/Ka'u residents (52% as opposed to 33% islandwide).

- Environmental and/or crowding concerns (rapid population growth, crowded parks, destruction of natural beauty, pollution) were counted as "big problems" by more than a third of North Kona residents; higher than in most other parts of the island.

- Overall quality of life was felt to have grown worse over the past five years by about a third of North Kona residents (compared to only 18% islandwide). However, 36% of North Kona residents felt that overall quality of life had grown better. Statewide, North Kona was the only heavily resort-impacted area in which a few more people felt life had grown "better" rather than "worse". In West Maui 63% said "worse" versus just 16% "better".

- Negative attitudes toward future tourism growth were prevalent throughout the island (and the state), but even more so in West Hawaii than elsewhere in Hawaii County. Statewide preliminary TIMS results indicate such attitudes largely reflect growth-related problems.

Both the TIMS survey and a recent study by the University of Hawaii School of Social Work (Matsuoka et al., 1988) found that most Kona respondents thought tourism impacts to date have been, on balance, very positive because of the economic benefits. There were, however, strong concerns about continued growth.

1.4.2 Issues and Concerns Regarding the Current Project

As part of its socioeconomic impact analysis for the Kealakehe Planned Community, CRI conducted interviews with 88 "key informants" who were selected on the basis of knowledge of the community and/or being tentatively identified as belonging to some potentially affected interest group such as nearby residents, business operators, Hawaiians, and community leaders. The interviews were conducted in October and November, 1989. Following is a summary of the findings.

Kona interviewees generally welcomed the Kealakehe project as the first major effort to address the area's need for affordable housing. Still, they were concerned that such a solution might further aggravate current problems with traffic congestion and impact other infrastructure.

Kona residents identified housing as a critical problem that had grown much more severe in the past two years. They felt the demand for houses in the proposed project would be strong since there are now so few units that the average Kona family can buy or rent.

The interviewees pointed out that the project's location would mean more traffic on Palani Road, a road they depend on greatly but they consider to be unsafe and a major traffic bottleneck.

More than anything else, the interviewees wanted to see all of the project's infrastructure in place before anyone moved into the project. They felt this would minimize traffic congestion and strain upon water and sewer lines.

Kona residents identified several current social concerns in their area. They thought these could be either magnified or alleviated in the new Kealakehe community. They felt that if those problems were addressed in the planning and design of the project, then the new neighborhood would serve as a model community for the entire West Hawaii region. The Kealakehe project would, they hoped, respond to needs for affordable housing, recreational facilities, transportation, and child care, without straining the limited means of community residents.

Most of those interviewed said they hoped the proposed housing would be available to the

average Kona resort workers and others who currently have little chance of owning a home. People wondered if the housing would actually be priced to be affordable for young Kona families.

The interviewees clearly wanted the development to be attractive and a source of pride to its residents. They suggested financing methods to enable average working families to buy homes. They felt the area could remain desirable if strong community associations enforced housing standards. Many commented on lot sizes, setbacks, the mix of houses in the community, and overall layout of the project. Most wanted the project to include recreational facilities.

Kona residents raised concerns about the relation of the Kealakehe project to surrounding areas. First, some residents expressed very strong concern regarding possible future uses of the State's property makai of Queen Kaahumanu Highway. Some suggested that the golf course be located makai of the highway, to block other uses of that area. Others were divided in their views of the most appropriate site for the proposed golf course. Next, several persons were concerned about the impacts of the project on nearby residential areas and on Honokohau Harbor.

1.5 Probable Social Impacts

1.5.1 Quantitative Impacts

Major quantifiable socio-economic impacts of the proposed development are population and employment. This section deals with the resident population at the project, employment associated with the project, both during construction and after buildout, and indirect and induced employment linked to the project.

1.5.1.1 Population

The project will be built out over about 20 years; sooner or later depending partly upon demand for affordable housing in West Hawaii. A market assessment conducted for the project shows that 3,620 to 5,530 units could be absorbed at Kealakehe by about the year 2010, based upon an average household size of about 2.7 persons. While the ultimate number of units to be built at Kealakehe is not yet fixed due to continuing planning efforts, current estimates place the actual number of units in the range from 4,100 to 4,400, about mid-way within the market assessment's range.

At full occupancy, the proposed project's expected on-site population will range from between 9,774 to 14,931 persons, depending upon the actual number of units built. This is based upon the market assessment's range of units that could be absorbed. However, it is more likely

that occupany of the project will average at about 95%. Therefore, the number of projected occupants will more likely fall into a range of between 9,285 and 14,184 persons. For purposes of evaluation, the higher number is assumed to be the ultimate increase in population.

1.5.1.2 Employment

Employment associated with the proposed project includes: 1) construction jobs, which are generated for a limited time; 2) operational jobs, which are presumed to last the lifetime of the project; and, 3) indirect and induced jobs in the larger State economy, created as the development and project workers buy goods and services from other establishments. (Note: indirect and induced jobs are estimated using a model of the State economy which can be applied to any project or enterprise).

Project construction is estimated to generate a total of 3,830 to 5,570 direct jobs over the entire construction period. The actual average number of construction jobs in any given year is expected to be in the range of 190 to 280 jobs, while the number of jobs on-site will be somewhat smaller.

Indirect and induced jobs generated by construction of the project are calculated as amounting to roughly 8,000 to 12,000 jobs over the construction phase, of which about 3,000 to 5,000 could be located in Hawaii County -- yielding an estimated annual average of 170 to 250 indirect and induced jobs in Hawaii County. The total direct, indirect, and induced jobs for project construction would then average about 360 to 530 in Hawaii County annually.

On-site jobs (operational jobs) will be created as the residential and other components in the project area are developed. After buildout, the project is estimated as providing about 370 to 470 direct jobs, and from 50 to 80 indirect and induced jobs.

1.5.2 Qualitative Impacts

By adding thousands of housing units to the West Hawaii housing supply, the project is likely to have a stabilizing effect on the price of housing and rentals. By providing units for families with low, moderate, and gap-group incomes, the project will address needs of existing West Hawaii residents. The project will give many families a chance to own their own home. It will encourage less crowding in existing households by providing new opportunities for young adults who are presently living with parents or relatives. It will also help to decrease stress and social problems that can accompany crowded living conditions.

Impacts on project residents' incomes will vary. Renters are likely to benefit from lower rents and/or a decrease in the rate of appreciation of rents. Many new homeowners will pay more for housing than they would in rental housing, but they will be gaining equity.

The project will most obviously benefit its residents by providing them homes. Others who will also be affected by a larger housing supply include in-migrants and commuters. More rental units for low- and moderate-income families can encourage working in-migrant couples (from other counties of Hawaii or from outside Hawaii) to stay in the area, leading to lower transience among new in-migrants. New in-migrants attracted by visitor sector jobs will be more likely to find appropriate housing in the future than they have in recent years. Some of the "working homeless" -- commuters from other parts of Hawaii County who work in West Hawaii but live in their cars during the work week -- are likely to find better shelter. Finally, as West Hawaii affordable housing supply increases, commuters and new West Hawaii employees from elsewhere in Hawaii will move to West Hawaii in increasing numbers.

The creation of a large-scale planned community in West Hawaii will affect residential life in the larger West Hawaii area both directly and indirectly. The project's community association and enforcement of controls on building and use violations (such as illegal rentals) may serve as a model for other neighborhoods. With an increased housing supply, the demand for illegal rental units and the need for families to double up will decrease, leading to lowered population density in some neighborhoods. The provision of licensed child care providers in the project area will help to meet growing needs among West Hawaii families for child care.

1.5.3 Impacts on Nearby Areas and Activities

1.5.3.1 Residential Areas

As West Hawaii's population grows, residents of existing neighborhoods will see residential areas grow, and new residential areas created where there is now open space. With a large-scale residential project located at Kealakehe, residents of the existing Kealakehe neighborhoods and adjacent neighborhoods, including Kailua Village, are likely to see their surroundings as changing markedly. By increasing the nearby area's population, the project is likely to bring mixed impacts:

- According to residents, increased traffic congestion on Palani Road is highly likely. This increase will be offset to some degree by the proposed mauka-makai roadway.
- With greater population, the frequency of crime and domestic disturbances in the nearly area is likely to increase. However, the proposed mauka-makai

roadway will reduce travel time between the police station and the Palani Road subdivisions, improving police response time. New social programs and services at the proposed Civic Center may also help to compensate for some of the problems of urban growth.

- The project's commercial areas will include stores and services of use to residents, so nearby residents will no longer have to go down Palani Road to Kailua for their shopping. This will increase convenience to residents while reducing traffic impacts on Palani Road.

- Public facilities, infrastructure, and services developed within the project or in connection to the project will benefit nearby residential areas as well. The location of a high school and elementary school at Kealakehe, for example, will greatly reduce commuting time for students living north of Kailua Kona. In addition, the public golf course, while of benefit to golfers living throughout West Hawaii will be especially convenient for nearby residents.

- By locating homes with larger lots near existing market price subdivisions, and by mixing product types within the project, the project will avoid creating the low-income "slum" that some area residents fear could be created in time.

- Improved access to public facilities on the project site, such as the proposed high school and elementary school, is likely to add to the value of an area home.

1.5.3.2 Industrial and Commercial Areas

The Kealakehe community's impact upon businesses at the Kaloko Industrial Park north of the project site, the Queen Liliuokalani Trust lands south of the project area, which include the existing industrial subdivision and expansion area, and in Kailua town is generally positive. A large residential population in the immediate vicinity would help to support retail, amusement, and service establishments.

Increased traffic flow on Queen Kaahumanu Highway -- likely if the QLT commercial areas attract many customers -- would have a negative impact on these sites. Road improvements are accordingly planned as part of the Keahuolu Lands project.

1.5.3.3 Honokohau Harbor and Kaloko-Honokohau National Historic Park

Honokohau Harbor and Beach. Development of the Kealakehe Planned Community will increase the number of users of the Honokohau boat harbor, commercial area, and shoreline, since these will be easily accessible to residents. As a result, demand for boat slips will increase. This demand will eventually be addressed by the State's proposed expansion of the boat harbor, but before this occurs, boat owners living in the Kealakehe project will likely keep their boats on

trailers. Increased use of Queen Kaahumanu Highway and other roadways to transport boats is likely. The existing commercial area at the harbor and additional 20 parcels being developed by the State will benefit from increases in the nearby population of potential customers and workers. Honokohau beach, which is now used by fishermen and nudists along with others, will be impacted by increases in usage. This increase may limit current uses.

Kaloko-Honokohau National Historic Park. Development of the proposed project will increase the number of potential visitors to the Historic Park which is operated by the National Park Service. The park boundaries include the 20-acre Aimakapa Fishpond, a brackish water pond and wetland providing habitat for endangered Hawaiian waterbirds, waterfowl and shorebirds. Archaeological sites and anchialine ponds within the park could be impacted by increased numbers of visitors. Knowledge of the park area is presently limited to area residents. However, significant increases in population will be accompanied by increased knowledge of the park as a destination area and potentially increased demand for services and activities at the park. However, the National Park Service estimates a daily visitor capacity for the park at 1,500 visitors and a "projected annual visitation" of 500,000 visitors, once the park's proposed facilities are fully developed. Planned facilities include a parking area for up to 250 cars and buses, an orientation structure and an administrative office building.

1.5.3.4 State-owned Lands (Kealakehe Makai)

In addition to the Kealakehe Sewage Treatment Plant (STP) presently under construction on the state-owned Kealakehe lands makai of Queen Kaahumanu Highway, the State's Department of Transportation is proposing the expansion of Honokohau Harbor and the development of an industrial area to provide support services for the harbor, as well as the construction of a shoreline highway extending from the proposed mauka-makai roadway across the makai parcel and into Kailua.

Project development will require expansion of the STP to accommodate the increased demand for sewage treatment. As discussed above the Harbor will likely experience increased numbers of users. The proposed makai extension of the mauka-makai roadway would likely be used regularly by project residents travelling to shoreline recreational areas and Kailua.

1.5.3.5 Other Nearby Property and Activities

Adjacent Pasture Land. The Lanihau Corporation and Palani Ranch run cattle on two parcels adjacent to the northern boundary of Kealakehe at the mid-level elevation. Incidents of

trespassing, causing conflict between ranchers and residents, are likely when pasture land is located next to residential areas. Landowners hope that fencing can keep hunters, children, dogs, and others out of the area.

Adjacent Industrial Land. Property owned by Robert S. McClean and located along the northern boundary of Kealakehe extending east from Queen Kaahumanu Highway is proposed for a variety of industrial uses including production and sale of concrete and concrete products; boat storage, sales and repair; lumber and hardware sales; automotive sales, service and repair; storage of trucks, buses and construction equipment; self-storage facilities; offices and storage areas for contractors; and other light industrial uses. Development of the proposed residential project will have a positive impact upon the industrial area by providing new customers for the proposed services. Since the proposed light industrial activities will be located adjacent to the Kealakehe commercial shopping center, no direct impacts generated from the residential areas are anticipated. The Kealakehe commercial area will have no adverse impact on the proposed light industrial activities on the McClean property.

Kealakehe Landfill, Transfer Station, Police Substation, Amfac Distribution Center and West Hawaii Animal Shelter. A mixture of light industrial uses are located along the southern boundar of the Kealakehe community near Queen Kaahumanu Highway. These activities are located on land owned by the County of Hawaii. The County has indicated that it intends to close the existing landfill. Conversion of the site to usable land will take between 10 and 30 years based on standards established by the federal Environmental Protection Agency. In view of this, access to the site from the residential community will most likely be restricted.

The existing County transfer station is expected to remain during the early phase of the proposed residential development. It will provide a convenient service for community residents wishing to dispose of bulky items.

Until May, 1990, the County's recently constructed Police substation was proposed as the core of a planned Civic Center reflected on the Kealakehe master plan. However, the Hawaii County Planning Commission has recently approved a proposal that the Civic Center be located on state-owned land makai of the Queen Kaahumanu Highway. Therefore, it is unclear at this time what the County's long-term plans are for its site. The Amfac warehouse and West Hawaii Animal Shelter are leased from the County. The status of their continued presence at the site will be determined by the County and is presently not known. However, the proposed residential development will have little impact upon them.

Nearby Shoreline Recreational Space. The growth in population at Kealakehe will mean an increased demand for recreational space at the Old Airport State Park. The park is currently the only major park in the Kailua Kona area and its open space and limited sports facilities will be more easily accessible to Kealakehe residents using the proposed mauka-makai roadway and shoreline roadway extending from Kealakehe into Kailua. Recently, Hawaii County has approved construction of a new gymnasium at the County park adjacent to the Old Airport Park. Increases in population at Kealakehe will result in increased demand for services and activities at the proposed gym. Expansion of the park is also proposed and will include multi-purpose playing fields, tennis courts, and a swimming pool.

Increased use of the Harbor area, the Old Airport Park and County park, and the QLT's vacant property makai of the highway will mean more people will be closer to the Trust's Children Center and its family camping program at Papawai Beach. The program may be impacted by more people along the shoreline, more neighborhood lighting, and increased noise. However, the Kealakehe project's contribution to these impacts is considered to be minor.

Minimum-Security Corrections Facility. The State of Hawaii's Department of Accounting and General Services (DAGS) is presently preparing a site evaluation study and draft environmental impact statement for a 100-bed Minimum-Security Corrections Facility in the Kealakehe area. Although the actual site has not been determined, HFDC has been advised that the proposed Civic Center and the Kealakehe lands makai of the highway are under consideration and that the facility would be constructed in conjuction with a State Judicial complex. According to DAGS, "this facility will take advantage of all the most recent technologies, combining courts, detention, and a justice center with a minimum of neighborhood impacts." While the proposed planned community will have little impact upon such a facility, the development of a correctional facility near the residential community may have substantial and significant impacts.

1.5.4 Social Impacts of Golf Course Development

By providing a public golf course (to be built by the County or its designated developer on land transferred to the County), the project will offer West Hawaii residents a less expensive alternative to resort courses. Demand for a golf course from residents is projected as generating high levels of play on the course.

Only limited locational impacts of golf course development are evident. Its placement could minimize potential difficulties with the siting of a residential development adjacent to existing industrial areas. Golf course frontage will increase the value of adjacent lots, providing additional

subsidies for affordable housing and encouraging the development of a wide range of units in the project's product mix.

2. MARKET CONDITIONS

The following discussion summarizes the findings of a market assessment prepared for the projet by KPMG Peat Marwick in June 1990. The complete market assessment is included in the appendix to this environmental impact statement.

2.1 Housing Demand

The Kealakehe Planned Community is being developed to accommodate existing and future demand for affordable housing units associated with current and projected development in West Hawaii. The visitor industry is expected to be the primary source of economic and demographic growth during the development period for the Kealakehe project. Development of new resorts on the South Kohala coast over the past twenty years has contributed to a five-fold increase in population in North Kona (see Table 5-1).

Many new and expanded resorts are planned for development by the year 2010 on the Big Island. New resort development will result in a substantial increase in employment opportunities leading to increased demand for more affordable housing from new workers entering the West Hawaii market. Indicators of this projected growth include the following:

- The 450-unit Ritz Carlton Mauna Lani hotel is presently under construction.
- Nine resorts have all principal development approvals, including six with existing hotels. Additional hotel rooms at existing resorts could amount to almost 5,000 units.
- Three new resorts have received all principal development approvals, and could be built out to about 2,700 rooms.
- The sum of planned resorts could represent almost 13,000 new hotel rooms, compared with the current inventory of less than 6,000 rooms.
- More than 75% of the hotel rooms proposed would be developed in the West Hawaii region.
- A total of 697 resort condominium units are under construction or expected to begin construction before the end of the year.

- More than 7,350 additional resort condominium units could be developed in existing resorts.
- About 1,300 resort condominium units are planned for new resorts with government approvals.
- Almost 3,600 additional condominium units are proposed.
- A total of almost 13,000 condumium units could be developed by 2010. More than 10,000 of these units could be constructed in West Hawaii.

The construction activity discussed above is expected to result in almost 24,000 new visitor industry related positions on the island of Hawaii. The location within the County of the new employment will depend on many factors, such as transportation links and the availability of land for industrial use. However, since more than 75% of the new visitor jobs are projected for West Hawaii, that region is expected to be most heavily impacted by employment growth. As presented below, this growth in employment could result in demand for over 25,150 new housing units in West Hawaii by 2010, with an annual average demand of over 1,100 units.

TABLE 5-5: WEST HAWAII CUMULATIVE HOUSING DEMAND

	1990	1995	2000	2005	2010	Units per Year
North Kona	800	2,920	5,800	9,130	13,680	570
South Kona	840	1,210	1,720	2,210	2,870	120
North Kohala	190	370	630	850	1,160	50
South Kohala	500	1,540	3,020	4,830	7,440	30
West Hawaii Total	2,330	6,040	11,170	17,020	25,150	1,050

(1) Baseline for estimation is 1987 Hawaii County Planning Department Inventory (14,094 units in West Hawaii)

2.2 Housing Supply

With regard to present development plans for housing units, about 21,000 units are presently planned for construction in the West Hawaii region. However, more than 11,500 of these units are still in the conceptual design stage or are awaiting government approvals. In most cases, major infrastructure improvements will be necessary before actual residential construction can begin. An additional 800 of the 21,000 units are planned as agricultural or large-lot estates at either Waikoloa Village or Kohala Ranch.

If all proposed projects are built as planned, State and County affordable housing requirements will result in developers having to commit to about 7,000 affordable units. About half of these units represent potential commitments by resort developers. The remaining half represent affordable housing project planned by government agencies.

2.3 Demand for Affordable Units

Historically, the extent of homeownership has been related to household income level in the State of Hawaii. There is a direct relationship between income and ownership. While less than 25% of households earning under $10,000 in 1979 were homeowners, more than 80% of those earning more than $35,000 owned their own homes. Although homeownership is less widespread in lower income brackets, many lower-income households are owners. This reflects many elderly-headed households, whose lower incomes do not reflect long-term ownership of homes purchased at far lower price levels than currently prevail. On the other hand, a sizable minority of households with incomes seemingly sufficient to qualify for homeownership still rent. In 1979, almost half (45%) of households earning from $20,000 to $25,000 annually were renting. This reflects a shortage of moderately-priced housing, and also a possible lack of units suitable for families at moderate prices.

Using the State Housing Functional Plan's goal of 60% homeownership among resident households as a target, the demand for affordable housing in Hawaii County is determined by distributing the projected number of households by the year 2010 among income deciles according to historical patterns. The result is that homeownership is projected to decline in the County from 57.3% of resident households in 1980 to 38.3% in 2010. A total of 13,100 units of affordable housing will be needed in Hawaii County to enable the 60% goal to be attained. Of these units, approximately 7,860 will be needed in the Kealakehe market area. Using a similar analysis, it is projected that approximately 8,500 rental units will be needed in Hawaii County by 2010. Of these rental units, about 5,100 will be needed in the Kealakehe area.

2.4 Kealakehe Market Share

The number of homes of each type supportable at the project site is estimated on the basis of project demand in the market area and anticipated market conditions.

The Kealakehe project is estimated to capture from about 30% to 35% of affordable homeownership in the West Hawaii market area, and from about 15% to 25% of affordable rental unit demand. By the year 2010, total affordable housing unit support at Kealakehe is estimated at

about 2,490 to 3,260 units.

The Kealakehe project is intended to address a broad range of housing needs, including those which can be met with market-priced units. Market housing demand is based on the overall market area demand of 25,150 units discussed above, minus a mid-range estimate of affordable units demand of approximately 2,150 units. The result is a market area demand of about 23,000 units through the year 2010. It is estimated that the Kealakehe community could capture from 5% to 10% of this demand. The Kealakehe share of new market units could represent from 1,130 to 2,270 units.

In general, market support will increase over the 20-year development period, in line with projected regional growth. Annual absorption of units from 1990 to 1995 could reach from 180 to 270 units at average capture rates. The highest degree of potential market absorption, after initial development, could occur in the 2005 to 2010 period, when from 190 to 290 units could be absorbed annually. Over the entire development period, annual absorption could range from 160 to 250 units, depending upon the size of the development program.

Cumulative market support for Kealakehe housing units is projected to be from 220 to 290 affordable units and from 110 to 220 market units in 1990. Cumulative support could increase from 1,720 to about 2,590 units by the year 2000. Market support for the total project could further grow to a range of 3,620 units to 5,530 units by 2010.

2.5 Development Phasing

The Kealakehe Planned Community would be built out over a period of about 20 years, with all housing units completed by about 2010. The mix of housing developed (affordable ownership units, affordable rental units, and market units) should be relatively flexible in order to respond to market needs and opportunities. Housing development could proceed at higher levels to the year 1995, in order to accommodate growth in a period of strong employment expansion and to service pent-up demand for housing units in the market area. Market units could be phased in early in the Kealakehe development program so as to establish the community as an attractive location and to provide future move-up opportunities for home owners.

TABLE 5-6: RECOMMENDED ANNUAL PRODUCTION RATES

Type of Unit	1990-1995	1996-2000	2001-2005	2006-2010	Average	Total
Affordable:						
-Ownership units	90	90	70	40	70	1,400
-Rental units	60	35	45	70	50	1,000
Market:						
-Market units	100	60	60	90	80	1,600
TOTAL UNITS PER YEAR:	250	175	175	200	200	4,000

The phasing of units recommended in Table 5-6 differs somewhat from projected absorption rates discussed above. Absorption estimates were based on average capture rates. Recommended phasing produces absorption at the same average capture rate over the 20-year period, but with varying (rather than constant) capture rates in each of the four five-year intervals constituting the overall development program. Overall development would be highest in the first five years at 250 units per year, stabilize at about 175 units each year over the next ten years, and be completed with about 200 units in each of the last five years. Affordable ownership housing production would decline as a proportion of total development after the first five years, and would range from about 40 to 90 units annually. Affordable rental units would represent about 60 units per year through 1995, but would decline for the 1996-2005 period, when other rental projects in the market area are expected to be developed. Market units would range from about 60 to 100 units per year, with the highest production levels in the first and final five-year periods.

3. FISCAL IMPACTS

This section estimates the projected incremental revenues and costs which may accrue to the State of Hawaii and County of Hawaii from the development of the Kealakehe Planned Community. To assess the impact of this project, estimates of incremental revenues and costs were used to calculate a revenue-cost ratio. The approach consisted of:

- Identification of the major revenue and cost components, based on discussions with the planner and economist.

- Estimation of the dollar amounts that would be associated with each revenue and cost component.
- Comparison of the 1990 constant dollar total revenues and costs.

The objective of the analysis was to determine whether the additional public revenues from this project would be sufficient to offset the additional public costs incurred.

The purpose of this analysis was to provide information to HFDC concerning the fiscal impacts that may result from the estimated incremental revenues and costs and should not be construed to be a presentation of expected future results. Accordingly, this analysis may not be useful for other purposes. Even if the projected impacts occur, there will usually be differences between projected and actual results, because events and circumstances frequently do not occur as expected, and those differences may be material.

3.1 Information and Data

During the analysis, verbal and written information was obtained from planners, government officials, and other knowledgeable individuals. This information was accepted as accurate and no responsibility is assumed for information furnished by others and believed to be reliable. The right to make such adjustments to the values reported, as may be required by the consideration of additional or more reliable data that may become available is reserved, but there is no obligation to do so.

All project estimates are based on 1990 constant dollars. Actual results will vary, due to inflation and other economic conditions.

3.2 Revenue and Cost Variable Selection and Estimation

Only those variables which were expected to produce a significant impact on the State of Hawaii and County of Hawaii revenues and costs were analyzed in detail in this study. The major incremental sources of revenue for the State of Hawaii were the 4% general excise tax and individual income taxes from the development and operations of the golf course and commercial property. Secondary sources of revenue were from additional state income taxes from corporations developing and operating the project. The major source of incremental revenue for the County was from real property taxes on the residential units and commercial property. Other County revenues were assumed to increase proportionally based on current per capita levels.

Based on the Market Assessment for Kealakehe, it was assumed that most of the families who will reside in the proposed project are current residents of the area. Therefore, increases in public services will primarily be due to general population growth rather than the project. The major incremental costs for the State will be for new schools. Major capital costs for roads, water, sewer, electricity, and parks were included in the project Master Plan. These capital costs were allocated to the project and therefore were not included in the analysis. Other County costs were assumed to increase based on current per capita expenditure levels.

Revenues and costs were estimated for a twenty year period from 1992 to 2011, based on the Market Assessment.

3.3 Public Revenues

Major incremental public revenues were estimated for 5 major sources:

- General Excise Tax (G.E.T.)
- Corporate Income Tax
- Individual Income Tax
- Real Property Tax
- *Other County Revenues*

Each major source of revenue is described below with the rationale for its inclusion, the estimation procedure and any significant assumptions.

3.3.1 General Excise Tax

3.3.1.1 Development

Under the planned development concept, only the construction cost of the golf course, the commercial center, schools, and the churches/child care centers would be subject to the 4% G.E.T. These construction costs were estimated and assessed the 4% tax rate.

Using the authority provided in Chapter 201E-205 of the Hawaii Revised Statutes, the Housing Finance and Development Corporation (HFDC) intends to exempt the developers of the affordable and market housing, off-site infrastructure and on-site infrastructure from G.E.T.

3.3.1.2 Operations

The golf course operations and the various businesses operating within the proposed commercial center will be assessed general excise taxes under the Hawaii Revised Statutes. All businesses were assumed to engage in transactions taxed at the 4% rate.

Golf course revenues from greens fees, pro shop sales, snackbar sales and driving range charges were estimated at $20 per round, based on the Market Assessment. The number of golf rounds were estimated in the Market Assessment at 54,000 - 90,000 rounds per year from 1995 to 2011. All revenues were assumed to be taxed at the 4% G.E.T. rate.

Gross revenues for the commercial center were based on an estimated $ 231 per net leasable square foot. The commercial center was estimated to have 260,000 square feet of net leasable space. All revenues were assumed to be taxed at the 4% G.E.T. rate.

The churches/child care centers were assumed to be non-profit organizations exempt from the G.E.T. The rental projects developed in accordance with the HFDC Rental Housing System were also assumed to be exempt from the G.E.T.

3.3.1.3 Personal Consumption Expenditures

The construction of the residential units, commercial center, golf course and new elementary and high schools will create new jobs for the community. These new jobs will result in additional income that can be used to purchase various goods and services which would be subject to the 4% G.E.T.

The G.E.T. for these additional personal consumption expenditures was calculated by estimating the net take-home pay for the "average" family. Net take-home pay was calculated by using gross pay less payroll taxes. Gross pay was based on the 1989 County of Hawaii median income for the type of work adjusted to 1990 dollars. Payroll taxes were estimated at 20% of gross pay. From this net take-home pay, it was assumed that 60% of this amount would be spent on consumable goods, excluding mortgage/rental expenditures. This consumable goods amount was used as the base figure to calculate the revenue subject to general excise tax per family/household.

3.3.2 Corporate Income Tax - Operations

It was assumed that all businesses developing the residential units, commercial center, schools, and golf course would be corporations. The net income from the proposed housing development and other operations would be subject to corporate income tax under the Hawaii Revised Statutes (HRS), Chapter 235. The current corporate income tax rate specified in HRS 235-761(a) is 6.4%.

The income subject to State income tax for the housing development was based on the estimated profit per housing unit. The net income for the commercial center, schools and golf course were based on assumed profit margins of 4% of gross sales for the commercial center, 4% of construction cost for the schools and 5% of gross sales for the golf course. The taxable income was then subject to the 6.4% corporate income tax rate.

3.3.3 Individual Income Tax

Individual income taxes were estimated for income earned by the construction workers, employees of the elementary and high school, the golf course and businesses located in the commercial center. Using the gross income estimates for family incomes and an average of $5,020 in exemptions and deductions per family/household, the taxable income of the "average" household was estimated. The income tax was then computed assuming all employees file a married and joint return.

3.3.4 Real Property Tax

The 3,306 for-sale units will provide additional real property tax revenue for the County of Hawaii. The rental projects consisting of 852 units will be exempt from real property tax. It was assumed that all for-sale dwelling units will be fee simple. Based on the Socio-Economic Study, it was assumed that all affordable units and 50% of the market units will be owner-occupied by Hawaii residents applying for their homeowner's exemption of $20,000. The remaining 50% of the market units were assumed to be owned by non-residents not qualifying for a homeowner's exemption. The average unit sales prices were adjusted as appropriate for comparable market costs and the buy back provision. The estimated assessed value was taxed at $8.50 for each $1,oOO value of property and land.

The commercial property assessment was based on the cost of land, improvements and construction. The total value was then assessed at $8.50 per $1,ooo value of property and land.

The golf course will be owned by the county, therefore, no real property taxes will be incurred.

3.3.5 Other County Revenues

Other incremental County revenues were based on current per capita levels for the following items:

- Real property tax - other (industrial, agricultural, conservation, hotel/resort and unimproved residential land and improvements)
- Fuel and public utility franchise tax

The per capita levels were multiplied by the cumulative number of new housing units produced to estimate the incremental annual revenues.

3.4 Incremental Public Cost

Major incremental public costs were estimated for 2 major areas:

- Education
- Other County Costs

Major infrastructure costs for roads, water, sewer, electricity, and parks were included in the project Master Plan. These capital costs were allocated to the project and therefore were not included in this analysis. A description of the incremental costs, the rationale for inclusion, the estimation procedure and significant assumptions are provided below.

3.4.1 Education

The Department of Education estimates that the change or shift in population will increase public education costs for teachers and schools. The Department of Education Facilities Branch estimates that the project will require one new elementary school and one new high school plus additional postions to meet the increased student population. The Facilities Branch estimates that an additional 68 positions will be needed to meet this increase. These new positions were assumed to be added as the population increases at the project.

The capital costs of building and equipping the new elementary school and high school were estimated at $65 million by the Department of Education. Construction was assumed to be

completed in 1995.

3.4.2 Other County Costs

Other incremental County costs were based on current per capita levels for the following items:

- General government
- Public Safety
- Highways
- Sanitation and waste removal
- Health, education and welfare
- Culture and recreation
- Pension and retirement
- Health fund
- Miscellaneous

The current per capita levels were multiplied by the cumulative number of new housing units produced to estimate the incremental annual costs.

3.5 Results of Analysis

For the Kealakehe project, a revenue-cost ratio of 1.03 to 1 was attained. This indicates that an additional $1.03 of public revenue benefits was estimated to accrue to the State of Hawaii and the County of Hawaii for every dollar of public cost caused by the proposed development. These revenues and costs are summarized in Table 5-7.

As a standard for comparison, the U.S. Army Corps of Engineers recommends proceeding with a project if the revenue-cost ratio is unity (1.0) or greater.

Based on this analysis, the estimated combined fiscal impacts on the State of Hawaii and County of Hawaii appear to be favorable and should result in a net public benefit if the project is developed.

TABLE 5-7: PUBLIC REVENUES AND COSTS

	Schedule	County FY90 Budget	FY 1992-2011 Incremental Revenues and Costs County	State	Total
Public Operating Revenues:					
General Excise Tax	A			39,362,781	39,362,781
Corporate Income Tax	B			3,472,976	3,472,976
Individual Income Tax	C			29,655,431	29,655,431
Real Property Tax					
Residential, Apt., Comm'l	D	24,022,000	43,573,355		43,573,355
Other County Revenue	E				
Real Property Tax-Other		26,923,000	27,226,012		27,226,012
Fuel & Utility Taxes		6,419,563	6,742,650		6,742,650
Licenses & Permits		4,290,770	4,480,875		4,480,875
Money & Property[1]		2,714,800			
Intergovernmental Revenues		20,830,954	21,762,136		21,762,136
Charges for Services		2,368,160	2,474,027		2,474,027
Other Revenues		5,059,278	5,285,474		5,285,474
Fund Balance, Previous Year		3,374,016			
Total Public Operating Revenues		96,002,541	111,544,528	72,491,188	184,035,716
Public Operating Costs	F-2				
General Government		14,332,164	14,978,925		14,978,925
Public Safety		34,075,014	35,590,950		35,590,950
Highways		6,738,874	7,041,375		7,041,375
Sanitation & Waste Removal		4,237,651	4,438,200		4,438,200
Health, Education & Welfare	F-1	3,907,164	4,096,800	34,468,720	38,565,520
Culture & Recreation		7,299,374	7,638,825		7,638,825
Debt Service[1]		8,357,492			
Pension & Retirement		2,592,182	2,688,525		2,688,525
Health Fund		3,314,000	3,456,675		3,456,675
Miscellaneous		11,148,626	11,650,275		11,650,275
Total Public Operating Costs		96,002,541	91,580,720	34,468,720	126,049,270
Net Operating Income		0	19,963,978	38,022,468	57,986,446
Capital Costs (not incl. in Master Plan funding)					
Elementary School[2]				16,000,000	16,000,000
High School[3]				36,000,000	36,000,000
Total Capital Costs				52,000,000	52,000,000
Net Incremental Revenues/(Costs)			19,963,978	(13,977,532)	5,986,446
Revenue/Cost Ratio			1.22	0.84	1.03

[1] Not included in incremental revenue and cost estimates

[2] Pro-rata portion of $20 million construction cost financed over 20 years

[3] Pro-rata portion of $45 million construction cost financed over 20 years

CHAPTER VI

CHAPTER VI
INFRASTRUCTURE AND PUBLIC FACILITIES

1 GROUND TRANSPORTATION FACILITIES

Following is a summary of the traffic impact assessment prepared for the proposed project in June 1990. The report is included in its entirety in the appendix to this document.

1.1 Existing Roadway Conditions

1.1.1 Highway Facilities

The major roadways in the North Kona region are Queen Kaahumanu Highway, Palani Road, and Mamalahoa Highway (see Figure 6-1).

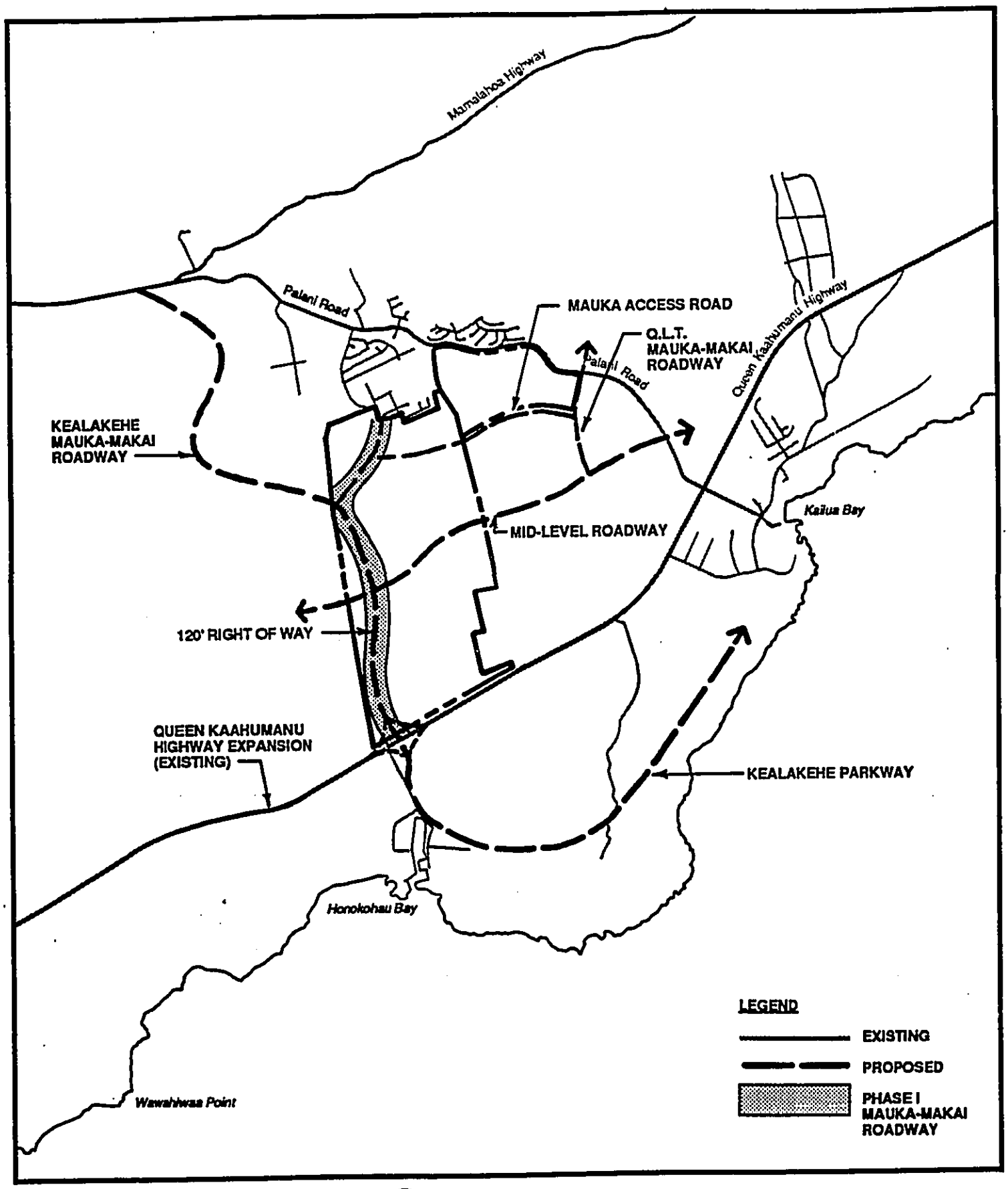
Queen Kaahumanu Highway is the main highway in the Kona region running in a north-south direction about a mile inland from the coastline between Kawaihae and Kailua-Kona. It is a State maintained two-lane undivided highway with a 24-foot wide pavement and variable speed limits of 35 to 55 mph. The major intersections along Queen Kaahumanu are channelized with left-turn storage lanes, deceleration and acceleration lanes. Queen Kaahumanu Highway forms a 4-way signalized intersection with Palani Road at the main entrance of Kailua-Kona. The posted speed limit is reduced to 35 mph near this intersection.

Mamalahoa Highway is a two-lane roadway running in a north-south direction parallel to Queen Kaahumanu Highway and serves the higher elevation areas between Waimea and North Kona. This State highway was built over a former horse-and-buggy trail and is a winding substandard roadway with a pavement width varying between 18 and 24 feet.

Palani Road is a two-lane roadway running in a northeast direction from Kuakini Highway on the coastline of Kailua Village mauka to Mamalahoa Highway. It serves as the major mauka-makai connector road between Queen Kaahumanu Highway and Mamalahoa Highway in the North Kona region. Palani Road is a Hawaii County maintained road with 12-foot wide lanes and a posted speed limit of 25 mph. Palani Road currently serves as the main vehicular access road for the existing Kealakehe and surrounding residential subdivision.

1.1.2 Street Facilities

Kealakaa Street and Ulua'oa Street are relatively new two-lane roadways serving the



0 1000 2000 4000

SCALE IN FEET

NORTH

Prepared By: BELT COLLINS AND ASSOCIATES • JUNE 1990

Figure 6-1

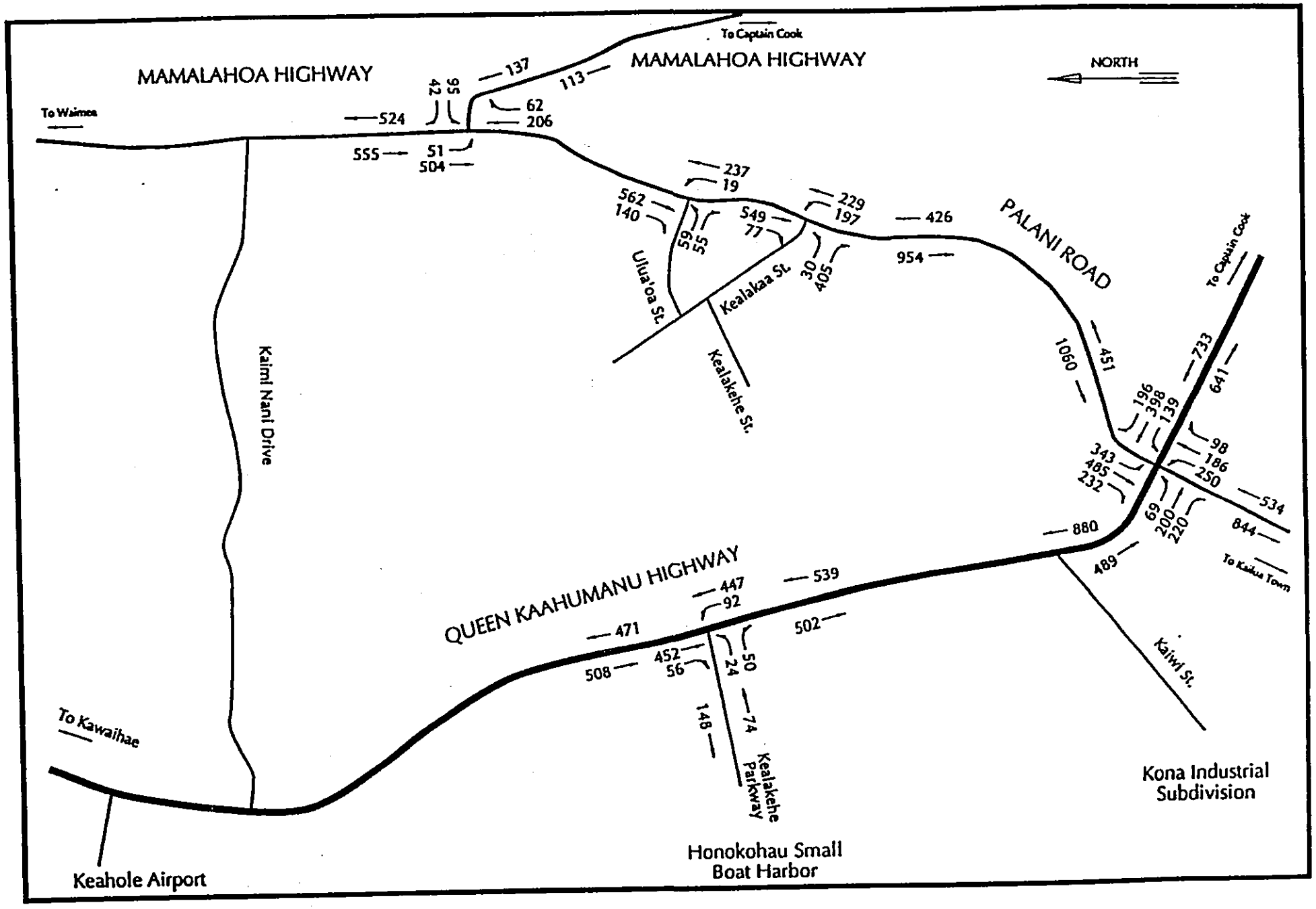
REGIONAL ROADWAY NETWORK

Kealakehe subdivision and are maintained by Hawaii County. Both streets are located makai of Palani Road and form unsignalized T-intersections with it. They both have speed limits of 25 mph. Kealakaa Street has 18-foot wide paved lanes and generally runs in a north-south direction, providing access to Kealakehe Intermediate and Elementary Schools. Ulua'oa Street generally runs in a mauka-makai direction linking Kealakaa Street to Palani Road. Ulua'oa Street has 16-foot wide paved lanes.

Kealakehe Parkway Road is a two-lane roadway running in a mauka-makai direction with 12-foot wide paved lanes. It forms an unsignalized T-intersection with Queen Kaahumanu Highway providing access to Honokohau Harbor. The posted speed limit is 25 mph.

1.1.3 Traffic Conditions

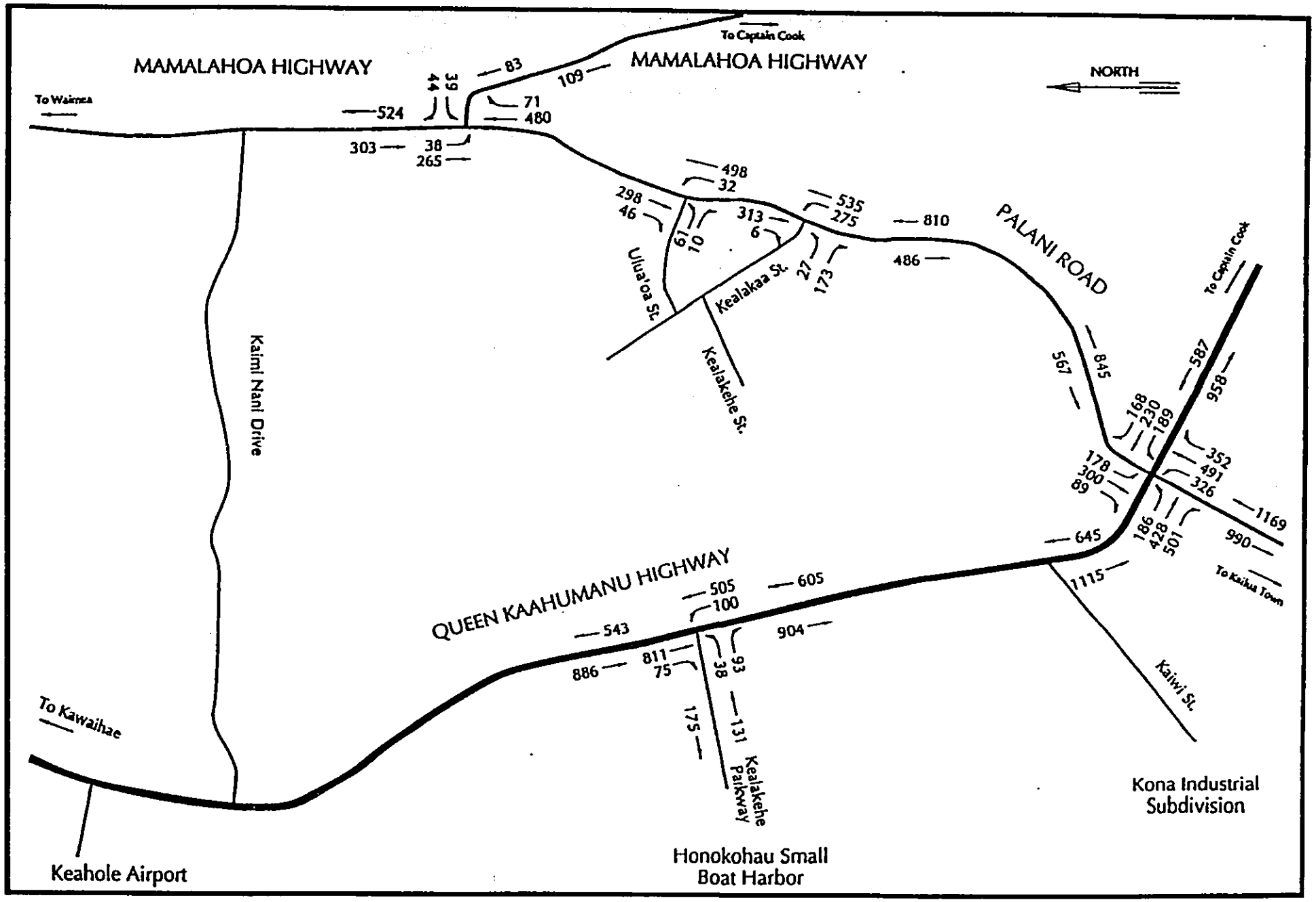
A review of State DOT 1988 vehicular traffic counts for Queen Kaahumanu Highway and Palani Road near the project site indicates that the peak hours along Queen Kaahumanu Highway and Palani Road generally occur between 7:00 am and 9:00 am (A.M. Peak) and between 3:30 pm and 5:30 pm (P.M. Peak). Manual traffic counts were taken for the intersections of Queen Kaahumanu Highway with Palani Road, Queen Kaahumanu Highway with Kealakehe Parkway Road, Palani Road with Kealakaa Street, and Palani Road with Ulua'oa Street on January 16 and 17, 1990. Manual counts were also taken on May 15 and 16, 1990 at the intersection of Mamalahoa Highway and Palani Road, and on May 2 and 3, 1990 at the intersection of Queen Kaahumanu Highway with Kaiwi Street. These counts provide the baseline condition with which future estimated traffic volumes are compared. Figures 6-2 and 6-3 show present volumes and movements of vehicular traffic at the study intersections. Figure 6-4 presents the State DOT's 1988 vehicular 24-hour traffic counts. Generally, traffic levels along Queen Kaahumanu Highway reach about 12,000 vehicles during a 24-hour period. Higher volumes approaching 13,450 vehicles are experienced on Palani Road between Queen Kaahumanu Highway and Kealakaa Street. Table 6-1 summarizes peak period traffic counts. As shown, nearly 800 vehicles utilize Palani Road during the peak periods. On Queen Kaahumanu Highway, the A.M. peak traffic totals about 900 vehicles and the P.M. peak totals over 1,300 vehicles. On Mamalahoa Highway, A.M. peak traffic totals just over 700 vehicles, while P.M. peak traffic is slightly more at about 740 vehicles. At the intersection of Queen Kaahumanu Highway and Palani Road, between 600 and 670 vehicles move through the intersection on each roadway during the A.M. peak. At the P.M. peak, traffic increases to between 650 and 800 vehicles on each roadway.



KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

Source: PACIFIC PLANNING & ENGINEERING, INC.
TRAFFIC IMPACT ASSESSMENT REPORT
Date: JUNE 1990
Prepared by: BELT COLLINS & ASSOCIATES

Figure 6-2
EXISTING MORNING PEAK HOUR VOLUMES

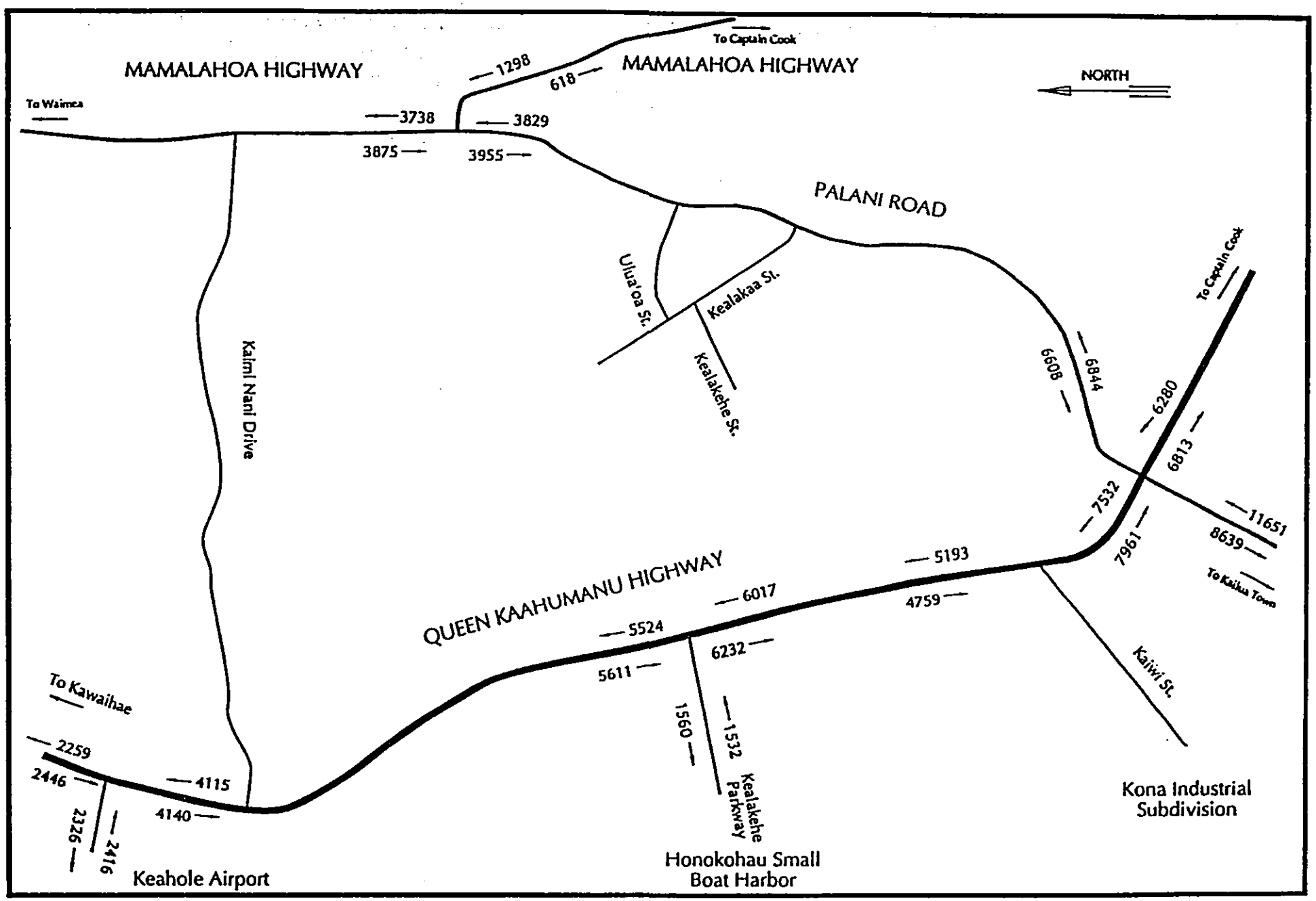


VI-5

KEALAKEHE PLANNED COMMUNITY ENVIRONMENTAL IMPACT STATEMENT

Source: PACIFIC PLANNING & ENGINEERING, INC.
TRAFFIC IMPACT ASSESSMENT REPORT
Date: JUNE 1990
Prepared by: BELT COLLINS & ASSOCIATES

Figure 6-3
EXISTING AFTERNOON PEAK HOUR VOLUMES



KEALAKEHE PLANNED COMMUNITY
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Source: PACIFIC PLANNING & ENGINEERING, INC.
TRAFFIC IMPACT ASSESSMENT REPORT
Date: JUNE 1990
Prepared by: BELT COLLINS & ASSOCIATES

Figure 6-4
EXISTING 24-HOUR TRAFFIC VOLUMES

TABLE 6-1: PEAK PERIOD TRAFFIC COUNTS

Location: Palani Road and Ulua'oa Street

Time	Palani Road Northbound LT	Palani Road Northbound TH	Palani Road Southbound TH	Palani Road Southbound RT	Ulua'oa Street Eastbound LT	Ulua'oa Street Eastbound RT
A.M. Peak Totals	19	237	562	140	59	55
P.M. Peak Totals	32	498	298	46	61	10

Location: Palani Road and Kealakaa Street

Time	Palani Road Northbound LT	Palani Road Northbound TH	Palani Road Southbound TH	Palani Road Southbound RT	Kealakaa Street Eastbound LT	Kealakaa Street Eastbound RT
A.M. Peak Totals	197	229	549	77	30	405
P.M. Peak Totals	275	535	313	6	27	173

Location: Queen Kaahumanu Highway and Kealakehe Parkway Road

Time	Queen Kaahumanu Highway Northbound LT	Queen Kaahumanu Highway Northbound TH	Queen Kaahumanu Highway Southbound TH	Queen Kaahumanu Highway Southbound RT	Kealakehe Parkway Road Eastbound LT	Kealakehe Parkway Road Eastbound RT
A.M. Peak Totals	92	447	452	56	24	50
P.M. Peak Totals	100	505	811	75	38	93

Location: Queen Kaahumanu Highway and Palani Road

Time	Queen Kaahumanu Highway Northbound LT	TH	RH	Southbound LT	TH	RT	Palani Road Eastbound LT	TH	RT	Westbound LT	TH	RT
A.M. Peak Totals	139	398	196	69	200	220	343	485	232	250	186	98
P.M. Peak Totals	189	230	168	186	428	501	178	300	89	326	491	352

Location: Mamalahoa Highway and Palani Road

Time	Mamalahoa Highway Southbound LT	TH	Palani Road Northbound TH	RT	Mamalahoa Highway Eastbound LT	RT	Westbound LT	RT
A.M. Peak Totals	51	504	206	62			95	42
P.M. Peak Totals	38	265	480	71	39	44		

An analysis was made of the conditions for vehicles turning left or right from the various roadways using the methodology in the Highway Capacity Manuel, which rates the expected delays for vehicles between Level of Service "A" (little delay) to "F" (extreme delay meriting mitigative actions). At the intersection of Queen Kaahumanu Highway with Kealakehe Parkway Road, drivers experience less delays during the morning peak hour than during the afternoon peak hour. While northbound drivers turning left from Queen Kaahumanu onto Kealakehe Parkway Road experience little or no delays (LOS A) during the morning peak hour, they experience LOS C, or average delays, during the afternoon peak hour. The same situation holds true for drivers turning right from Kealakehe Parkway Road onto Queen Kaahumanu Highway. Vehicles turning left onto Queen Kaahumanu Highway from Kealakehe Parkway Road experience long delays (LOS D) during the morning peak hour and very long delays during the afternoon peak hour.

The intersection of Palani Road with Kealakaa Street operates with short delays to long delays during the morning peak hour. Vehicles turning left from Palani Road experience short delays (LOS B) while vehicles exiting Kealakaa Street experience long delays (LOS D). During the afternoon peak hour, vehicles turning left onto Palani Road continue to experience LOS D (long delays) while vehicles turning right from Kealakaa Street onto Palani Road and vehicles turning left into Kealakaa Street experience LOS A (little or no delay).

At the intersection of Palani Road with Ulua'oa Street, vehicles turning left into Ulua'oa Street and vehicles turning right onto Palani Road experience little or no delay (LOS A) during both the morning and afternoon peak hours. Drivers turning left from Ulua'oa Street experience average delays (LOS C) during the morning peak hour and experience long delays (LOS D) during the afternoon peak hour.

The intersection of Palani Road with Mamalahoa Highway experiences from little or no delays to long delays. During the morning peak hour, drivers turning left from Mamalahoa Highway experience long delay (LOS D) while drivers for the other movements experience little or no delay (LOS A). During the afternoon peak hour, drivers turning left from Mamalahoa Highway experience average delays (LOS C) while the other movements continue to experience little or no delay (LOS A).

At the signalized intersection of Queen Kaahumanu Highway and Palani Road, the roadways are operating at capacity during the morning peak hour with extremely long delays (LOS E). During the afternoon peak hour, the intersection operates at capacity with LOS E along the Queen Kaahumanu Highway approaches and near-gridlock (LOS F) along the Palani Road approaches.

Traffic conditions along Queen Kaahumanu Highway between Kealakehe Parkway Road and Palani Road reach LOS D during the morning peak period and LOS E during the afternoon peak. At LOS E, passing is virtually impossible. On Palani Road, between Queen Kaahumanu Highway and Ulua'oa Street, traffic demand exceeds roadway capacity (LOS F) during the morning and afternoon peak hours. Between Ulua'oa Street and Mamalahoa Highway traffic conditions along Palani Road are characterized by LOS E.

1.2 Probable Impacts

Based upon projections provided by the County of Hawaii, South Kohala and North Kona will experience dramatic inceases in population and employment, resulting in corresponding increases in traffic. The traffic analysis of impacts is based upon the following County projections:

TABLE 6-2: HAWAII COUNTY POPULATON AND EMPLOYMENT FORECASTS

	----------POPULATION----------				----------EMPLOYMENT----------			
District	1987	2010	Growth	% Growth	1987	2010	Growth	% Growth
South Kohala	7,097	22,300	15,203	214%	4,246	15,333	11,087	261%
North Kona	20,503	52,620	32,117	157%	13,276	26,189	12,913	97%
South Kona	7,293	10,660	3,367	46%	302	4,459	4,157	1376%

Note: While these figures differ slightly from the market study forecasts presented in Table 5-4, they are generally consistent and are presented here because they represent the basis for Hawaii County traffic planning.

The South Kohala, North Kona, and South Kona districts will have the most impact on the planned community due to their close proximity to the project site and because of their forecasted large growth. The growth in the West Hawaii region will create a tendency for more people to travel between the South Kohala and Kona Districts.

1.2.1 Methodology

Computer modeling conducted for this traffic analysis forecasts the number of vehicular trips generated by this population growth and assigns them to the existing and planned roadways based upon the distribution of existing proposed residential and employment centers. The output of the model provides a 2010 forecast of future traffic conditions without the proposed project.

The residential and non-residential land uses included in the proposed project are similarly converted to vehicular trips and assigned to the existing and planned roadways. This output provides a 2010 forecast of future traffic generated by the proposed project at build-out. These volumes are then added to the future forecast discussed above to determine future traffic conditions with the proposed project. Thus, the levels of traffic impact generated by the proposed project are determined by comparing the traffic volumes forecasted for the year 2010 without the project with the 2010 forecast that includes the project. Table 6-3 presents a summary of the turning movements at key intersections in the project area derived from the computer model.

Once traffic volume is forecast, it is compared to the design capacity of the roadway network. The results of this comparision are presented in Table 6-4, which reflects the level of service with and without the project resulting from the turning movements presented in Table 6-3. Traffic impacts resulting from the project were measured by determining the improvements required to accommodate future traffic without the project for the year 2010 and then determining the additional improvements required to accommodate traffic with the project. The additional improvements are a measure of traffic impact.

1.2.2 2010 Roadway Network Without the Project

Even without the project, extensive roadway improvements will be necessary to handle the projected future traffic from other planned developments in the West Hawaii area. The following improvements may be required based on the analysis of forecasted traffic without the project in the year 2010.

- Widen Queen Kaahumanu Highway to 4 lanes between Palani Road and the Keahole Airport
- Widen Palani Road to 4 lanes between Mamalahoa Highway and Queen Kaahumanu Highway
- Widen Mamalahoa Highway to 4 lanes between Kaimi Nani Street and Palani Road
- Signalize the intersection of Mamalahoa Highway and Palani Road when warranted
- Provide a grade separated interchange at the intersection of Queen Kaahumanu Highway and Palani Road
- Signalize the intersection of Queen Kaahumanu Highway and the Honokohau Harbor Access Road until a frontage road is in place to connect to the proposed Kealakehe Parkway (this is to conform to the State DOT policy regarding uninterrupted traffic flow condition along Queen Kaahumanu Highway)

Analysis of the projected traffic in 2010 indicates substantial increases over the existing levels. Table 6-4 assumes no major improvements to the existing intersections, but does include an eastbound roadway through the project area that intersects (unsignalized) with Queen Kaahumanu Highway. The results indicate that for 7 of the 10 applicable turning movements at key intersections, if no signalization or improvements are provided, level of service will be F by 2010 without the project. Inclusion of the project without intersection improvements results in 12 of the 18 turning movements experiencing level of service F and only four turning movements demonstrating some improvement.

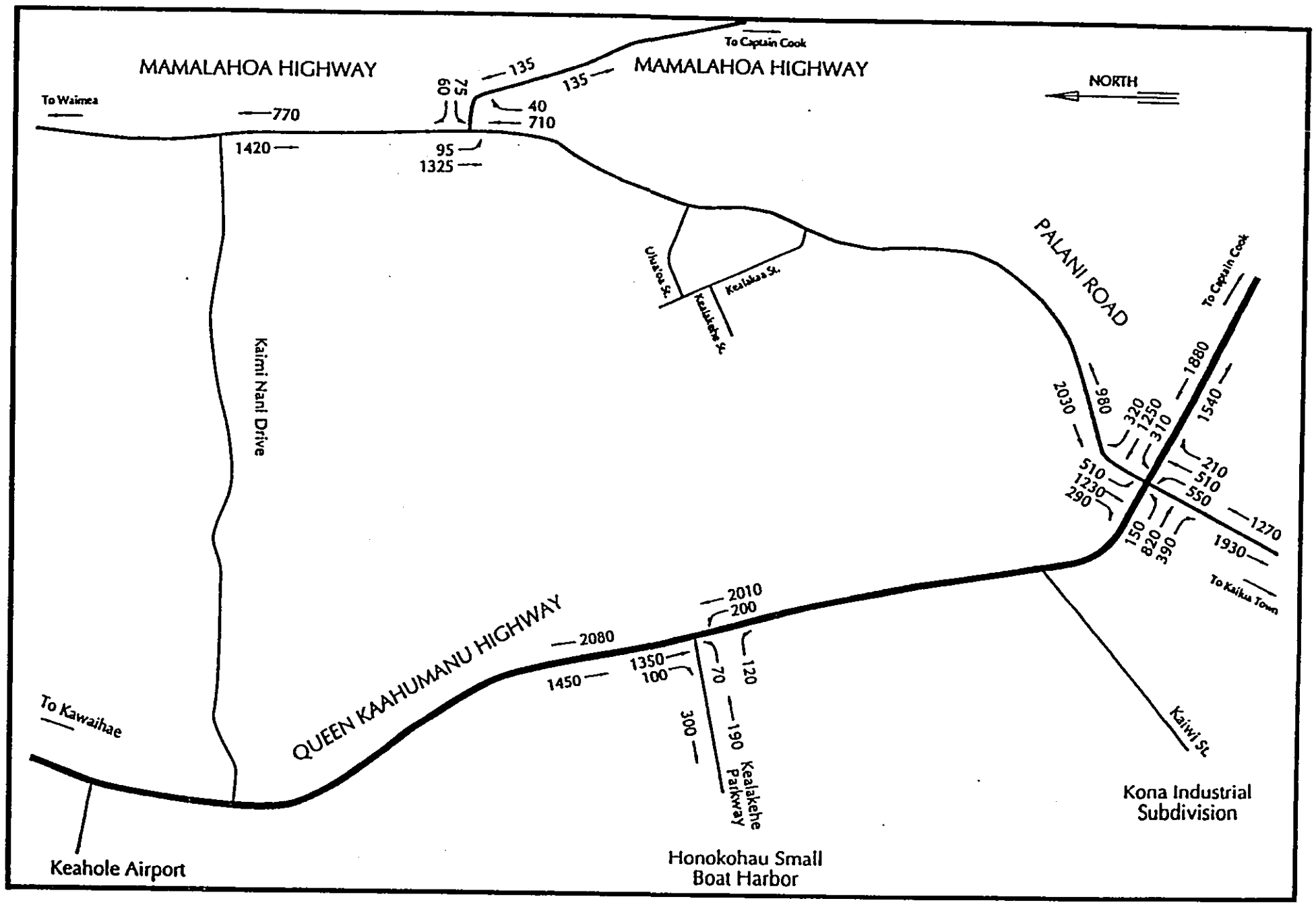
Additional results of the analysis indicate that without the project, drivers attempting left-turns from or onto Palani Road from Kealakaa Street or Ulua'oa Street will experience very long delays during both morning and afternoon peak hours if the intersections are not signalized. With the project, drivers attempting left-turns will continue to experience very long delays.

As with the intersections of Palani Road with Kealakaa and Ulua'oa Street, drivers attempting left-turns from the project's proposed southern access road (Waena Drive) will experience very long delays during both morning and afternoon peak hours.

The impacts of traffic, with and without the project, are further demonstrated in Table 6-5. Without improvements to the major roadway intersections by 2010, Queen Kaahumanu Highway at Kealakehe Parkway Road will be operating over capacity with or without the project.

Based on the figures presented in Table 6-3, traffic volumes in 2010 will exceed 1990 existing traffic volumes by 149% during the A.M. peak hour and 121% during the P.M. peak hour, if the proposed project is not built. If the the project is built, A.M. peak hour traffic volumes will increase an additional 20% over the 2010 volume without the project, and P.M. peak hour traffic volumes will increase 10% over the 2010 volume without the project.

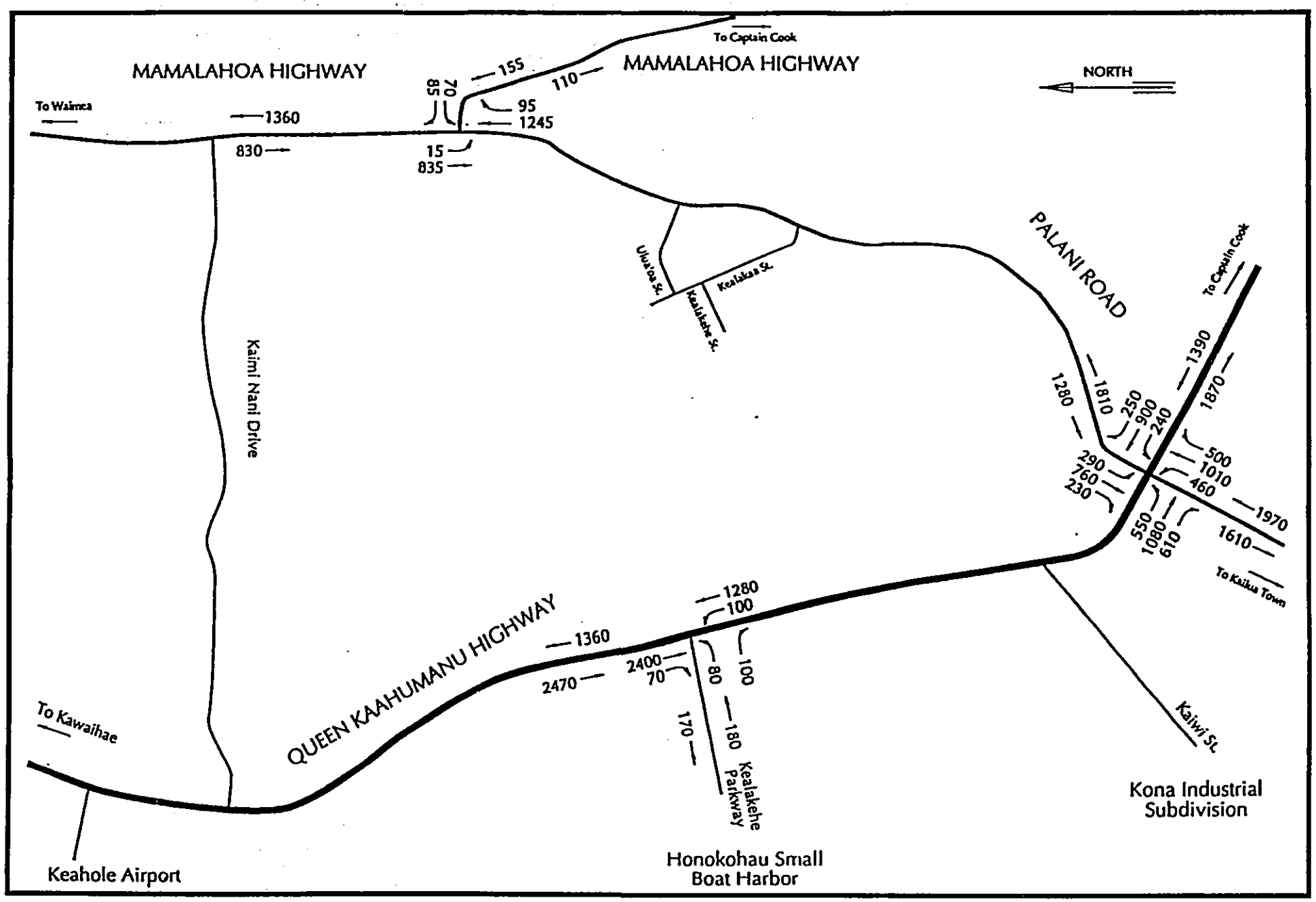
The peak hour volumes forecast without the project are depicted in Figure 6-6 (A.M.peak) and Figure 6-7 (P.M.peak). The peak hour volumes with the project are depicted in Figure 6-8 (A.M.peak) and Figure 6-9 (P.M.peak).



KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

Source: PACIFIC PLANNING & ENGINEERING, INC.
TRAFFIC IMPACT ASSESSMENT REPORT
Date: JUNE 1990
Prepared by: BELT COLLINS & ASSOCIATES

Figure 6-5
2010 MORNING PEAK HOUR VOLUMES WITHOUT PROJECT



VI-13

KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

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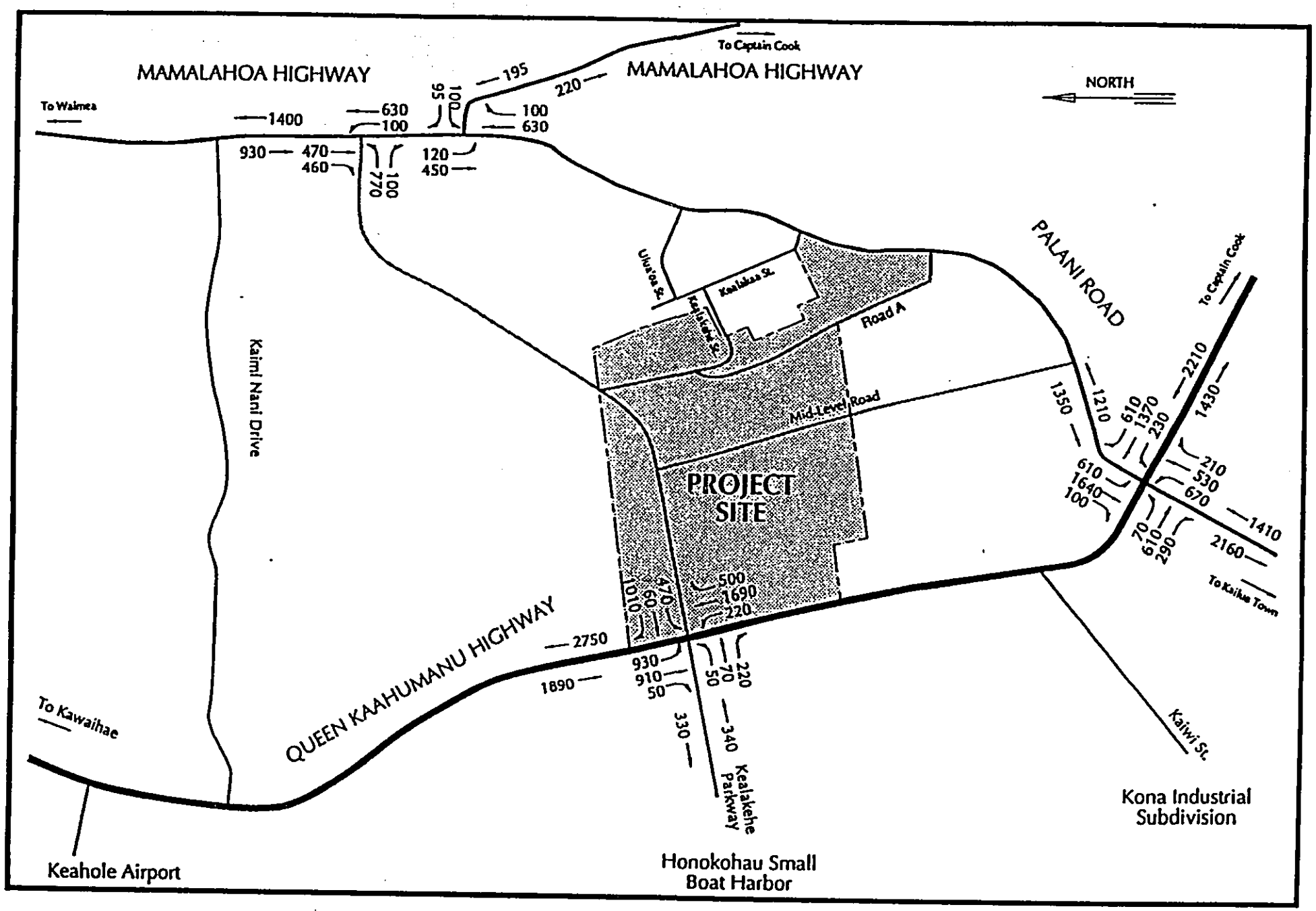
TRAFFIC IMPACT ASSESSMENT REPORT
Date: JUNE 1990
Prepared by: BELT COLLINS & ASSOCIATES

Figure 6-6
2010 AFTERNOON PEAK HOUR VOLUMES
WITHOUT PROJECT



KEALAKEHE PLANNED COMMUNITY
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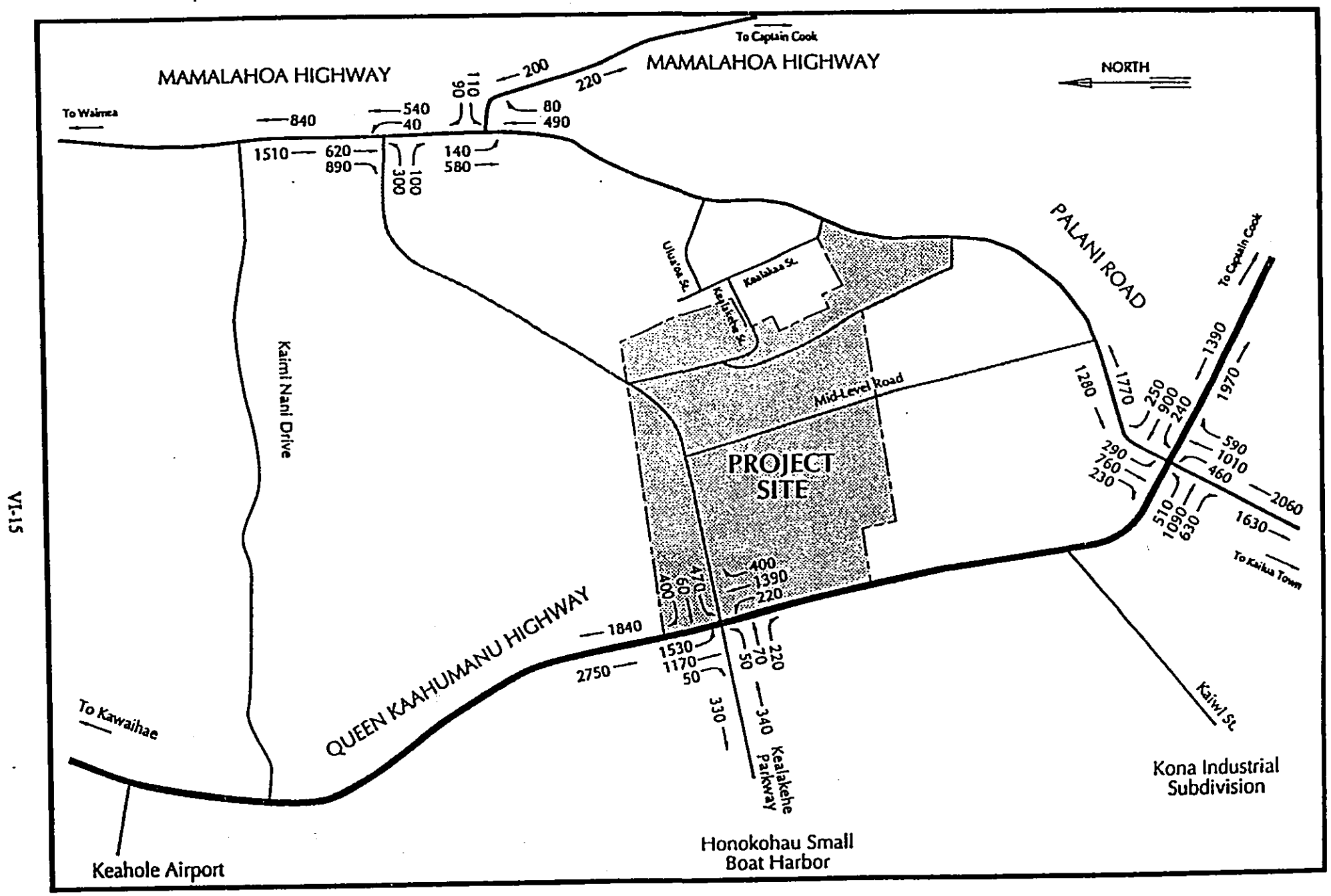
Figure 6-7
2010 MORNING PEAK HOUR VOLUMES WITH PROJECT



VL-15

Source: PACIFIC PLANNING & ENGINEERING, INC.
TRAFFIC IMPACT ASSESSMENT REPORT
Date: JUNE 1990
Prepared by: BELT COLLINS & ASSOCIATES

Figure 6-8
2010 AFTERNOON PEAK HOUR VOLUMES WITH PROJECT

TABLE 6-3: FORECAST TRAFFIC IMPACTS

Turning Movements		1990 Existing Traffic A.M.Peak	1990 Existing Traffic P.M.Peak	2010 Without Project A.M.Peak	2010 Without Project P.M.Peak	2010 With Project A.M.Peak	2010 With Project P.M.Peak
Queen Kaahumanu at Kealakehe Parkway Road							
(Queen Kaahumanu Highway):							
Northbound	LT	92	100	200	100	220	220
	TH	447	505	2010	1280	1690	1390
	RT	N/A	N/A	N/A	N/A	500	400
Southbound	LT	N/A	N/A	N/A	N/A	930	1530
	TH	452	811	1350	2400	910	1170
	RT	56	75	100	70	50	50
(Kealakehe Parkway Road):							
Eastbound	LT	24	38	70	80	50	50
(harbor road)	TH	N/A	N/A	N/A	N/A	70	70
	RT	50	93	120	100	220	220
Westbound	LT	N/A	N/A	N/A	N/A	470	620
(project road)	HT	N/A	N/A	N/A	N/A	60	60
	RT	N/A	N/A	N/A	N/A	1010	400
Queen Kaahumanu Highway at Palani Road							
(Queen Kaahumanu Highway):							
Northbound	LT	139	189	310	240	230	240
	TH	398	230	1250	900	1370	900
	RT	196	168	320	250	610	250
Southbound	LT	69	186	150	550	70	510
	TH	200	428	820	1080	610	1090
	RT	220	501	390	610	290	630
(Palani Road):							
Eastbound	LT	250	326	550	460	670	460
	TH	186	491	510	1010	530	1010
	RT	98	352	210	500	210	590
Westbound	LT	343	178	510	290	610	290
	TH	485	300	1230	760	1640	760
	RT	232	80	290	230	100	230
Palani Road at Mamalahoa Highway							
(Palani Road):							
Northbound	TH	206	480	710	1245	500	640
	RT	62	71	40	95	80	80
Southbound	LT	51	38	95	15	140	140
	TH	504	265	1325	835	560	440
(Mamalahoa Highway):							
Westbound	LT	95	39	75	70	100	110
	RT	42	44	60	85	95	90
TOTAL TURNING MOVEMENTS:		**4,897**	**5,988**	**12,200**	**13,255**	**14,595**	**14,640**

N/A - Not Applicable

TABLE 6-4: FORECAST LEVELS OF SERVICE FOR 2010

Intersection		2010 Without Project A.M.Peak	2010 Without Project P.M.Peak	2010 With Project A.M.Peak	2010 With Project P.M.Peak
Queen Kaahumanu at Kealakehe Parkway Road					
Queen Kaahumanu Highway:					
Northbound	LT	F	F	D	E
Southbound	LT	N/A	N/A	F	F
Kealakehe Parkway Road:					
Eastbound (harbor road)	LT	F	F	F	F
	TH	N/A	N/A	F	F
	RT	F	F	F	F
Westbound (project road)	LT	N/A	N/A	F	F
	HT	N/A	N/A	F	F
	RT	N/A	N/A	E	F
Queen Kaahumanu Highway at Palani Road					
Queen Kaahumanu Highway:					
Northbound		F	F	F	F
Southbound		E	F	F	F
Palani Road:					
Eastbound		F	F	F	F
Westbound		F	F	F	F
Palani Road at Mamalahoa Highway					
Palani Road:					
Northbound	LT	B	C	B	A
Mamalahoa Highway:					
Westbound	LT	F	F	F	F
	RT	B	D	B	A

N/A - Not Applicable

TABLE 6-5: CRITICAL TRAFFIC VOLUMES & CAPACITY LEVELS

Intersection	2010 Without Project Morning	Afternoon	2010 With Project Morning	% Change	Afternoon	% Change
Queen Kaahumanu at Kealakehe Parkway Road:						
Critical Volume	3,080	2,650	3,160	+2.6%	3,610	+36%
Capacity Level	Over	Over	Over		Over	
Palani Road at Mamalahoa Highway:						
Critical Volume	1,400	1,330	850	-39%	740	-44%
Capacity Level	Near	Near	Under		Under	

1.3 Mitigation Measures

Highway capacity, intersection capacity, and level-of-service (LOS) were used to determine the needed improvements without and with the project. Highways were sized (number of lanes) using LOS D as the minimum acceptable LOS. Intersections were sized to operate under capacity when signalized. Unsignalized intersections were signalized if minor streets encountered extreme delays. At major intersections where signalization was deemed unacceptable, grade separated interchanges were considered.

The Kealakehe Planned Community, when completed in 2010, will have a major impact on Queen Kaahumanu Highway and Palani Road. However, a much greater impact will arise despite the project. Even without the project in 2010, Queen Kaahumanu Highway, Mamalahoa Highway, and Palani Road will be over their capacities to handle predicted traffic demand with drivers encountering intersection congestion and delays. Queen Kaahumanu Highway will need to be widened to four lanes between Palani Road and Keahole Airport. Palani Road will also need to be widened to four lanes, as well as Mamalahoa Highway between Palani Road and Kaimi Nani Drive.

The signalized intersection of Palani Road and Mamalahoa Highway will also be over capacity and will need to be either vastly widened or converted to a grade separated interchange. The intersection of Palani Road and Mamalahoa Highway will need to be signalized when warranted. The minor intersections along Palani Road that access the existing subdivision, such as Kealakaa Street, will also need to be signalized even without the project.

It is assumed that a four-lane, mauka-makai Kealakehe Parkway running between Queen

Kaahumanu Highway and Mamalahoa Highway would be constructed along with the project's development as a means of relieving projected traffic congestion along Palani Road. It would serve as the major access road to both Queen Kaahumanu Highway and Mamalahoa Highway for the Kealakehe community. Therefore, with the construction of Kealakehe Parkway, traffic along Palani Road will not be significantly affected by the project because of assumed driver choice of the routes' relative travel time.

Due to the impact of the traffic volumes of the proposed project, the following actions are deemed necessary to further mitigate adverse impacts upon the regional network:

1) A grade-separated interchange at the intersection of Queen Kaahumanu Highway and Kealakehe Parkway due to traffic demand and the requirement of the State Department of Transportation for non-interrupted flow along the highway.

2) A signalized intersection at Mamalahoa Highway and Kealakehe Parkway.

3) The Kealakehe Parkway extension between Queen Kaahumanu Highway and Mamalahoa Highway should be constructed as a four-lane roadway. Depending upon the number of intersections accessing the project, additional improvements such as the following may be necessary:

    a. Signalize the intersections along Kealakehe Parkway when warranted; and
    b. Provide auxiliary lanes (primarily left turn storage lanes) along Kealakehe Parkway and minor streets when warranted.

2 AIR TRANSPORTATION FACILITIES

2.1 Existing Conditions

Keahole Airport, owned and operated by the State Department of Transportation, is located approximately four and a half miles north of the project site. It provides air transportation service to the entire western half of the Big Island. In 1987, operations (arrivals or departures) at Keahole Airport totalled 67,497, down 13,970 operations from 1986. Forty-three percent of Keahole's 1987 operations were air carriers, twenty-six percent were air taxi operations (interisland carriers), sixteen percent were general aviation operations, and the remaining fifteen percent were military operations. In 1987, 815,185 passengers departed from Keahole, 224,391 more departures than from General Lyman field in Hilo. During the same period, 791,094 passengers arrived at Keahole, 179,224 more arrivals than Hilo. However, Keahole handled only 8,347 tons of cargo, as opposed to over 21,175 tons of cargo handled at General Lyman Field. Proposed development

in West Hawaii is projected to result in a significant increase in operations, passenger arrivals and departures and cargo handling at Keahole Airport. The State Department of Transportation is presently proposing to expand airport facilities, including extension of the runway, to meet projected increases in demand for airport services.

2.2 Probable Impacts

As previously discussed, full buildout at Kealakehe will result in a population increase of up to 14,000 persons. This increase will generate greater demand for airport services, primarily relating to interisland air service and cargo operations. However, visitor arrivals and departures resulting from planned expansion of the resort industry in West Hawaii is expected to have a far more significant impact upon air operations. Thus, although the demand generated by Kealakehe is not viewed as significant, it will have an impact on the cumulative increase in demand for airport services.

2.3 Mitigation Measures

Because improvements and expansion plans have already been proposed for Keahole Airport, no specific mitigation measures related to Kealakehe are necessary. The State's West Hawaii Regional Plan identifies Kealakehe as a major regional support community, and its implementation should therefore be accommodated in the Department of Transportation's Keahole master plan.

3 HARBORS

3.1 Existing Conditions

Three principal harbors provide service to the western side of the Big Island; Kawaihae Harbor, Honokohau Small Boat Harbor, and Kailua Kona Harbor. Kawaihae Harbor is the only State commercial harbor in West Hawaii and has a basin area of nearly 50 acres. It is located approximately 30 miles north of the Kealakehe Planned Community project site. In 1986, Kawaihae Harbor handled a total of 451 vessels (excluding domestic fishing craft). Of the total, 173 (38%) were self-propelled vessels, and 95% of these were tugboats or towboats. In that same year, the harbor handled over 592,000 short tons of cargo.

The Honokohau Small Boat Harbor is located immediately makai of the project site. It is the only protected boat harbor in North Kona and contains a total of 162 slips. It used primarily by private recreational boaters and commercial fishermen. Facilities at the harbor include boat launch

ramps and retrieval cranes, a boat repair yard, fueling dock, administration office, commerical and retail facilities, restrooms and parking lots. The Department of Transportation's 1970 master plan for the harbor proposed expansion of the facility to a total of 455 slips. A twenty acre industrial area is also proposed east of and adjacent to the harbor. It would include harbor-related light industrial activities.

Kailua-Kona's harbor serves as a recreational resource for visitor-related activities associated with Kailua Village. In addition to charter fishing boats, the harbor provides facilities for sunset dinner cruise boats, daytime tours, the Atlantis submarine tour service, parasails, and other ocean-oriented recreational activities. The harbor also provides off-shore docking for interisland cruise ships.

3.2 Probable Impacts

The proposed development will impact Kawaihae Harbor in two areas; increased cargo activity and increased recreational boating activity. Development of the Kealakehe community will require shipment of construction materials and equipment through the Kawaihae terminal. Projected increases in population will also generate increase demands for goods and services which will result in an increase in the volume of cargo handled at Kawaihae.

Development of the proposed residential community will result in greater activity at the Honokohau Small Boat Harbor. Specifically, the project will result in an increase of recreational boat activity at the harbor and greater demand for slips and boat launchings from Kealakehe residents who own recreational and/or commercial fishing boats. The commercial and retail facilities at the harbor will also experience an increase in activity.

Although recreational activities at Kailua Kona harbor are targeted primarily for visitors, the population increase associated with the Kealakehe community will result in increases in recreational activities by area residents. Increasing demand for services may, however, generate adverse impacts by increasing the volume of ocean-related activities which may result in greater competition for limited recreational space and activities.

3.3 Mitigation Measures

No adverse impacts are forecasted to result from the proposed development. Cargo handling at Kawaihae to meet increased demand for goods and services will result in new job opportunties at the harbor. The DOT's plans for harbor expansion at Honokohau will help to

address increased demand for boat-related services and facilities. Increased activities at Kailua Kona harbor may result in the need for more stringent regulation of recreational services, and in some cases, limitations on daily operations.

4. WATER SUPPLY

4.1 Existing Conditions

Hawaii County's Department of Water Supply (DWS) administers municipal water systems and infrastructure on the Big Island, including the North Kona area where the subject property is located. Existing potable water wells in the Kailua-Kona area include Kahalu'u Wells A, B, C, and D, located at 600 foot elevation, about one and a half miles inland from the coast just north of Keauhou. These wells have a safe yield capacity of 4.5 million gallons per day (mgd). The maximum yield of the aquifer has been calculated to be about 10 mgd. The project area is linked to the existing wells by a 16 inch transmission line along Queen Kaahumanu Highway and a 16 inch line extending east along Palani Road and diminishing to a 12 inch line just above the existing Kealakehe community. Three primary reservoirs and booster stations serve the project area; a 300,000 gallon reservoir and booster station at the 325 foot elevation on Palani Road, a 100,000 gallon reservoir and booster station at the 590 foot elevation on Palani Road, and a 50,000 gallon reservoir and booster station at the 935 foot elevation on Palani Road.

Hawaii County has proposed that the regional water system serving the project area as well as the Keahole to Kailua area be improved and has developed a Water Supply Plan to guide implementation. According to the County:

> A series of wells is proposed to be drilled in the 1,500 to 1,800-foot water resource development zone, spaced approximately half a mile apart. Approximately 36 wells would be required to supply the maximum day demand with one well out of service. Wells will be tied into a 24-inch transmission line approximately 20.3 miles long bringing water to the junction of Palani Road and Mamalahoa Highway. Two booster pump stations will be required along the length of the transmission line. From the 1,500 to 1,600-foot level the water will flow by gravity from the transmission line through the looped distribution system to the lower reaches of the system. The distribution system will be divided into service zones with pressure reducing valves between zones to maintain a water pressure range of approximately 40 to 100 pounds per square inch...Nine 2.0 million gallons (sic) reinforced concrete reservoirs are required for the maximum day storage of 17.1 million gallons...Along the Belt Hawaii an existing booster pump station will be enlarged and a new booster station and reservoir are proposed to improve water pressures at the upper reaches of the water system. The existing water system along Palani Road from the junction of Hina Lani Drive to Kealakehe Drive will be reinforced with a 16-inch line. Flow in the existing system along Palani Road will be reversed with water flowing down to Kailua Village instead of pumping up Palani Road.

Existing booster pump stations along Palani Road will no longer be required and could be placed on standby. (Keahole to Kailua Draft Development Plan, September 1989, page 4-10)

The State's Department of Land and Natural Resources (DLNR) is proposing the development of a new potable water well in the vicinity of Kalaoa mauka of Mamalahoa Highway and has recently begun construction. The estimated production from this well is 700 gallons per minute (gpm). The well is intended to support state projects in the region. In addition, the DLNR, in coordination with the State's Department of Transportation (DOT) is proposing the development of a 1.0 million gallon (MG) reservoir at the 325-foot elevation within the Kealakehe project area. The reservoir will be located along the project's northern boundary and will be utilized to serve proposed expansion at the Honokohau Harbor. Originally proposed as a 0.5 MG facility, it has been upsized to provide additional capacity for the Kealakehe project.

4.2 Probable Impacts

Based upon the number of units to be developed, the proposed project will require approximately 4.75 mgd of potable water to satisfy residential and non-residential demand. The DWS has committed potable water for the initial phase of the proposed development in the form of water credits or "commitments" earned by the State based upon previous State financed water infrastructure in the area. With the understanding that one "commitment" is equal to the potable water demand generated by one residential unit (600 gallons per day), the DWS has allocated 660 "commitments" to the HFDC. Water "commitments" totaling 200 have been allocated to the existing La'ilani multi-family project, leaving approximately 460 "commitments" for the initial phase of development at Kealakehe. This is the equivalent of 276,000 gpd and will be sufficient for about 460 residential units, which is more than adequate for implementation of the project's first phase, Village 1.

The DWS has advised HFDC that development of a supply source to meet the demand of the Kealakehe project should be undertaken by the project developer and then dedicated to the DWS for long term maintenance and operation.

4.3 Mitigation Measures

Extensive water development will be required to adequately serve the Kealakehe Planned Community. This system would include the drilling of new wells, and the development of transmission lines and storage reservoirs. Treated effluent will be used for golf course irrigation as a means of reducing demand for potable water.

4.3.1 Water Source Development

The supply source for the development will be wells drilled above 1,600 feet mean sea level (MSL). This elevation has been determined through previous well drilling activities in the region to be the elevation above which potable quality water can be obtained. Wells below this elevation such as an existing QLT well at 40 feet MSL and a Kaloko well at 520 feet MSL produce brackish water with chlorides ranging from 3,400 to 700 milligrams per liter, respectively. Domestic drinking water supply wells at or above 1,600 feet MSL have been successfully developed by Huihui Ranch and the Nansay Corporation.

Ancient lava flows comprise the geologic formations throughout the project area. The nature of the lava rock allows rainfall percolation and ground water migration. Subsequently, the long term sustained yield from any area well is indefinite, provided that over pumping or siting another well in close proximity such that it withdraws water from the same subsurface source is avoided.

Well pumping rates and spacing are established by on-site field-testing and operational experience from other area wells. For the project area, a yield of 700 to 1000 gpm per well can be anticipated. The spacing between the wells should be from 1,200 to 1,500 linear feet.

Because all wells will be located mauka of the Department of Health's Underground Injection Control (UIC) line, they will be designed and constructed to prevent the possibility of groundwater contamination. Preventive measures should include a concrete pad and full grouting at each well to prevent seepage or floodwaters from migrating down the well shaft. In addition, all new wells will require approval of the State Director of Health.

4.3.2 Sizing and Demand Analysis

The basis for the determining the capacity of the project's water transmission system was the DWS' "Water Systems Standards", 1985. Area water demands were determined based on the number of planned housing units or land use area. The DWS' domestic consumption guideline for average daily demand and demand factors was used to determine pipeline flows to the various areas. Pipelines were aligned to conform to major area right-of-ways. Reservoirs were located immediately above or within the subject property's boundary.

Three reservoir elevations were considered in the analysis, based on the established DWS pressure zones:

TABLE 6-6: DEPARTMENT OF WATER SUPPLY PRESSURE ZONES

Pressure Zone	Service Area
325 foot elevation	0 to 225 feet
595 foot elevation	225 to 495 feet
935 foot elevation	495 to 835 feet

The above elevations are referenced to mean sea level. The 935-foot elevation reservoir is consistent with a proposed 1.0 (MG) facility that the County has proposed for location above Palani Road and north of Laimana Street. This facility will serve the existing La'ilani housing development as well as the Kealakehe project's first phase. A site for reservoirs at the 595-foot elevation has been identified in the project's land use plan, and is located just south of the proposed Archaeological Preserve. These reservoirs will be accessed from an extension of Kealakehe Street, through a short section of residential roadway. The site for a 325-foot elevation reservoir has been selected and is currently under design by the Department of Land and Natural Resources' Division of Water and Land Development (DOWALD). It is located near the northern project boundary just mauka of a proposed neighborhood commercial area.

Using the DWS criteria, the total project water demand was calculated and a summary is presented in Table 6-8. Although the Kealakehe property makai of Queen Kaahumanu Highway is not included in the proposed project, it was determined that regional infrastructure should be sized to accommodate future development in that area. Consequently, the Concept Feasibility Study prepared for the entire Kealakehe property was used as the basis for determining the makai area's potential water demands. The demands for the Honokohau Small Boat Harbor were provided by the DOT through DOWALD. From the overall project tabulation, the demand within each of the three pressure zones discussed above was calculated and the area water lines sized.

4.3.3 System Description

The specific location of proposed wells will be coordinated through DOWALD and DWS. The development of water infrastructure will be phased to coincide with the phased development of the 14 villages which constitute the Kealakehe project.

Based on the overall project demand at full buildout, a total production of 3,298 gallons per minute (gpm) will be required from wells serving the project. HFDC has contributed to source development with DWS for a portion of this demand (the 276,000 gallons discussed above), so the

remaining 4.47 MG will need to come from new supply wells. These wells are proposed to be located above the 1,600-foot elevation at sites yet to be determined.

At full development, a total storage of about 5.0 MG will be required for the project. This storage will be required as follows:

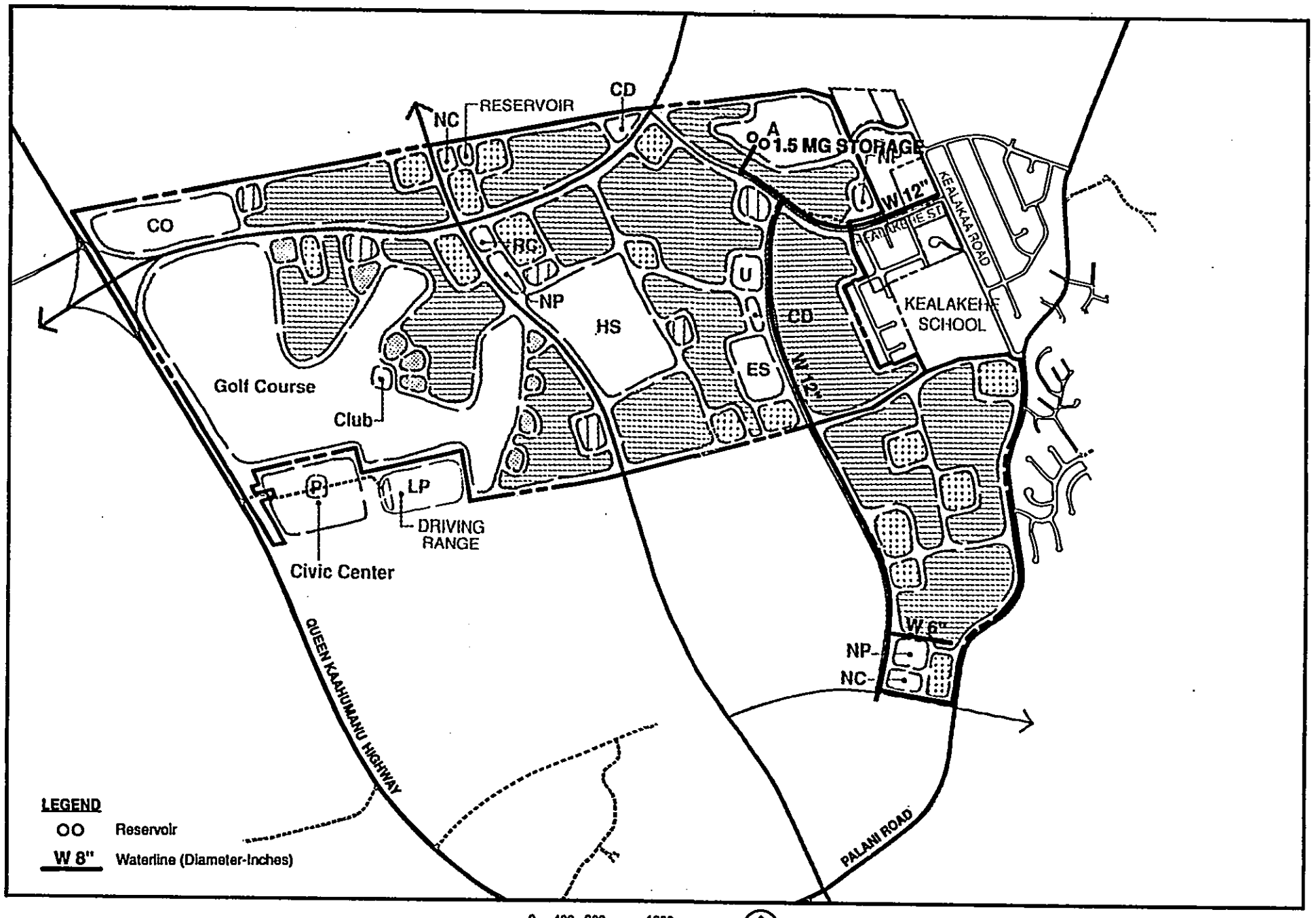
TABLE 6-7: POTABLE WATER STORAGE REQUIREMENTS

Pressure Zone	Storage
325 foot elevation	2.5 MG
595 foot elevation	1.5 MG
935 foot elevation	1.0 MG

There are no sites within the Kealakehe property at the 935-foot elevation. Therefore, HFDC will be coordinating with the DWS or other area developers to acquire the requisite storage within this pressure zone. The sites for the other zone reservoirs have been identified, as stated above.

Three separate water line systems are proposed based on the established pressure zones. The 935-foot elevation zone is indicated in Figure 6-9. This system will extend the 12-inch diameter transmission line from the new reservoir above Palani Road, from Kealakaa Street along the new Kealakehe Street extension to the 595-foot elevation reservoir site. A 12-inch branch main serving proposed housing areas to the south will be required, if interconnection with the existing system along Palani Road is not undertaken. If a looped system is installed within Villages 1, 12, 13, and 14, then it may be possible to down-size the branch main. The interconnection and final line sizing should be evaluated as part of the village subdivision water system design.

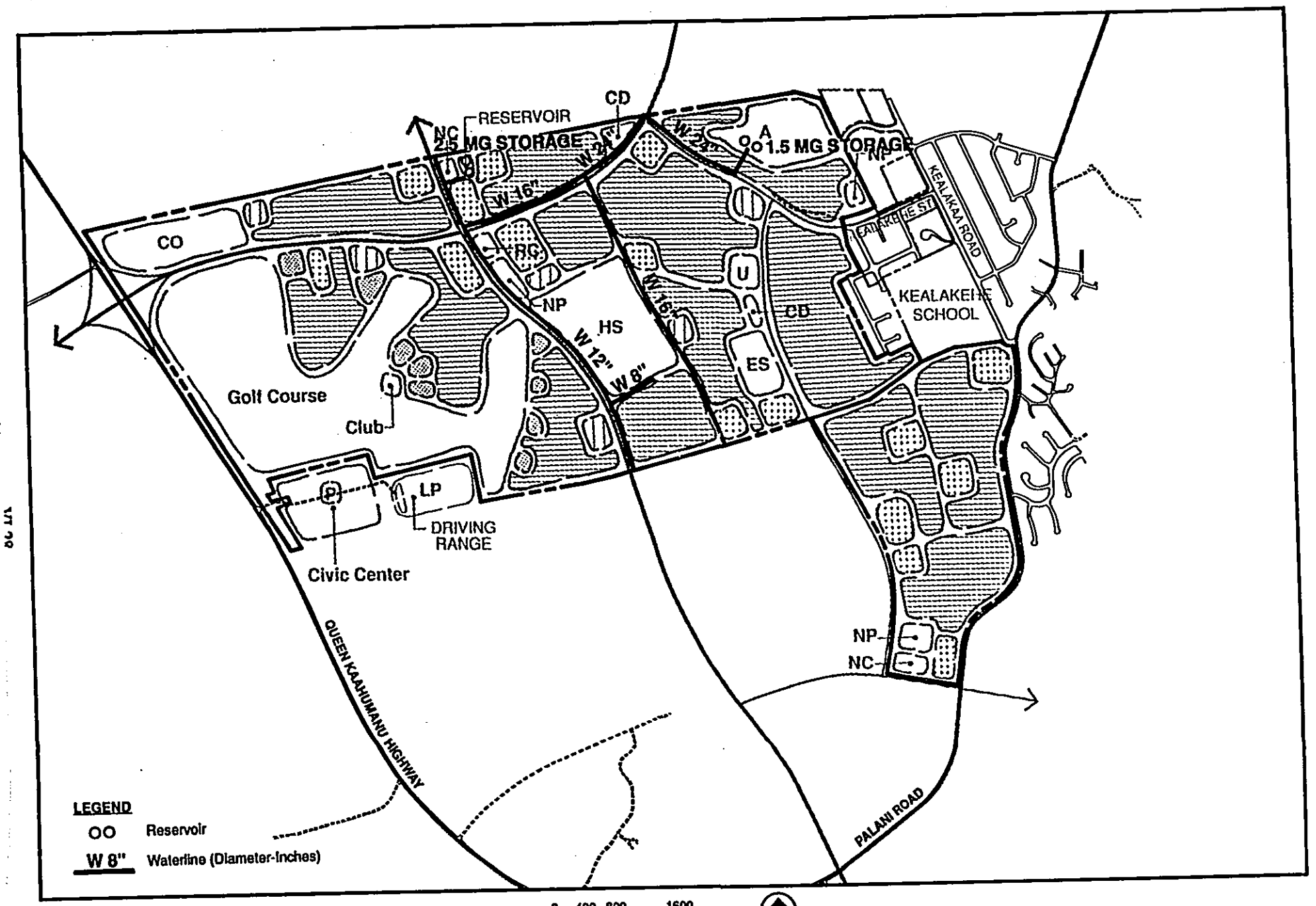
The 595-foot zone was also analyzed based on having a single supply line from the reservoir with no connection to other lines. Based on this consideration, a 24-inch transmission line will be required as indicated in Figure 6-10. Also because of the single supply line system, a 16-inch branch line to the southern housing areas will be required. As for the 935-foot system, should an interconnection with another supply system be undertaken, down-sizing of the lines is possible.



KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

Prepared by: BELT COLLINS & ASSOCIATES
Date: JUNE 1990

Figure 6-9
PROPOSED WATER INFRASTRUCTURE PLAN
935' PRESSURE ZONE WATER SUPPLY SYSTEM



KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

Prepared by: BELT COLLINS & ASSOCIATES
Date: JUNE 1990

Figure 6-10
PROPOSED WATER INFRASTRUCTURE PLAN
595' PRESSURE ZONE WATER SUPPLY SYSTEM

TABLE 6-8: SUMMARY OF PROJECT WATER DEMAND

Land Use	Pressure Zone	Total Daily Demand (gallons)	Average Daily Flow Rate (gal/min)	Maximum Day Demand (gallons)	Peak Hour Flow Rate (gal/min)
Community Shopping Center(a)	325'	60,000	42	90,000	208
Neighborhood Commercial(a)	595'	9,000	6	13,500	31
Neighborhood Commercial(a)	595'	9,000	6	13,5000	31
Civic Center(a)	325'	90,000	63	135,000	313
Recreation Center(a)	595'	9,000	6	13,500	31
High School(b)	595'	180,000	125	270,000	625
Elementary School(b)	935'	40,000	28	60,000	139
Church/Day Care Center(b)	935'	12,000	8	18,000	42
Church/Day Care Center(b)	595'	12,000	8	18,000	42
Neighborhood Park(b)	595'	16,000	11	24,000	56
Neighborhood Park(b)	595'	16,000	11	24,000	56
Neighborhood Park(b)	935'	16,000	11	24,000	56
Landfill Park(b)	325'	60,000	42	90,000	208
Mauka Golf Course Club House(a)	325'	9,000	6	13,500	31
Village 1(c)	935'	142,400	99	213,600	494
Village 2(c)	935'	75,200	52	112,800	261
Village 3(c)	935'	133,200	93	199,800	463
Village 3(c)	595'	66,800	46	100,200	232
Village 4(c)	935'	18,400	13	27,600	64
Village 4(c)	595'	151,200	105	226,800	525
Village 5(c)	595'	76,000	53	114,000	264
Village 6(c)	595'	96,800	67	145,200	336
Village 7(c)	595'	87,200	61	130,800	303
Village 8(c)	595'	41,600	29	62,400	144
Village 8(c)	325'	59,400	41	88,800	206
Village 9(c)	325'	123,200	86	184,800	428
Village 10(c)	595'	37,600	26	56,400	131
Village 10(c)	325'	75,200	52	112,800	261
Village 11(c)	595'	18,800	13	28,200	65
Village 11(c)	325'	50,800	35	76,200	176
Village 12(c)	935'	144,800	101	217,200	503
Village 13(c)	935'	14,400	10	21,600	50
Village 13(c)	595'	130,400	91	195,600	453
Village 14(c)	935'	24,000	17	36,000	83
Village 14(c)	595'	96,000	67	144,000	333
Makai Development(d)	325'	965,000	670	1,447,5000	3,350
DEVELOPMENT TOTALS		3,166,200	2,199	4,749,300	10,994
MAXIMUM FIRE DEMAND		3000 GPM X 60 MIN/HR = 540,000 GALS			

(a) Average Daily Water Demand = 3000 gallons/acre
(b) Average Daily Water Demand = 4000 gallons/acre
(c) Average Daily Water Demand = 400 gallons/unit
(d) Infrastructure is sized to accommodate possible use of makai lands in the future
Notes: Demands = DWS standards. Maximum Day = 1.5 x avg.day. Peak Hour = 5 x avg.day

From the branch line to Villages 3, 4, 5 and 6, the 24-inch transmission line can be decreased to a 16-inch diameter line. This line will tie to a 12-inch line at the mid-level road. The north branch will extend to the 325-foot reservoirs and will also serve the upper portions of Village 8. The southern branch will serve the remaining portions of the 595-foot zone development area, including the proposed high school.

The proposed system for the 325-foot zone is presented in Figure 6-11. The transmission main will extend along the mauka-makai road, with taps as required to serve adjacent developments. The main will decrease from 24- to 12-inches in diameter as it extends from the reservoir through the Kealakehe lands makai of the Queen Kaahumanu Highway to the southern property line of the makai parcel.

The down-sizing of the initial portions of the transmission lines from 24- to 16-inch diameter was discussed with the DWS relative to the Keahole to Kailua water system plan (referenced above). DWS has indicated that the proposed implementation schedule is in advance of any other area development and that, as such, water lines installed along the mauka-makai road will become the primary distribution lines for the region. Subsequently, the 24-inch line is to be installed to assure adquate supply during the initial stages of possible development of the makai parcel and to support the overall regional water distribution system.

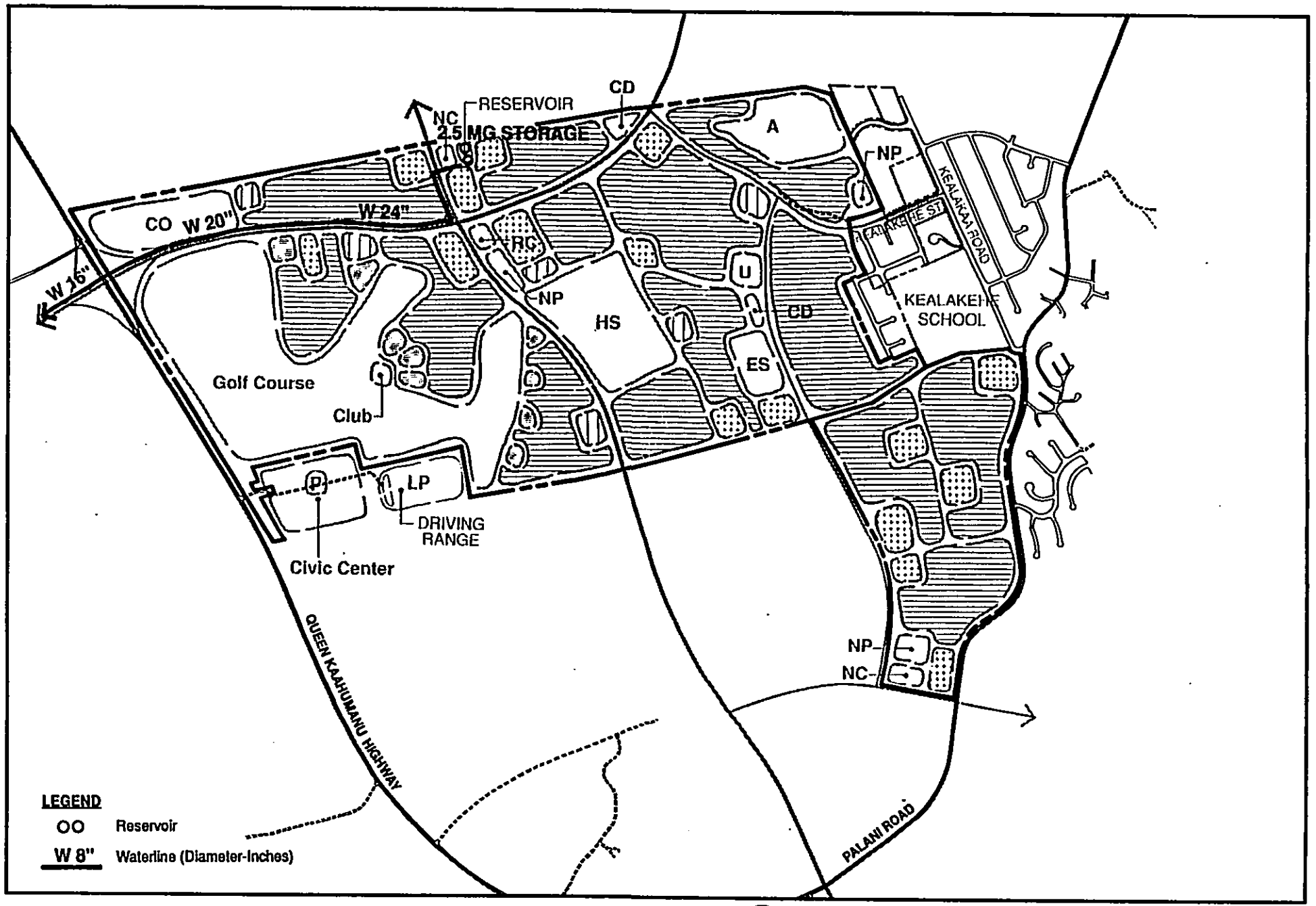
All transmission lines must receive final approval from the County DWS before they can be constructed.

5. WASTEWATER AND DISPOSAL

5.1 Existing Conditions

Wastewater in the Kona region is presently disposed of utilizing two alternate methods, municipal/private sewage treatment plants and private cesspools. Kailua Village is presently served by a municipal wastewater treatment plant located in the Kona Industrial subdivision. This facility is a secondary, activated-sludge treatment plant with a design capacity of 1.0 mgd. Residential, commercial and industrial areas surrounding Kailua Village rely upon private cesspools or private treatment plants for wastewater disposal. The project site is not presently served by a wastewater collection system.

Hawaii County is currently undertaking a project to expand wastewater service in the Kailua-Kona region. A new municipal STP is presently being constructed makai of Queen Kaahumanu Highway on State owned land in the Kealakehe *ahupua'a* and is projected for



KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

Prepared by: BELT COLLINS & ASSOCIATES
Date: JUNE 1990

Figure 6-11
PROPOSED WATER INFRASTRUCTURE PLAN
325' PRESSURE ZONE WATER SUPPLY SYSTEM

completion in February 1992. It's present design capacity is 2.89 mgd. Once the new facility is completed, the existing STP in the Kona Industrial subdivision will be closed. The new plant will occupy a land area of approximately 50 acres with an effluent disposal area of approximately 150 acres.

The State Department of Health has recently announced that no new cesspools will be allowed to be developed mauka of its UIC Line and on lands with elevation of less than 100 feet above mean sea level. In these areas, septic tanks and leach fields will be required for any new construction that is not tied into a municipal or private treatment system.

5.2 Probable Impacts

The average daily wastewater flow generated by the proposed development is projected at 1.86 mgd. This figure includes 1.186 mgd generated from the residential components of the project and 0.672 mgd generated by proposed non-residential uses. Design peak flow is calculated to be 9.627 mgd.

The proposed project will utilize the new Kealakehe STP for wastewater disposal. Expansion of the plant's capacity to accommodate the Kealakehe Planned Community was considered in the planning for the new facility. However, the first phase of construction does not include the Kealakehe Planned Community as a source of wastewater. Design capacity of the STP must be increased about 2.0 mgd to service the proposed development. This expansion would require an additional 10 acres of land for the STP facility and an appropriate increase in size of the leaching area (effluent disposal area). Expansion of the facility is anticipated to constitute phase two of STP construction. Utilization of the Kealakehe STP as the means of disposal for the proposed development's wastewater will result in no significant adverse impacts.

The proposed golf course has been sited at Kealakehe to serve as an effluent disposal area for the STP. The 195-acre golf course is of sufficient size to accommodate the first phase of the STP (2.8 mgd), as well as the eventual 2.0 mgd expansion of the plant necessitated by the proposed development of the Kealakehe Planned Community. Environmental impacts of the County's STP are the subject of a separate environmental impact statement which has been prepared by DPW. A supplement to that document is presently being prepared by DPW to address the environmental issues concerning the effluent disposal area.

5.3 Mitigation Measures

Because no significant adverse impacts have been identified, no mitigation measures are warranted. The potential impact of the project upon the area's existing wastewater system will be addressed through a collection and transmission system to be constructed as part of the project. This system is depicted in Figure 6-12. It includes 12-inch gravity mains serving Villages 1-7, and 11, as well as the proposed elementary and high schools, linked to a 21-inch gravity trunk line extending along the length of the projects southern property boundary and across Queen Kaahumanu Highway to the Kealakehe STP. Villages 8-11 are served by 12-inch and 8-inch gravity mains flowing to a main trunk sewer along the southern property boundary. A sewage pump station discharging via an 8-inch force main to the 21-inch trunk line will be required to serve the community shopping center at the northwest corner of the project area. Villages 12-14 will be served by 12-inch force mains linked to a sewage pump station near Palani Road which will utilize an 8-inch force main to pump the wastewater north to the 21-inch gravity trunk line.

6. STORM DRAINAGE

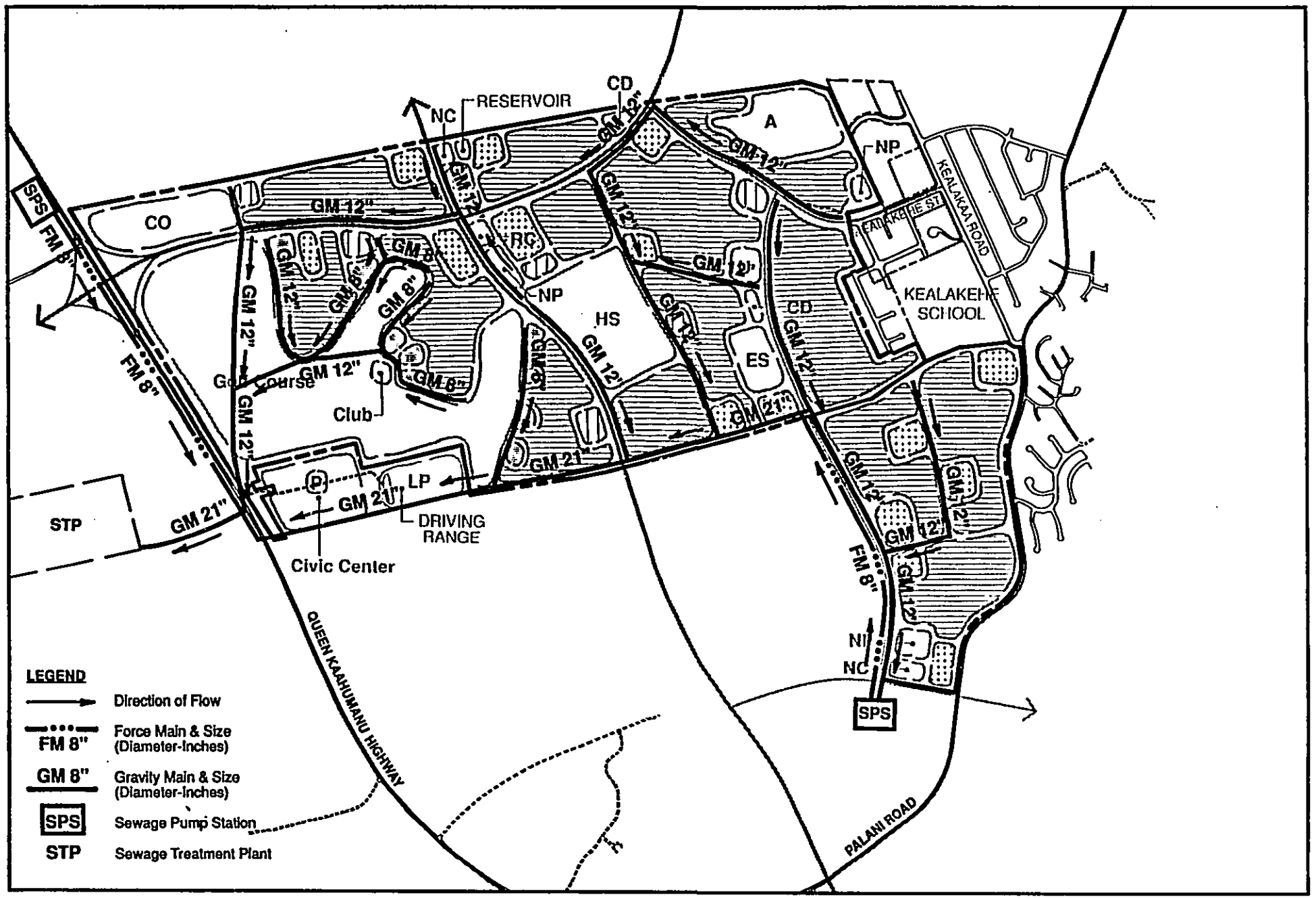
6.1 Existing Conditions

As previously discussed, the project site is characterized by a predominance of lava that is either barren or covered with a thin layer of soil. The porous character of the lava results in relatively rapid percolation of rainwater. This condition, coupled with semi-arid climate of North Kona results in the fact that there are no established drainage ways on the subject property. Nor is there any evidence of streams or flooding. Because the property is vacant and undeveloped, there are presently no drainage structures on site.

6.2 Probable Impacts

Development of the subject property with residential and non-residential uses will alter the character of surface runoff from the area. The presence of paved roadways, sidewalks, rooftops, parking lots and other impermeable surfaces will all contribute to an increase in surface runoff. The overall volume of rainwater percolating through the porous lava into the underground water table will therefore be reduced due to a decrease in permeable surface area. However, drywells utilized to capture storm runoff will redirect the runoff into the water table.

Because of the increased presence of automobiles utilizing the regional arterial, collector and secondary roadways proposed for development in the project, an increase in petrochemicals in surface runoff is expected. Therefore, it is possible that these pollutants could make their way into



KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

Prepared by: BELT COLLINS & ASSOCIATES
Date: JUNE 1990

Figure 6-12
WASTEWATER MASTER PLAN

the underground water table. However, it is expected that most pollutants will be filtered by percolation through the porous underlayers of lava before reaching the water table, which is brackish and not suitable for potable use.

6.3 Mitigation Measures

Due to the hilly terrain and porous nature of the volcanic soils throughout the island, storm water drainage is typically handled by sheet runoff flow to the ocean or by drywells. The proposed method of storm water disposal for the project is by drywells. Project drywells are proposed for construction within road right-of-ways. Residential lots will be designed to direct storm runoff to streets. Grease and oil traps will be located at designated points. The contents of traps will be handled and disposed of in accordance with EPA rules and procedures.

Design and use of drywells within the project area will be based upon DPW policies, guidelines and design specifications, and the State Department of Health's UIC regulations. The Hawaii County Code contains provisions regarding protection of receiving waters and prevention of hazards. The DPW's Storm Drainage Standards addresses pipe networks and culvert design.

The DPW policy is to allow 6 cubic feet per second of storm water discharge per drywell. Drywells are to be constructed are to be 5 feet in diameter with a depth of 20 feet. Based on these guidelines, the project's typical drywell is considered to be an injection well and will require a UIC permit from the Department of Health. County application for drywell permits will be undertaken at the time of design for each village or phase of the project. The actual siting of drywells will be determined at the design stage. The design engineer will prepare the permit application and submit the requisite test report to the Department of Health to obtain the necessary permit. Following construction, the permit will be transferred to the County or the State, based on the ultimate determination of roadway jurisdiction. Thus, all applicable State and County standards will be followed.

7. SOLID WASTE COLLECTION AND DISPOSAL

7.1 Existing Conditions

Solid waste disposal for West Hawaii is presently handled at the Kealakehe Landfill and Transfer Station, located on approximately 15 acres of land adjacent to the proposed project area. The landfill is rapidly nearing capacity and is proposed for closure sometime in 1992, according to Hawaii County. A new 177-acre sanitary landfill site has been proposed by the County for location at Puu Wa'awa'a in North Kona, approximately 15 miles north of Kealakehe. The new

landfill is designed to accommodate initial solid waste volumes of 46,300 tons per year, and more as the population of West Hawaii increases. However, it is possible that challenges to this site may prevent its use as a landfill. If this is the case, the County will initiate a new site selection process.

Over the past several years, underground fires at the existing landfill have continued to be a source of nuisance for the surrounding area. The new County police substation located immediately makai of the landfill has experienced numerous instances of strong odors and fumes. Residents of the existing Kealakehe community have complained of odors and fumes. As recently as May 2, 1990, a large surface fire at the landfill resulted in the evacuation of Kealakehe Intermediate and Elementary schools. The County has proposed to close the landfill and has contracted to have it mined and removed to the new landfill site. This action would probably result in the extinguishing of the underground fires, removal of the threat of surface fires, and the elimination of fumes and odors.

7.2 Probable Impacts

Development of the proposed planned community will generate a substantial increase in solid waste. Using the County's refuse generation rate of 6.0 pounds per capita per day, it is projected that at buildout, the planned community will generate between 54,000 pounds and 84,000 pounds of refuse per day. This is equivalent to 27 to 42 tons per day, 9,800 to 15,300 tons per year, or approximately 21 to 33% of the new landfill's initial capacity. Because occupancy of the initial phase of Kealakehe homes is not anticipated until early 1992, the project is not expected to create an adverse impact upon solid waste disposal conditions and its implementation should coincide with the County's plans for the opening of a new landfill.

7.3 Mitigation Measures

The County of Hawaii DPW has indicated that a trash transfer station would be required to serve the immediate vicinity including the Kealakehe Planned Community. This transfer station would require a minimum of five acres and could be developed in the vicinity of the present site used for this activity, or it could be located at some other area within the project site. The County has indicated that it prefers a location within the Kealakehe project area. No further mitigation measures are necessary due to the lack of adverse impacts.

However, the timely closing of the existing landfill will have a significant effect upon the proposed residential community. Development of homes in the general vicinity of the landfill may be constrained by continuing problems with fumes and odors, and the potential threat of fire.

Therefore, phasing of the proposed community has been designed to allow the development of the most mauka villages first, with villages closer to the landfill area being developed after the landfill has been closed and/or removed.

Should development of a new landfill site be delayed beyond the occupancy of the first phase of residential development, solid waste generated by the project will be transported by truck from the transfer station to a landfill in East Hawaii. The expense of this operation would ultimately be borne by the new Kealakehe Community residents.

A waste reduction program such as composting and recycling of construction wastes will be considered in an effort to mitigate the impacts of the proposed project upon solid waste generation.

8. ELECTRICAL POWER AND COMMUNICATIONS

8.1 Existing Conditions

The Hawaii Electric Light Company (HELCO) provides and maintains electrical power for the island of Hawaii. HELCO's available generating capability is approximately 150 megawatts (MW) with a present peak demand of about 130 MW. The utility has forecast the need to generate an additional 200 MW of power on the Big Island by the year 2007. Sources of this additional energy may include geothermal power.

HELCO presently maintains a 69 KV(1000 volts = 1KV) transmission line along the mauka side of Queen Kaahumanu Highway and a 1.5 million volt amperes (MVA) substation on County property adjacent to the existing police substation at Kealakehe which is presently serving the Honokohau Small Boat Harbor and the light industrial uses and police substation located in its immediate vicinity.

The property owner of a parcel abutting the northwestern boundary of the Kealakehe parcel has proposed the creation of a 300 foot long utility easement across the northwestern corner of Kealakehe to allow the extension of a 12 KV line into his property.

Hawaiian Telephone provides telephone service to the North Kona area. Cable television is provided in the area by a private company serving the Kailua and Waimea areas.

8.2 Probable Impacts

The proposed development at build out will generate a demand for approximately 14,350 kva, which is equal to 10,762 Kilowatts or 10.76 MW. This will result in the need for the development of two new 10 MVA/12 KV substation transformers and a new region-serving 69 KV transmission line to serve the proposed community. Major transmission lines will be located along primary arterial roadways and will require necessary governmental approvals or private easements.

The Hawaiian Telephone Company would serve the planned community through its existing system. Expansion of the system will be required.

8.3 Mitigation Measures

All electrical systems serving the property will be in compliance with the standards of the Hawaii Electric Light Company and the County of Hawaii. Underground utility lines shall be provided wherever practical. In an effort to minimize future demand for fossil-fuel based electrical power, design guidelines for the project will encourage the implementation of energy conservation measures. Infrastructure allowing the provision of natural gas to the project may be included.

9. POLICE AND FIRE PROTECTION SYSTEMS

9.1 Existing Conditions

Police protection for the Big Island is provided by the Hawaii County Police Department. A new police substation at Kealakehe is the center for operations in the North Kona district. The substation is located on a five acre parcel of County owned land makai of the Kealakehe Landfill.

Fire protection and rescue services are provided by the Hawaii County Fire Department. The Kailua-Kona fire station is located on Palani Road just mauka of its intersection with Queen Kaahumanu Highway, approximately two miles from the project site.

9.2 Probable Impacts

Development of the proposed project will significantly increase demand for police and fire protection services. The addition of up to 14,000 new residents and about 4,100 new homes over a twenty year or more period will require the expansion of existing services.

9.3 Mitigation Measures

A 30-acre Civic Center is included in the proposed project's master plan. This center is envisioned to be located on the 30-acre parcel of land adjacent to the project area, which is owned by the County of Hawaii and presently occupied by the police substation, transfer station, AmFac distribution center and West Hawaii animal shelter. Provision of a fire station and expansion of the existing police station at this site would provide the Kealakehe community with immediate response to emergencies.

Since the preparation of the project master plan, the County of Hawaii has proposed an alternate location for the Civic Center. The May, 1990 revision of the Draft Keahole to Kailua Development Plan depicts a 100-acre Civic Center located on the State's Kealakehe land makai of the project area. It is unclear at this time where the Civic Center may be ultimately located, however, it is likely that it will be located in the general vicinity of the planned community.

10. HEALTH CARE FACILITIES

10.1 Existing Conditions

The Kailua-Kona region is served by the Kona hospital, a "full-service" health care facility operated by the State of Hawaii and located in Kealakekua. The hospital provides a variety of services including surgical, special care, O.B, emergency and long-term care units. It has a total of 75 licensed beds. According to hospital staff, the facility is presently operating "at capacity". Emergency ambulance services are located at the Kailua-Kona fire station. Response times for a health emergency would include dispatch of the vehicle from the Kailua station to the emergency site followed by a 10-15 minute "sprint" to Kona Hospital in Kealakekua.

10.2 Probable Impacts

The development of a 4,100 unit residential community will have a significant impact upon the existing health care service system. Because the Kona Hospital is presently operating at capacity, any significant increase in population in the region would likely impact the hospital's level of service.

10.3 Mitigation Measures

Although no health care facility is proposed in the Kealakehe community master plan, due to the projected growth of the region, the development of a new regional health facility has been a

topic of recent discussion. A West Hawaii Regional Hospital Task Force, made up of private business leaders, issued a report in early 1990 indicating a preference for a new hospital to be located in the vicinity of Kailua-Kona and Keahole Airport. The construction of a regional hospital in that area would greatly benefit the proposed Kealakehe community as well as the community-at-large.

11. SCHOOLS AND EDUCATIONAL FACILITIES

11.1 Existing Conditions

The State Department of Education operates a total of eleven schools in the West Hawaii region. Those servicing the immediate project area include Konawaena Elementary, Intermediate, and High Schools, and the Kealakehe Elementary and Intermediate Schools. The total enrollment of these facilities in the 1988-89 school year was about 3,700 students. In addition to the public schools, private educational opportunities are available at the Hawaii Preparatory Academy and Parker School, both in Waimea, about 45 miles north of the project site.

11.2 Probable Impacts

In view of the present growth projected for West Hawaii without the proposed project, the Department of Education forecasts the need for a new West Hawaii High School in about 10 years. However, due to overcrowding at the existing elementary schools, a new elementary school is needed immediately.

The development of the proposed project would result in significant impacts to the public education system in West Hawaii. The Department of Education indicates that at build out the project would generate approximately 900 elementary students and approximately 1,700 high school students.

11.3 Mitigation Measures

The proposed project includes a 45-acre site for a new public high school and a 10-acre site for a new elementary school. The sites proposed in the Kealakehe master plan have received preliminary approval from the facilities management branch of the DOE. Development of the high school and elementary schools would likely occur within the first phase of the project with the schools tentatively planned for opening in 1994 or 1995. The proposed schools will include a full range of support services including administrative buildings, libraries, recreational fields and playcourts, and dining rooms.

12. RECREATIONAL FACILITIES

12.1 Existing Conditions

In general, recreational facilities in the Kailua-Kona region are considered by many residents to be inadequate for the needs of the growing population. Of particular concern is the lack of playgrounds and the need for a regional sports center.

Public recreational facilities presently serving the project region include the Old Kona Airport State Park, Pahoehoe Beach Park, White Sands Beach Park, Kahaluu Beach Park, and the recreational facilities at Konawaena and Kealakehe Schools. In addition, construction of a new County gymnasium at the Old Kona Airport is scheduled to begin in mid-1990, along with expansion of the park's facilities to include tennis courts and a swimming pool.

12.2 Probable Impacts

The development of a 4,100 unit residential community will have significant impacts upon the existing recreational facilities in the region. Residents of the project will generate demand for a full range of recreational opportunities including parks, playgrounds, playing fields and sports facilities for such activities as tennis and golf.

12.3 Mitigation Measures

The proposed project includes three four-acre neighborhood parks as well as over thirty acres of passive, open-space. In addition, the project area includes a 195-acre public golf course to be developed by Hawaii County.

CHAPTER VII

CHAPTER VII
RELATIONSHIP OF THE PROPOSED ACTION TO LAND USE PLANS, POLICIES, AND CONTROLS FOR THE AFFECTED AREA

1. HAWAII STATE PLANS AND CONTROLS

All lands in the State have been placed in one of four land use districts (Urban, Agriculture, Conservation, or Rural) by the State Land Use Commission (SLUC). State Land Use District Boundary Reviews are undertaken by the State Land Use Commission to update its Land Use District Maps. Besides this SLUC-initated review, provisions for applicant-initiated amendments to the district boundaries have been established in Section 205-4 of the Hawaii Revised Statutes (HRS), and further promulgated in the State Land Use Commission: Rules of Practice and Procedure and District Regulations (12-21-75 as amended).

1.1 Existing and Proposed District Boundaries

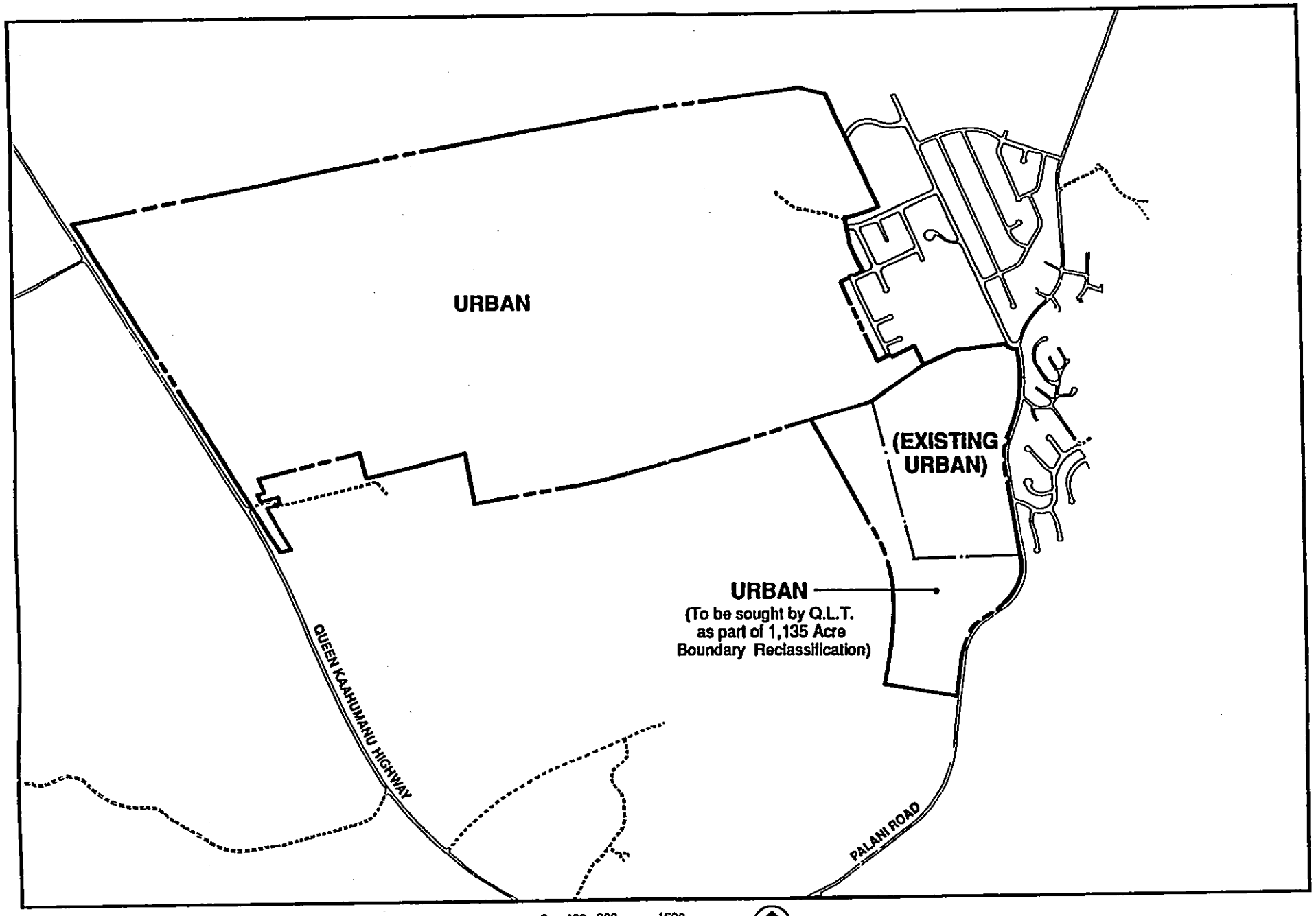
The existing State Land Use District boundaries are shown in Figure 4-5. The proposed project area contains three State Land Use District classifications. Within the State owned property: approximately 360 acres consisting of an area extending from Queen Kaahumanu Highway to a point about 4,000 feet inland are designated Conservation, General subzone; approximately 100 acres extending makai from the existing community are designated Urban; and, approximately 350 acres in the central portion of the property between the Urban and Conservation areas are designated Agriculture.

The project area also includes a 150 acre area presently owned by the Queen Liliuokalani Trust. As shown in Figure 4-5, this property is divided between two State Land Use District designations; a 90 acre area designated Urban, and a 60 acre area designated Agriculture.

The HFDC will request amendments to the State Land Use District boundaries to change the Conservation and Agriculture designations to an Urban designation. Figure 7-1 shows the proposed District boundary amendments. This environmental impact statement is being prepared to accompany the HFDC's Petition for Boundary Reclassification.

1.2 Requirements for Boundary Amendments

Section 205-17, Hawaii Revised Statutes (HRS), establishes the following decision making criteria for reclassification of District boundaries by the State Land Use Commission:



KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

Prepared by: BELT COLLINS & ASSOCIATES
Date: JUNE 1990

Figure 7-1
PROPOSED STATE LAND USE

(1) The extent to which the proposed reclassification conforms to the applicable goals, objectives, and policies of the Hawaii state plan and related to the applicable priority guidelines of the Hawaii state plan and the adopted functional plans;

(2) The extent to which the proposed reclassification conforms to the applicable district standards; and

(3) The impact of the proposed reclassification on the following areas of state concern:

(A) Preservation or maintenance of important natural systems or habitats;

(B) Maintenance of valued cultural, historical, or natural resources;

(C) Maintenance of other natural resources relevant to Hawaii's economy, including but not limited to, agricultural resources;

(D) Commitment of state funds and resources;

(E) Provision for employment opportunities and economic development; and

(F) Provision for housing opportunities for all income groups, and gap groups.

The subject matters of these criteria are addressed in the following sections in this chapter and also in Chapter IV regarding probable impacts on the environment. Based upon these discussions, the proposed project meets the criteria contained in Section 205-17, HRS.

The SLUC District Regulations require that the application for a boundary amendment show that it is "reasonable, not violative of Section 205-2 and consistent with the Interim Statewide Land use Guideline Policies." The reasons for the requested changes in the State Land Use District Boundaries are discussed in Chapter II, Sections 3, 4 and 8, of this document. The consistency of the proposed district designation with Section 205-2, HRS and with the Interim Statewide Land use Guideline Policies are discussed in the following sections. A discussion of how the proposed revisions meet the special requirements for petitions for urban classification then follows.

1.2.1 Section 205-2, Hawaii Revised Statutes

The proposed amendments to the State Land Use District boundaries are consistent with the basic standards for determining boundaries that are set forth in Section 205-2, HRS. Relevant standards from this section are presented below and followed by a discussion of the proposed designations' consistency with each standard. Note that numbers have been added for ease of reference.

Agricultural District

"Agriculture districts shall include activities or uses as characterized by the

1. cultivation of crops, orchards, forage, and forestry;
2. farming activities or uses related to animal husbandry, aquaculture, game and fish propagation;
3. aquaculture, which means the production of aquatic plant and animal life for food and fiber within ponds and other bodies of water;
4. wind generated energy production for public, private and commercial use;
5. services and uses accessory to the above activities including but not limited to living quarters or dwellings, mills, storage facilities, processing facilities, and roadside stands for the sale of products grown on the premises;
6. wind machines and wind farms;
7. agricultural parks;
8. open area recreational facilities, including golf courses and golf driving ranges, provided that they are not located within agricultural district lands with soil classified by the land study bureau's detailed land classification as overall (master) productivity rating class A or B;
9. These districts may include areas which are not used for, or which are not suited to, agricultural and ancillary activities by reason of topography, soils, and other related characteristics."

Discussion: An examination of the proposed Agricultural to Urban redesignation in reference to each of the above-listed points follows.

1. The Agricultural District land that is proposed for Urban is not suitable for the cultivation of crops, orchards, forage, or forestry. The land is classified E by the land study bureau detailed land classification system and is characterized as bare and almost bare a'a and pahoehoe lava.

2. The land is largely unsuited for farming activities due to its virtual lack of top soil.

3. Due to its distance from the shoreline, the area is not appropriate for the development or operation of aquaculture activities.

4. The land under consideration is located on the leeward side of the island and is not exposed to trade winds of sufficient strength to justify development of wind generate energy production facilities.

5. Due to the relative unsuitability of the subject property for the above mentioned agricultural activities, consideration of services and uses accessory to those activities is irrelevant.

6. As discussed above, the land is not suitable for the cultivation of crops, orchards, forage, or forestry. Consequently, it is not suitable for the development of agricultural parks.

7. Reserving the property solely for open space recreational activities would not fulfill the goals and objectives of the HFDC in relation to the proposed project. However, the proposed development project does include open area recreational activities such as a public golf course and neighborhood parks as part of its master planned residential community.

8. The Agricultural District land under consideration for the Urban District is largely unsuited for agricultural development. However the topography, soils, and other characteristics of the property do not preclude its use for residential development. In fact, the property's location and proximity to Kailua, its upland elevations and panoramic views, and topography all render it particularly appropriate for residential use.

Conservation District

"Conservation districts shall include areas necessary for
1. protecting watersheds and water sources;
2. preserving scenic and historic areas;
3. providing park lands, wilderness, and beach reserves;
4. conserving endemic plants, fish and wildlife;
5. preventing floods and soil erosion;
6. forestry;
7. open space areas whose existing openness, natural condition, or present state of use, if retained would enhance the present or potential value of abutting or surrounding communities, or would maintain or enhance the conservation of natural or scenic resources;
8. areas of value for recreational purposes;
9. other related activities;
10. and other permitted uses not detrimental to a multiple use conservation concept."

Discussion: An examination of the proposed Conservation to Urban redesignation in reference to each of the above-listed points follows.

1. The Conservation District land that is proposed for Urban is not a watershed or water source area that needs to be protected and is designated as a General subzone.

2. The land slopes up from Queen Kaahumanu Highway to roughly the 700 foot elevation. It has good scenic qualities, especially at the higher elevations. Scenic views will be preserved whenever possible as they are a valuable asset to the proposed residential development. The residential character of the project with low-rise structures which will not significantly detract from existing views. Archaeological surveys and testing have been performed in the proposed project area. Based upon study findings discussed in Chapter 4, significant historic sites will undergo further study and data collection, or will be preserved and integrated into the overall development plan. As areas are prepared for development, the Historic Sites Office of the Department of Land and Natural Resources and the Hawaii County Planning Department will be consulted regarding the necessity for additional archaeological work.

3. The Conservation District land proposed for Urban is neither a wilderness nor beach reserve area. It is adjacent to the Kealakehe Landfill. The land uses proposed for this area do not include a park.

4. Portions of the Conservation Distirct area will be set aside for the preservation of the Uhi Uhi tree, a federally designated endangered species which has been identified on site. Specifically, two trees have identified in the Conservation District and a half acre buffer area is proposed for each tree.

5. Converting the Conservation District to Urban will not cause floods or soil erosion. There are no known drainageways or basins on the subject property. The area is largely devoid of soil. Landscaping will ensure that erosion does not occur.

6. The Conservation District land under consideration is relatively barren pahoehoe and a'a. It is not a forested area.

7. Retaining the area in open space would not enhance its value or the value of properties surrounding it. The natural scenic qualities of the land will be preserved whenever possible and integrated into the proposed development.

8. Approximately half of the Conservation District land proposed for Urban District is to be developed as a public golf course by the County of Hawaii and, therefore, will be used for recreational purposes. However, to provide the greatest flexibility for planning, design and operation of the golf course, a boundary redesignation from Conservation to Urban will be sought.

9. The land under consideration is suitable for residential uses and related activities.

10. The residential, public facility and commercial uses proposed for this land are not permitted uses in a Conservation District. The requested change from Conservation District to Urban District will not be detrimental to a multiple use conservation concept.

1.3 Hawaii State Plan

The Hawaii State Plan (Office of the Governor, Office of State Planning, 1989) consists of a series of broad goals, objectives and policies which are to serve as the guidelines for the growth and development of the State. The Plan is divided into three parts; Part I (Overall Theme, Goals, Objectives and Policies), Part II (Planning, Coordination and Implementation), and Part III (Priority Guidelines). Part II pertains to the administrative structure and implementation process for the State Plan. Because Part II is not relevant to the proposed action, it is not included in this analysis. Discussed below are the specific goals, objectives, policies, and priority actions contained in Part I and Part III of the State Plan which are thought to be most directly related to the proposed project.

1.3.1 Part I. Overall Theme, Goals, Objectives and Policies

The Hawaii State Plan lists three "Overall Themes": (1) Individual and family self-sufficiency; (2) Social and economic mobility; and (3) Community or social well being. These themes are considered to be "basic functions of society" and goals towards which government must strive. To guarantee the elements of choice and mobility embodied in the three themes, three goals are presented in the Plan:

SEC. 226-4 State goals. In order to guarantee, for present and future generations, those elements of choice and mobility that insure that individuals and groups may approach their desired levels of self-reliance and self-determination, it shall be the goals of the State to achieve:

(1) A strong, viable economy, characterized by stability, diversity, and growth, that enables the fulfillment of the needs and expectations of Hawaii's present and future generations.

(2) A desired physical environment, characterized by beauty, cleanliness, quiet, stable natural systems, and uniqueness, that enhances the mental and physical well-being of the people.

(3) Physical, social, economic well-being, for individuals and families in Hawaii, that nourishes a sense of community responsibility, of caring, and of participation in community life.

Discussion: The HFDC's proposed Kealakehe Planned Community fully supports the three goals. The development of the proposed land use activities on the Kealakehe property is intended to accommodate a portion of the population growth projected for the West Hawaii region. Development of the property for up to 4,200 housing units, 60% of which will be affordable, will greatly benefit individuals and families on the Island of Hawaii. A well-planned residential community with a full range of support services and facilities will enhance the physical, social and economic well being of its residents.

SEC. 226-5 Objective and policies for population.

Objective: It shall be the objective in planning for the State's population to guide population growth to be consistent with the achievement of physical, economic, and social objectives contained in this chapter.

Policies: (2) Encourage an increase in economic activities and employment opportunities on the Neighbor Islands consistent with community needs and desires.

(3) Promote increased opportunities for Hawaii's people to pursue their socio-economic aspirations throughout the islands.

(7) Plan the development and availability of land and water resources in a coordinated manner so as to provide for the desired levels of growth in each geographic area.

Discussion: The proposed project will provide residential, commercial, recreational, and civic land uses for the Kailua area. Construction of the project will be phased to meet the present and future housing demand as it arises. Infrastructure, including water, will be provided to ensure the new development is fully serviced. Development of the residential community over a period of twenty or more years will ensure steady employment in the construction trades.

SEC. 226-6 Objectives and policies for the economy--in general.

Objectives:

(1) Increased and diversified employment opportunities to achieve full employment, increased income and job choice, and improved living standards for Hawaii's people.

(2) A steadily growing and diversified economic base that is not overly dependent on a few industries.

Policies:

(6) Strive to achieve a level of construction activity responsive to, and consistent with, State growth objectives.

(8) Encourage labor-intensive activities that are economically satisfying and which offer opportunities for upward mobility.

(9) Foster greater cooperation and coordination between the public and private sectors in developing Hawaii's employment and economic growth opportunities.

(10) Stimulate the development and expansion of economic activities which will benefit areas with substantial or expected employment problems.

(14) Promote and protect intangible resources in Hawaii, such as scenic beauty and the aloha spirit, which are vital to a healthy economy.

Discussion: The proposed land use will contribute to the economy in two important ways. First, it will provide stability in the construction trades, and second it facilitate economic development by providing housing opportunities for workers. Implementation of the proposed project in accordance with State and County plans will facilitate a high level of cooperation with government agencies. Design of the residential components of the project will strive to protect the scenic beauty and cultural and historic resources of the area.

SEC. 226-11 Objectives and policies for the physical environment--land-based, shoreline, and marine resources.

Objectives:

(1) Prudent use of Hawaii's land-based, shoreline, and marine resources.

(2) Effective protection of Hawaii's unique and fragile environmental resources.

Policies:

(2) Ensure compatibility between land-based and water-based activities and natural resources and ecological systems.

(3) Take into account the physical attributes of areas when planning and designing activities and facilities.

(4) Manage natural resources and environs to encourage their beneficial and multiple use without generating costly or irreparable environmental damage.

(6) Encourage the protection of rare or endangered plant and animal species and habitats native to Hawaii.

(8) Pursue compatible relationships among activities, facilities, and natural resources.

(9) Promote increased accessibility and prudent use of inland and shoreline areas for public recreational, educational, and scientific purposes.

Discussion: The proposed project is situated mauka of the Queen Kaahumanu Highway and does not include any shoreline areas. The project area slopes up from about 50 feet to the 700 foot elevation, approximately two miles inland. The project will be designed in a manner which will maximize view planes of the ocean and Hualalai mountain while preserving view corridors. Development of the various project elements will be sensitive to existing environmental conditions. An endangered plant species, the uhi uhi tree, identified on the project site will be preserved through the establishment of half acre buffer areas around each individual plant and a five acre preserve for a cluster of eight trees in the mauka portion of the property. Endemic plants will be encouraged for use as landscape material wherever practicable. The project will be phased to correspond to future demand for homes at market levels ranging from assisted rental units to market homes with golf course frontage. The subject property will be developed in a prudent manner consistent with the master plan resulting in orderly and timely development of infrastructure. Public open space areas devoted to passive recreational activities will be provided within the phased development.

SEC. 226-12 Objective and policies for the physical environment--scenic, natural beauty, and historic resources.

Objective: Planning for the State's physical environment shall be directed towards achievement of the objective of enhancement of Hawaii's scenic assets, natural beauty, and multi-cultural/historical resources.

Policies: (1) Promote the preservation and restoration of significant natural and historic resources.

(2) Provide incentives to maintain and enhance historic, cultural, and scenic amenities.

(3) Promote the preservation of views and vistas to enhance the visual and aesthetic enjoyment of mountains, ocean, scenic landscapes, and other natural features.

(5) Encourage the design of developments and activities that complement the natural beauty of the islands.

Discussion: One hundred and five historic sites, many consisting of multiple features, have been identified on the subject property. A detailed archaeological study of these sites has been

conducted and treatment ranging from data collection to preservation has been recommended, depending upon the cultural and scientific value of individual sites. A 27 acre area containing a large complex of sites in the northeastern corner of the project area has been recommended to be set aside as an Archaeological Preserve. Management of the Preserve will be consistent with procedures established by the State Historic Sites Office and accepted archaeological procedures. Sites recommended for preservation outside of the Preserve will be managed in the same manner. Scenic views of the ocean and Hualalai mountain will be preserved wherever possible. The residential character of the proposed project will ensure the preservation of views, vistas, and the area's overall scenic beauty. Views of the subject property from Queen Kaahumanu Highway will be preserved. Views from the existing Kealakehe community will be improved by the replacement of dense thickets of Kiawe and Haole Koa with landscaped areas. The County golf course will create a large open space area which will significantly contribute to preserving coastal views from the subject property.

SEC. 226-13 Objectives and policies for the physical environment--land, air, and water quality.

Objective: (1) Maintenance and pursuit of improved quality in Hawaii's land, air, and water resources.

Policies: (2) Promote the proper management of Hawaii's land and water resources.

(3) Promote effective measures to achieve desired quality in Hawaii's surface, ground, and coastal waters.

(4) Encourage actions to maintain or improve aural and air quality levels, to enhance the health and well-being of Hawaii's people.

(5) Reduce the threat to life and property from erosion, flooding, tsunamis, hurricanes, earthquakes, volcanic eruptions, and other natural or man-induced hazards and disasters.

(6) Encourage design and construction practices that enhance the physical qualities of Hawaii's communities.

(7) Encourage urban developments in close proximity to existing services and facilities.

Discussion: The proposed project is located near North Kona's primary urban area and will be designed in a manner consistent with the desired character of the existing residential communities. Development of the project will ensure that threats to life and property from erosion and flooding are minimized through the engineering of drainageways to accommodate surface runoff. No portion of the property is located within a tsunami inundation zone. With regard to seismic activity, buildings will be constructed according to accepted engineering methods to minimize the

potential damage from earthquakes. The last historical eruption of Hualalai occurred in 1801 resulting in a lava flow which reached the sea in the Keahole area. The potential for lava inundation of the project area is considered to be slight. Nevertheless, evacuation routes will be incorporated into the overall project design. While air quality will be impacted to some degree by the conversion of vacant agricultural and conservation land to more active uses, State and Federal air quality standards will be observed. The creation of an efficient transportation network will help to minimize the impact of automobile emissions upon air quality. There are no surface waters on the proposed project site. Impact upon ground waters will be minimized by adherence to accepted construction techniques and standards. No industrial activities are proposed for the development. Consequently, noxious activities which might impact air and ground water quality are not expected to occur. Use of the property will be managed through the timely phasing of project elements in a manner that is compatible and beneficial to the environment as well as existing neighboring communities and the area's future population.

SEC. 226-14 Objective and policies for facility systems--in general.

Objective: Planning for the State's facility systems in general shall be directed towards achievement of the objective of water, transportation, waste disposal, and energy and telecommunication systems that support statewide social, economic, and physical objectives.

Policies:
(1) Accommodate the needs of Hawaii's people through coordination of facility systems and capital improvement priorities in consonance with State and County plans.

(2) Encourage flexibility in the design and development of facility systems to promote prudent use of resources and accommodate changing public demands and priorities.

Discussion: The key element of the proposed project is the design and implementation of facility systems which provide for the orderly and timely development of the project without placing undue strain on existing infrastructure. In fact, the roadway network included in the design proposal is specifically intended to assist in relieving existing traffic congestion on Palani Road and accommodating increased levels of traffic along Queen Kaahumanu Highway.

SEC. 226-15 Objectives and policies for facility systems--solid and liquid wastes.

Objectives:
(1) Maintenance of basic public health and sanitation standards relating to treatment and disposal of solid and liquid wastes.
(2) Provision of adequate sewerage facilities for physical and economic activities that alleviate problems in housing, employment, mobility and other areas.

Policy:
(1) Encourage the adequate development of sewerage facilities that complement planned growth.

Discussion: As a precursor to development in the Kailua region, the County of Hawaii is presently constructing the Kealakehe Sewage Treatment Plant makai of the Queen Kaahumanu Highway on state owned property near Honokohau Harbor. Discussions have been held with the County to ensure that expansion plans for the facility will include the Kealakehe Planned Community. With regard to solid waste, the County of Hawaii is presently proposing the development of a new landfill to serve the Kailua area at Pu'uanahulu in North Kona. The County has also proposed the closing of the Kealakehe landfill adjacent to the project site, including the removal of metals and recyclable materials from the landfill. Solid and liquid waste generated by the proposed project will be accommodated by these proposed facilities.

SEC. 226-16 Objective and policies for facility systems--water.

Objective: Planning for the State's facility systems with regard to water shall be directed towards achievement of the objective of the provision of water to adequately accommodate domestic, agricultural, commercial, industrial, recreational, and other needs within resource capacities.

Policy: (1) Coordinate development of land use activities with existing and potential water supply.

Discussion: The master plan for the proposed project includes the phased development of potable water wells to serve the project area. Water wells will be developed in conjunction with capital improvement projects undertaken by the State's Department of Land and Natural Resources. Development of water resources will be fully coordinated with State and County agencies.

SEC. 226-17 Objectives and policies for facility systems--transportation.

Objective: (1) An integrated multi-modal transportation system that services statewide needs and promotes the efficient, economical, safe, and convenient movement of people and goods.

Policies: (6) Encourage transportation systems that serve to accommodate present and future development needs of communities.

(10) Encourage the design and development of transportation systems sensitive to the needs of affected communities and the quality of Hawaii's natural environment.

Discussion: Specific transportation elements included in the project master plan are the provision of a 300 foot setback along Queen Kaahumanu Highway, development of a new mauka-makai roadway linking the Queen Kaahumanu Highway to Kealakehe Street, a grade-separated intersection at Queen Kaahumanu Highway, and a mid-level roadway across the project site. Also included within the proposed development are a series of pedestrian walkways within Village areas and linking project elements thereby providing an alternative to vehicular transportation.

SEC.226-18 Objectives and policies for facility systems--energy/telecommunications.

Objective: (2) Increased energy self-sufficiency.

Policy: (3) Promote prudent use of power and fuel supplies through conservation measures including education and energy-efficient practices and technologies.

Discussion: The proposed project is intended to utilize the latest advancements in energy-efficient construction practices and alternate energy development technologies to facilitate the prudent use of power and fuel supplies. Conservation methods including the use of shade trees to help shelter homes as a method of reducing reliance upon air-conditioning will be utilized wherever practicable. Design guidelines will be developed for the entire project and will include measures to promote energy conservation, such as the proper siting of structures.

SEC.226-19 Objectives and policies for socio-cultural advancement--housing.

Objectives: (1) Greater opportunities for Hawaii's people to secure reasonably priced, safe, sanitary, livable homes located in suitable environments that satisfactorily accommodate the needs and desires of families and individuals.

(2) The orderly development of residential areas sensitive to community needs and other land uses.

Policies: (1) Effectively accommodate the housing needs of Hawaii's people.

(2) Stimulate and promote feasible approaches that increase housing choices for low-income, moderate-income, and gap-group households.

(3) Increase homeownership and rental opportunities and choices in terms of quality, location, cost, densities, style, and size of housing.

(5) Promote design and location of housing developments taking into account the physical setting, accessibility to public facilities and services, and other concerns of existing communities and surrounding areas.

(7) Foster a variety of lifestyles traditional to Hawaii through the design and maintenance of neighborhoods that reflect the cultures and values of the community.

Discussion: Appoximately 4,200 housing units will be provided in the Housing Finance and Development Corporation's proposed Kealakehe Planned Community. The project is intended to provide affordable housing opportunities to meet existing and projected demand in West Hawaii. Included in the project are a wide range of housing unit types and for sale and rent, including multi-family unit rentals, affordable and market priced single family units and affordable and market priced multi-family units. Income groups to be served by the project include persons and

families earning 80% or less than the area's median income (assisted rentals), 80% to 120% median income (affordable homes), 120% to 140% of the median income (gap group/market priced), and 140% and above (market priced). Housing opportunities will be provided for the elderly, handicapped, single-parent families and other special need groups. The community will be developed in phases in the form of villages of approximately 300 units each. The overall design and location of the villages as well as the units within them take into account their physical setting and access to public services and facilities. In addition to residential development, the project will also include commercial areas, parks and public facilties such as schools, churches, day care centers, and a community recreation center.

SEC. 226-20 Objectives and policies for socio-cultural advancement--health.

Objectives: (2) Maintenance of sanitary and environmentally healthful conditions in Hawaii's communities.

Discussion: Phasing of the proposed development takes into account the potential impact of the Kealakehe landfill located near the project site. It is understood that the County of Hawaii intends to close the landfill and relocate its contents to a new site, away from residential development. Development of the Kealakehe Community will be phased from the mauka area down to the highway. The villages nearest the landfill are not intended to be developed during the time that the mining of the land fill will occur (with the next 10 years). With regard the disposal of liquid waste, the entire project will be connected to the Kealakehe Sewage Treatment Plant presently under construction. The project will therefore not require cesspools or septic tanks. Effluent from the STP will be used to irrigate the golf course. This is a common practice in a number of resort and residential areas around the State of Hawaii and across the continent United States and does not constitute a health hazard. Treatment of the sewage effluent removes virtually all harmful contaminants rendering the effluent safe for use in irrigation. Percolation of the effluent through the soil provides an additional level of purification, thereby ensuring that ground waters will not be contaminated.

SEC. 226-21 Objectives and policies for socio-cultural advancement--education

Objective: Planning for the State's socio-cultural advancement with regard to education shall be directed towards achievement of the objective of the provision of a variety of educational opportunities to enable individuals to fulfill their needs, responsibilities, and aspirations.

Policy: (2) Ensure the provision of adequate and accessible educational services and facilities that are designed to meet individual and community needs.

Discussion: The proposed project includes within its residential community, an elementary and high school which will help to fulfill the need for new public schools in West Hawaii.

SEC. 226-23 Objective and policies for socio-cultural advancement--leisure.

Objective: Planning for the State's socio-cultural advancement with regard to leisure shall be directed towards the achievement of the objective of the adequate provision of resources to accommodate diverse cultural, artistic, and recreational needs for present and future generations.

Policies:

(2) Provide a wide range of activities and facilities to fulfill the cultural, artistic, and recreational needs of all diverse and special groups effectively and efficiently.

(4) Promote the recreational and educational potential of natural resources having scenic, open space, cultural, historical, geological, or biological values while ensuring that their inherent values are preserved.

(6) Assure the availability of sufficient resources to provide for future cultural, artistic, and recreational needs.

(8) Increase opportunities for appreciation and participation in the creative arts, including the literary, theatrical, visual, musical, folk, and traditional art forms.

Discussion: The Archaeological Preserve, the public golf course, and a variety of parks and open spaces included in the proposed development contribute to the goals and objectives of providing recreational and leisure activities to the existing and growing population of the area.

SEC. 226-25 Objective and policies for socio-cultural advancement--culture.

Objective: Planning for the State's socio-cultural advancement with regard to culture shall be directed toward the achievement of the objective of enhancement of cultural identities, traditions, values, customs, and arts of Hawaii's people.

Policy: (1) Foster increased knowledge and understanding of Hawaii's ethnic and cultural heritages and the history of Hawaii.

Discussion: Preservation of historic and archaeological sites within the subject property will provide a direct means of communicating to existing and future residents of the area, the cultural traditions and customs of the area's Hawaiian population.

SEC. 226-26 Objective and policies for socio-cultural advancement--public safety.

Objective: Planning for the State's socio-cultural advancement with regard to culture shall be directed toward the achievement of the following objectives:

(1) Assurance of public safety and adequate protection of life and property for all people.

Discussion: Included in the project's master plan is a 30-acre Civic Center which will contain a variety of public services and facilities including a police sub-station and a fire station. These facilities in close proximity to the proposed project will help to ensure public safety.

1.3.2. Part III. Priority Guidelines

The purpose of this part of the State Plan is to establish overall priority guidelines to address areas of statewide concern. Section 226-102 of the Plan notes that the State shall strive to improve the quality of life for Hawaii's present and future population through the pursuit of desirable courses of action in five major areas of statewide concern which merit priority attention: economic development, population growth and land resource management, affordable housing, crime and criminal justice, and quality education. The priority guidelines applicable to the proposed project are discussed below.

SEC. 226-103 Economic priority guidelines.

(e) Priority guidelines for water use and development:

(1) Maintain and improve water conservation programs to reduce the overall water consumption rate.

(f) Priority guidelines for energy use and development:

(2) Initiate, maintain, and improve energy conservation programs aimed at reducing energy waste and increasing public awareness of the need to conserve energy.

Discussion: The conservation of natural resources, especially water, is an important concern to the proposed development. While new water resources will be developed to support the projected growth in the region, the conservation of those resources is vital to long-term growth and stability. For this reason, the proposed project will seek to aid in the attainment of the water conservation guidelines. Energy conservation is equally important. Construction and design techniques can be utilized to ensure that new buildings are energy-efficient.

SEC. 226-104 Population growth and land resources priority guidelines.

(a) Priority guidelines to effect desired statewide growth and distribution:

(1) Encourage planning and resource management to insure that population growth rates throughout the State are consistent with available and planned resource capacities and reflect the needs and desires of Hawaii's people.

(3) Ensure that adequate support services and facilities are provided to accommodate the desired distribution of future growth throughout the State.

(4) Encourage major State and Federal investments and services to promote economic development and private investment to the neighbor islands, as appropriate.

(b) Priority guidelines for regional growth distribution and land resource utilization:

(1) Encourage urban growth primarily to existing urban areas where adequate public facilities are already available or can be provided with reasonable public expenditures and away from areas where other important benefits are present, such as protection of important agricultural land or preservation of lifestyles.

(2) Make available marginal or non-essential agricultural lands for appropriate urban uses while maintaining agricultural lands of importance in the agricultural district.

(9) Direct future urban development away from critical environmental areas or impose mitigating measures so that negative impacts on the environment would be minimized.

(12) Utilize Hawaii's limited land resources wisely, providing adequate land to accommodate projected population and economic growth needs while ensuring the protection of the environment and the availability of the shoreline, conservation lands, and other limited resources for future generations.

Discussion: The proposed project is situated upon marginal agricultural land, near an existing urban area. The development of this land to support projected population growth in the region is consistent with population related priority guidelines. The development of infrastructure to support the proposed project, especially new transportation systems, sewage and solid waste disposal facilities, and water systems will ensure that the proposed development is implemented in an orderly and timely manner with adequate infrastructural capacities. The prudent investment of government funds in these facilities, especially in the area of waste disposal and transportation will help to alleviate current deficiencies. Finally, the proposed property is intended to be developed in a manner that is sensitive to the environment and protect valuable resources including archaeological sites and endemic plants. In this manner, the project will aid in the attainment of the above population related guidelines.

SEC. 226-106 Affordable housing. Priority guidelines for the provision of affordable housing:

(1) Seek to use marginal or non-essential agricultural land and public land to meet housing needs of low and moderate-income and gap-group households.

(2) Encourage the use of alternative construction and development methods as a means of reducing production costs.

(4) Create incentives for development which would increase home ownership and rental opportunities for Hawaii's low and moderate-income households, gap-group households, and residents with special needs.

(6) Encourage public and private sector cooperation in the development of rental housing alternatives.

(8) Give higher priority to the provision of quality housing that is affordable to Hawaii's residents.

Discussion: The proposed project is being developed on public land of which nearly half is non-essential agricultural (with the remainder being Conservation and Urban land). The project is specifically intended to help meet the demand for affordable housing among low, moderate and gap-group households. Development of market housing within the project, and especially along the golf course fairways provides a means of generating higher sales prices, which will in turn generate increased income for the provision of affordable housing. Development of commercial land uses within the project accomplishes similar goals while also helping to reduce regional traffic and improving the quality of life in the proposed community. The promotion of affordable housing by the State provides a catalyst for the development of for-sale and rental housing in the private sector.

1.4 State Functional Plans

The Hawaii State Plan sets forth in Section 2 that functional plans shall include "the policies, programs and projects designed to implement the objectives of a specific field of activity when such activity or program is proposed, administered, or funded by any agency of the State". The twelve functional plans were examined to determine the relationship of the proposed project to each of their administrative areas of responsibility.

1.4.1 State Agricultural Functional Plan (1985)

The entire project area consists of barren or nearly barren a'a and pahoehoe lava flows. Although approximately 350 acres are designated as Agricultural land by the State Land Use Commission, the general classification of these lands by the Land Study Bureau is E, indicating little intrinsic value as productive agricultural lands. Historically, portions of the property have been leased to the neighboring Palani Ranch for cattle grazing. Because these lands are not presently utilized for agricultural activities, the objectives, policies and implementing actions of the Agricultural Functional Plan are not relevant to the proposed project.

1.4.2 State Conservation Functional Plan (1984)

There are several objectives and policies in the State Conservation Functional Plan which pertain to the proposed project. These are identified below and followed by a discussion of how the proposed may assist in their implementation.

Objective: Effective protection and prudent use of Hawaii's unique, fragile, and significant environmental and natural resources.

Policy: (A1) Exercise an overall conservation ethic in the use of Hawaii's resources by protecting, preserving, and conserving the critical and significant natural resources of the State of Hawaii and controlling use of hazardous areas.

Objective: Effective protection and management of open space, watersheds, and natural areas.

Policy: (C3) Protect and manage the lands with historic or natural resources value.

Objective: Promote sound management and development of Hawaii land and marine resources for potential economic benefit.

Discussion: Phased development of the proposed project will ensure that development will occur in an orderly and timely manner with a minimal amount of negative impact upon the environment. Culturally significant historic and archaeological resources identified on the subject property will be preserved. The development of the property for residential and related uses will be done in a manner that promotes environmental awareness and protection.

1.4.3 State Educational Functional Plan (1989)

The State Education Functional Plan reflects the Department of Education's strategies to address the goals, policies and priority guidelines of the Hawaii State Plan and the goals of the State Board of Education. All of the actions are to be undertaken by the State Department of Education. The specific objectives and policies of the functional plan are not directly applicable to the proposed development.

1.4.4 State Higher Educational Functional Plan (1984)

There are no objectives, policies or implementing actions in this functional plan that are directly applicable to the proposed project.

1.4.5 State Employment Functional Plan (1989)

The State Employment Function Plan contains objectives, policies and implementing actions directed four major areas: Education and Preparation Services for Employment; Job Placement; Quality of Work Life; and Employment Planning Information and Employment Coordination. The proposed project will provide new employment opportunities primarily in the construction trades to the existing and future residents of the West Hawaii region which will, in turn, have a direct impact upon improving the quality of life in the region. However, there is no direct involvement by the HFDC in labor or employment practices associated with the project. It is intended that development rights for each village component included in the master plan will be awarded to a private developer who will be responsible for actual construction. For this reason, although the proposed project will foster opportunities for increased employment and supports the intention of the plan, the specific provisions of the functional plan are not directly applicable.

1.4.6 State Energy Functional Plan (1984)

The State Energy Functional Plan's objective to promote energy efficiency through land use and support facility systems planning relates directly to the overall master planning of the proposed project as well as its implementation. The project will be master planned to promote energy efficiency through the general siting of facilities to maximize access and minimize energy consumption. While specific building designs are not included in the master plan, the proposed project will adhere to energy conservation standards whenever possible. Specific elements of energy conservation such as the utilization of solar energy in building design for the purposes of water heating and air conditioning will be encouraged wherever practicable.

1.4.7 State Health Functional Plan (1989)

The State Health Functional Plan includes objectives and policies that relate directly to the proposed development. These are presented below followed by a discussion how the project will support their implementation.

Objective: To prevent degradation and enhance the quality of Hawaii's air, land and water.

Policy: (A1) Prevent and control the pollution of air, water and land through long-range planning, environmental impact assessments, interagency coordination, programs, regulations, and financial assistance to local governments.

Objective: Minimize the threat to public health from insanitary conditions by ensuring that facilities are built and maintained so that products and services are provided in a

healthful manner.

Discussion: The proposed project intends to comply with all applicable Department of Health rules and regulations as well as those established by Hawaii County. Environmental impacts on air quality are fully addressed within this EIS document. Drainage and runoff from the project, both during construction and long-term maintenance of planned facilities will be minimized to ensure the protection of ground water quality and offshore ocean water quality. Infrastructure intended to accomodate the sewage and solid waste generated by the project will be master planned to ensure its timely development and minimize environmental impacts.

1.4.8 State Historic Preservation Functional Plan (1984)

Objectives, policies and implementing actions in the Historic Preservation Functional Plan are intended for implementation by the Department of Land and Natural Resources and affiliated State agencies. The project area has been extensively surveyed and a description of identified historic and archaeological sites is included in this EIS document. Recommendations are included for the dispostion of the sites, including preservation of those sites identified as significant for cultural, scientific or educational value. Implementation of the proposed project will included the preparation of an Historic Sites Mitigation Plan to ensure conformance with all applicable state, county and federal regulations concerning historic sites.

1.4.9 State Housing Functional Plan (1989)

The Housing Functional Plan includes objectives, policies and implementing actions which are applicable to the proposed project. These are presented below followed by a discussion of how the proposed project will assist in their implementation.

Objective: Homeownership for at least sixty percent, or roughly 248,500 households by the year 2000.

Policies:

(A1) Direct Federal, State and county resources and efforts toward the development of affordable for-sale housing units.

(A2) Encourage increased private sector participation in the development of affordable for-sale housing units.

(A3) Ensure that (1) housing projects and (2) projects which impact housing provide a fair share/adequate amount of affordable homeownership opportunities.

(A4) Assist first time homebuyers in purchasing a home.

(A5) Use alternative approaches in providing affordable housing for sale.

Discussion: As one of the lead agencies designated to implement the objectives and policies of the Housing Functional Plan, the HFDC is committed to providing affordable housing opportunities thoughout the State. The Kealakehe project is intended to provide over 4,000 new housing units, 60% of which will be affordable. Specific programs within HFDC are intended to provide first time home buyers with financing to enable them to enter the housing market. The HFDC's ability to provide affordable housing is based upon policies of attracting private developers to participate in housing development, and helping to offset the cost of affordable housing development by encouraging the development and sale of market prices units and the sale of commercial land situated to benefit the residential community.

Objective: Sufficient amount of affordable rental housing units by the year 2000 so as to increase the State's rental vacancy rate to at least 3%.

Policies:

(B1) Direct State, county and federal resources toward the financing and development of rental housing projects.

(B2) Encourage increased private sector participation in the development of affordable rental housing.

(B4) Fully utilize rental subsidy programs funded by the Federal, State or county governments.

Discussion: Twenty percent of the planned units in the Kealakehe project are targeted as affordable rental units. The project master plan proposes the inclusion of rental units in many of the fourteen planned villages. This ensures that the rental units will be fully integrated into the community and that they will be developed in a timely manner as integral components of each village. The HFDC's programs for rental subsidies will be available to occupants of these rental units.

Objective: Increased development of rental housing units for the elderly and other special need groups to afford them an equal access to housing.

Policies:

(C1) Effectively use public resources to provide rental housing projects for elderly and handicapped persons.

(C7) Integrate special needs housing in new and existing neighborhoods.

Discussion: Housing units for the elderly, handicapped and special needs groups will be included in the proposed project.

Objective: Acquire and designate lands suitable for housing development in sufficient amount to locate the deficit in housing units by the year 2000.

Policies: (E1) Promote design and location of housing developments taking into account the physical setting, accessibility to public facilities and services, employment and other concerns of existing communities and surrounding areas.

(E2) Wherever practical, develop affordable housing projects on public lands.

(E3) Wherever feasible, acquire privately owned lands that are suitable for housing development.

Discussion: The development of the proposed project on State owned land at Kealakehe is intended to maximize the use of public lands. The proposed purchase of adjacent land owned by the Queen Liliuokalani Trust is intended to offset the State land to be transferred to the County for the development of the golf course/effluent disposal area.

1.4.10 State Human Services Functional Plan (1989)

Objectives and polices of the Human Services Functional Plan are directed specifically to administration and implementation by State agencies including the Department of Human Services, the Department of Health, the Department of Education, the Department of Labor and Industrial Relations, and the State Office of Children and Youth and Executive Office on Aging. The *functional plan does not relate directly to the proposed project.*

1.4.11 State Recreation Functional Plan (1984)

A number of objectives and policies of the Recreation Functional Plan are applicable to the proposed project. These are presented below and followed by a discussion of how the project will assist in their implementation.

Objective: Achieve a pattern of land and water resource usage which is compatible with community values, physical resources, recreation potential, and recreation uses which support comprehensive public land use policies.

Policies: (A2) Ensure that intended uses for a site respect community values and are compatible with the area's physical resources and recreation potential.

(A3) Emphasize the scenic and open space qualities of physical resources and recreational areas.

Discussion: Included in the proposed project are public parks and a public golf course. These facilities, together with a community recreation center will enhance the proposed community by providing valued open space areas as will as recreation opportunities. These facilities will be fully integrated into the development in a manner that is sensitive to the area's physical character.

Objective: Establish a system of maintaining natural and cultural resources for present and future generations, and of managing recreation and other uses in accordance with sound conservation practices.

Policy: (B1) Exercise an overall conservation ethic in the use of Hawaii's resources.

Discussion: The proposed project will include open space areas, an Historic Preserve, and public parks. Natural and cultural resources within the project area will be maintained and managed in accordance with sound conservation practices.

1.4.12 State Tourism Functional Plan (1984)

The objectives and policies of the Tourism Functional Plan do not directly relate to the proposed development.

1.4.13 State Transportation Functional Plan (1984)

The objectives and policies of the Transportation Functional Plan relate primarily to the administration and implementation of transportation policy by the State Department of Transportation. For this reason, the functional plan does not directly relate to the proposed project. However, because transportation is a crucial element of the proposed project, a variety of mitigation measures are recommended to assist in reducing the project's impacts upon existing and future traffic conditions in the area, including the development of a new mauka-makai roadway to help relieve traffic on Palani Road. Master planning of the proposed project is being undertaken by the HFDC. At the master planning stage, the HFDC is working closely with the State Department of Transportation to ensure that transportation systems proposed for inclusion in the project are consistent and supportive of the DOT's agency objectives and polices.

1.4.14 State Water Resources Development Functional Plan (1984)

Objectives and policies of the Water Resources Development Functional Plan are directed primarily to State and County agencies responsible for the management of water resources and are not directly applicable to the proposed project. The proposed project includes the development of water resources to serve the planned development. Implementation of water infrastructure will be done in cooperation with the appropriate State and County agencies.

1.5 Coastal Zone Management Act (Chapter 205-A, HRS)

The objectives of the Hawaii Coastal Zone Management (CZM) Program, as set forth in

Chapter 205A, Hawaii Revised Statutes, include protection and maintenance of valuable coastal resources. The proposed project does not directly impact the coastal area, in that, it is located on the mauka side of Queen Kaahumanu highway, nearly a mile from the shoreline. Likewise, no portion of the proposed project is located within the Special Management Area.

1.6 West Hawaii Regional Plan

Published in November, 1989 by the Office of State Planning, the West Hawaii Regional Plan "addresses critical topical issues which require State attention in order to most effectively meet the region's present and emerging needs". The plan identifies the subject property as contained within a subregional planning area and outlines a strategy to "concentrate future regional urbanization in designated Subregional Planning Areas and provide for their planning and future development in a manner which optimizes or mitigates subregional problems, issues and opportunities". The plan contains a number of goals which establish a "vision" for West Hawaii. Table 7-1 summarizes the relationship between these goals and the proposed project.

2. HAWAII COUNTY PLANS AND CONTROLS

2.1 Hawaii County General Plan

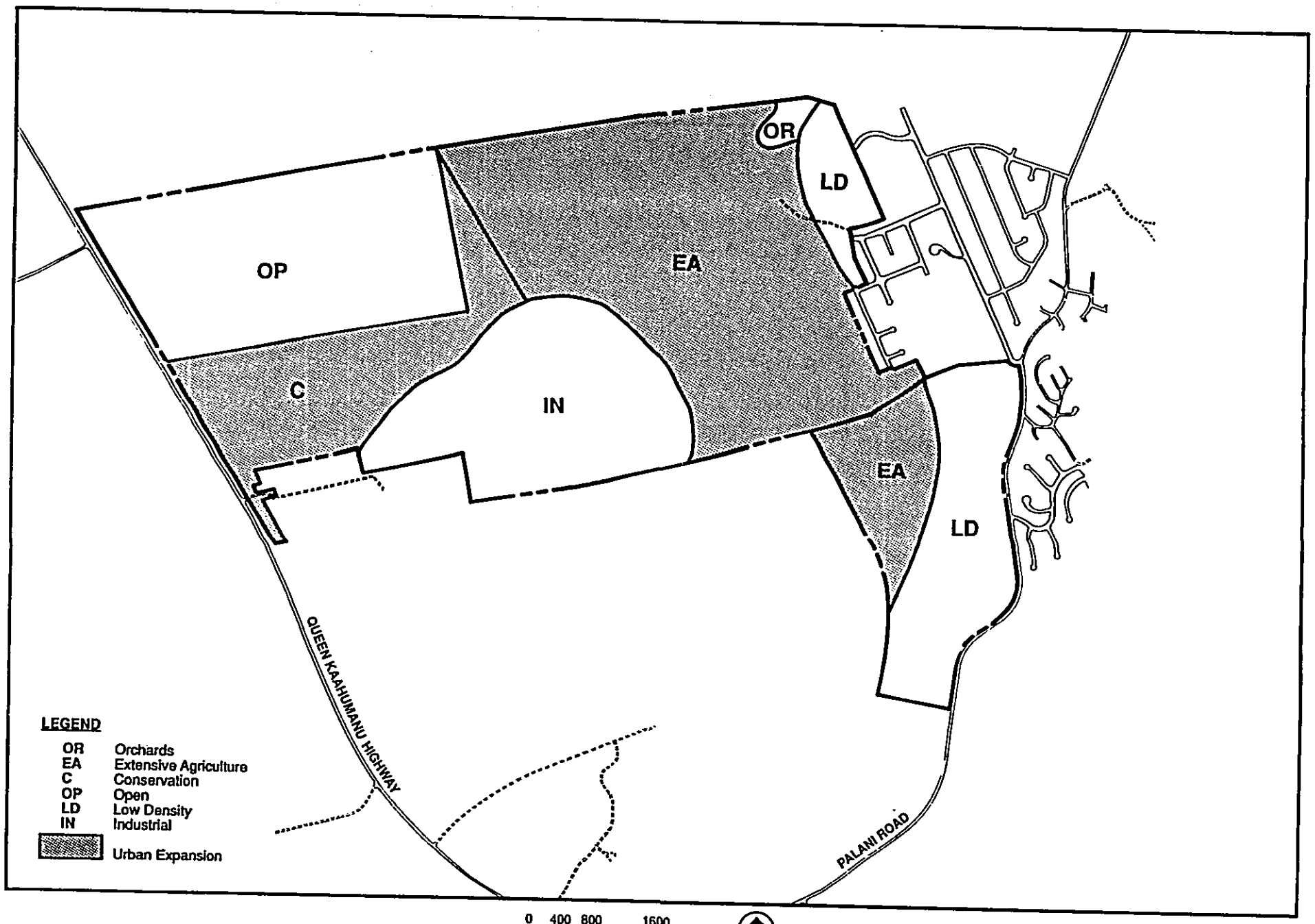
The Hawaii County General Plan is the policy document for the long-range comprehensive development of the island of Hawaii. The General Plan provides direction for balanced growth of the County. The Plan contains goal, policies, and standards concerning twelve functional areas as well as a series of land use maps referred to as General Plan Land Use Pattern Allocation Guide (LUPAG) Maps. The recently revised LUPAG map designations for the subject property identify it generally as Alternate Urban Expansion with a portion near the existing Kealakehe community designated for low density development, a portion in the northeastern corner identified as Orchard, a portion near the existing land fill designated for industrial uses, and a portion of the northwestern corner of the project area designated as open area (see Figure 7-2). The proposed project is generally consistent with the County General Plan. The proposed project is also consistent with the policies of the General Plan.

2.2 Hawaii County Zoning

The project area includes four zoning classifications: the area presently classified as Urban District by the State Land Use Commission is zoned RS-10, RS-15 and Open as depicted in Figure 7-3. The area presently classified as Conservation District and Agriculture District is zoned Open with a small portion zoned A-1a.

TABLE 7-1: RELATIONSHIP TO WEST HAWAII REGIONAL PLAN

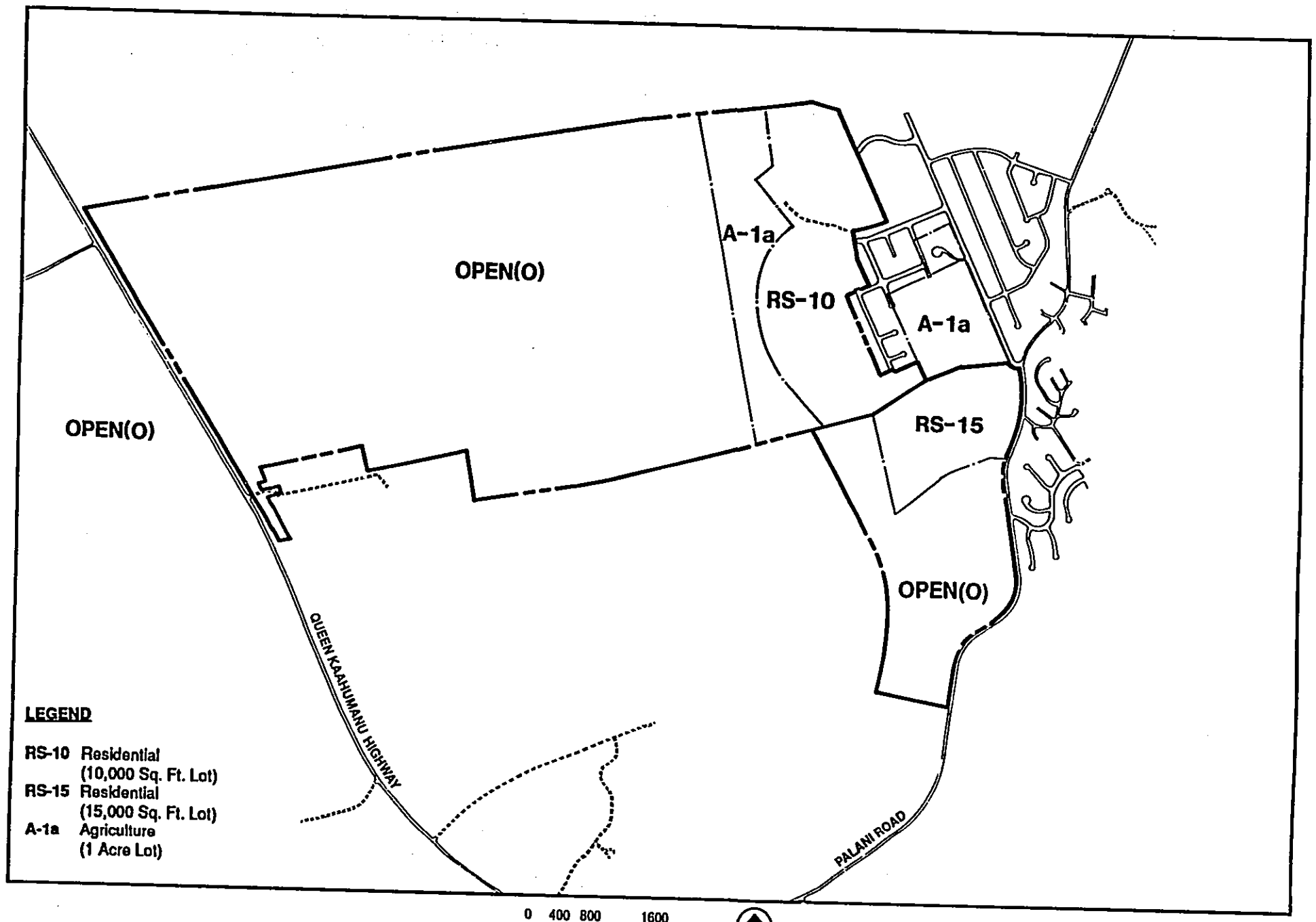
Goal:	Applicable	Supportive
Plan and maximize benefits for Hawaii's people.	Yes	Yes
Optimize the use of State owned lands.	Yes	Yes
Promote a diversified economic base which maximizes job choice and opportunities.		Yes
Ensure access to and adquacy of health, education, job-training, and human service programs.		Yes
Ensure provision and adequacy of affordable housing.	Yes	Yes
Minimize adverse impact of new development on local lifestyles, historic and cultural resources and community values.	Yes	Yes
Provide a wide range of outdoor recreational activities.	Yes	Yes
Protect scenic areas, natural landmarks, open space and viewsheds.	Yes	Yes
Ensure that existing and proposed developments can be adequately accommodated.	Yes	Yes
Support urban developments that maintain the unique character of the West Hawaii region.	Yes	Yes
Protect State investments at the Natural Energy Laboratory of Hawaii, the Hawaii Ocean Science and Technology Park, Keahole Airport, and the Mauna Kea observatories.		Yes
Ensure that new development does not adversely impact:		
agricultural resource activities	Yes	Yes
aquacultural resource activities	No	
the quality of the aquifer	Yes	Yes
the quality of nearshore waters	No	
the quality of offshore and deep ocean waters	No	
the quality of the air	Yes	Yes
the watersheds	Yes	Yes
Ensure that the servicing of resort development does not result in unnecessary in-migration.		Yes
Ensure the clustering of resorts in order to minimze public service costs.	No	
Promote quality and diversity in future resort developments.	No	
Develop only within infrastructure capacities and constraints.	Yes	Yes
Maintain the diversity of the region's natural and cultural assets.	Yes	Yes
Maintain the diversity and character of existing communities	Yes	Yes
Ensure that development does not lead to deterioration in the quality of life.	Yes	Yes
Maintain opportunities for community participation during plan implementation.	Yes	Yes



KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

Prepared by: BELT COLLINS & ASSOCIATES
Date: JUNE 1990

Figure 7-2
COUNTY GENERAL PLAN (1989)



KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

Prepared by: BELT COLLINS & ASSOCIATES
Date: JUNE 1990

Figure 7-3
HAWAII COUNTY ZONING

2.3 Hawaii County Special Management Area

The project is not located within the special management area.

2.4 Kona Regional Plan

The Kona Regional Plan is intended to serve as a guide for land use decisions by the public and private sectors rather than a regulatory document. To that end, it documents existing constraints as well as setting forth recommendations and growth policies. Since the original publication of the document in 1982, substantial growth and development has occurred in the Kona region necessitating updates to the plan. The County's present endeavor, the Draft Keahole to Kailua Development Plan, discussed below, represents the next logical step in the planning process to guide development in the Kona area. To that extent, the Kona Regional Plan is somewhat outdated. Nevertheless, it remains as a relevant guide for growth in the area.

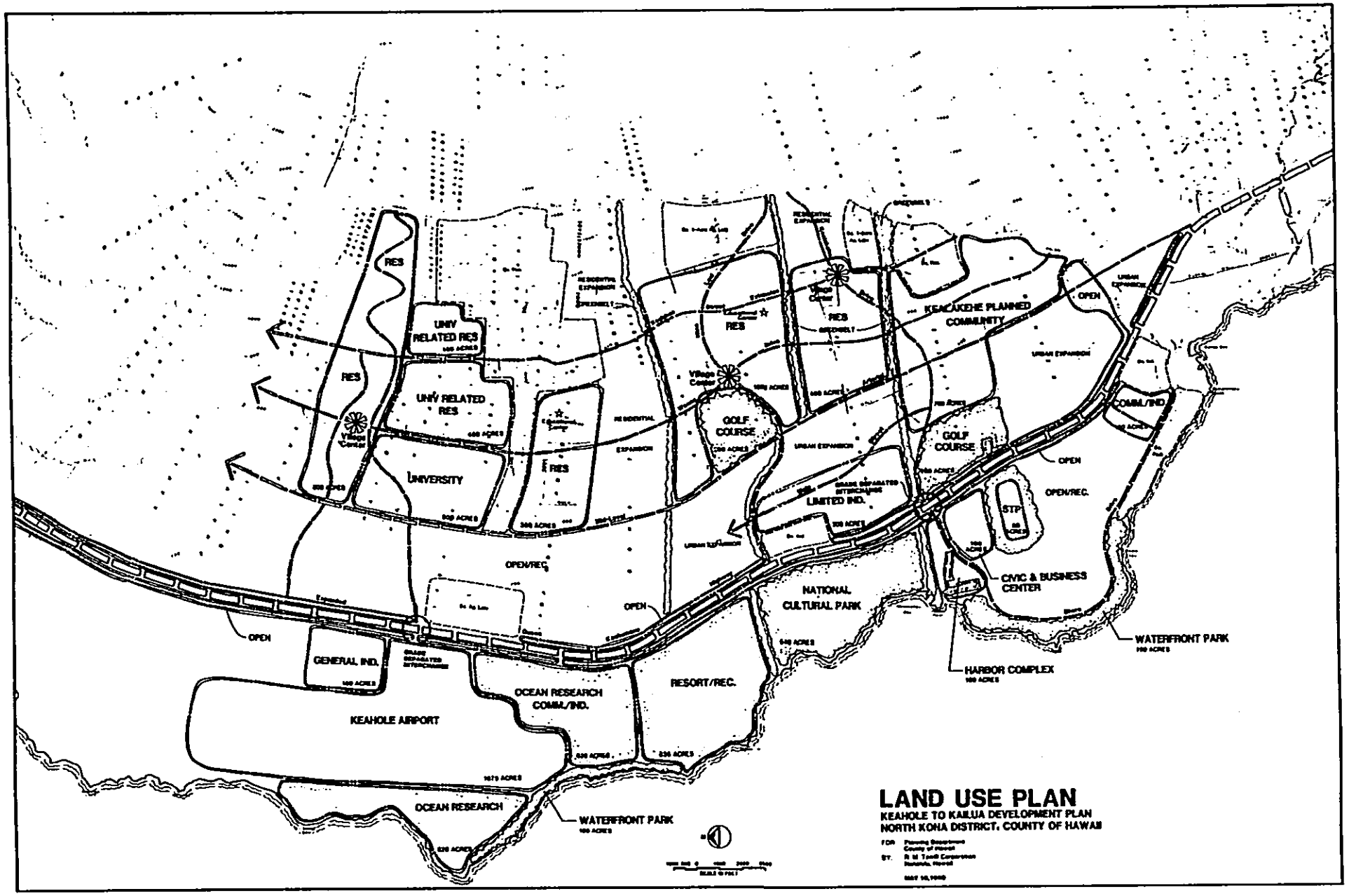
The proposed project is consistent with the Regional Plan's policies and recommendations concerning infrastructure, residential and commercial development.

2.5 Draft Keahole to Kailua Development Plan

The Hawaii County Planning Department has developed a draft development plan to address future development in the area from Keahole Airport to Kailua. The plan was approved by the County Planning Commission on July 5, 1990, and has been transmitted to the County Council for review and adoption.

The HFDC supports the intent and concept of the Keahole to Kailua Development Plan (K-K Plan). However, the present draft contains some elements that conflict with the proposed project. As currently drafted, the K-K Plan is largely a land use plan with an emphasis upon the siting of major region-serving land use elements and infrastructure. As the K-K Plan moves through the planning process it will continue to be refined. A discussion of the relationship between the proposed project and the draft plan (Figure 7-4) is therefore confined at this time to the compatibility between elements of the two plans.

Regional Center: The K-K Plan depicts a 100-acre Civic and Busines Center located within the State owned Kealakehe property makai of Queen Kaahumanu Highway. In presentations to the Planning Commission by the County Planning Department, the location has been justified on the basis of the appropriateness of locating public uses on public property. In earlier drafts of the



KEALAKEHE PLANNED COMMUNITY
ENVIRONMENTAL IMPACT STATEMENT

Prepared by: BELT COLLINS & ASSOCIATES
Date: JUNE 1990

Figure 7-4
DRAFT KEAHOLE TO KAILUA DEVELOPMENT PLAN

plan, the Civic and Business Center was shown as a larger Regional Center mauka of the highway.

Discussion: The proposed project includes a 30 acre Civic Center located in the vicinity of the County police substation on County property. This location was selected in response to the County's desire to expand public facilities around the police station and was consistent with earlier drafts of the K-K Plan. At this time it is assumed that the County intends to retain the police station at its present location. Whether the surrounding area will be developed with additional public uses is unknown. However, for planning purposes it is appropriate to include the Civic Center in the location shown in the Kealakehe Master Plan in order to maximize development options and ensure adequate sizing of infrastructure.

Residential Development: The K-K Plan depicts residential land uses for the entire project area mauka of the proposed golf course and designates it as the Kealakehe Planned Community.

Discussion: The Kealakehe Master Plan is generally consistent with the K-K Plan. However, the Kealakehe Planned Community does not include that portion of land owned by the Queen Liliuokalani Trust and situated between the County's Mid-Level Arterial and Waena Drive as depicted on the K-K Plan map.

Public Golf Course: The K-K Plan includes a public golf course situated mauka of the Queen Kaahumanu Highway on land included in the project area.

Discussion: The location of the golf course is consistent with the Kealakehe Master Plan.

Kealakehe Drive and Grade Separated Interchange: The K-K Plan depicts a mauka-makai roadway along the northern portion of the project area and a grade separated interchange on Queen Kaahumanu Highway at the intersection of Kealakehe Parkway.

Discussion: The Kealakehe Master Plan is consistent with the K-K Plan. Although the alignment of the roadway and interchange differ slightly between the two plans, they are generally consistent.

Mid level Arterial: The K-K Plan proposes a mid-level arterial roadway paralleling Queen Kaahumanu Highway and crossing the HFDC project area. As proposed, this roadway consists of 120 foot right of way to be developed as a major arterial roadway.

Discussion: The HFDC supports the mid-level roadway concept and has included it in the project Master Plan.

Queen Kaahumanu Setback: The K-K Plan proposes expansion of the existing highway to 4-6 lanes by establishing a 300 foot right-of-way to accommodate the proposed construction.

Discussion: The HFDC supports the expansion of the Queen Kaahumanu Highway and has included a similar setback in its Concept Plan.

Main Street: The K-K Plan proposes the location of a Main Street beginning at Kealakehe Parkway (Kealakehe Drive) and extending north.

Discussion: It is believed that the Main Street proposal is largely conceptual in nature. The HFDC is proposing a detailed internal roadway system with the project area as part of its Master Plan. The Main Street concept can be adapted to fit within the Master Plan.

In general, the HFDC supports the remaining elements of the plan, including the proposed location of recreational, educational and industrial uses. However, there is concern about how the various elements in the County plan will be funded.

2.6 Kailua Village Design Plan

The 1988 Kailua Village Design (KVD) Plan does not include the proposed project area. However, it is expected that the plan's jurisdiction will be expanded to include the proposed project should it be approved. To that end, the proposed project concept has been reviewed and has been found to be consistent with the intent of the KVD plan.

3. STATE ENVIRONMENTAL IMPACT STATEMENT REQUIREMENTS

3.1 Chapter 343, HRS

Section 343-5(b) of Chapter 343, HRS (revised) states that "the applicability of chapter 343, Hawaii Revised Statutes, to specific agency proposed actions is conditioned by the agency's proposed use of state or county lands or funds. Therefore when an agency proposes to implement an action to use state or county lands or funds, it shall be subject to the provisions of chapter 343, Hawaii Revised Statutes..." Accordingly, this Environmental Impact Statement for the proposed project has been prepared and is submitted pursuant to the provisions of Chapter 343.

Upon acceptance of this EIS and approval of the requested State Land Use Boundary Petition and subsequent state and county permitting requests,the proposed project would conform with relevant state and county land use regulations, as well as other appropriate regulations.

CHAPTER VIII

CHAPTER VIII
CONTEXTUAL ISSUES

1. RELATIONSHIP BETWEEN SHORT-TERM USES AND MAINTENANCE OF LONG-TERM PRODUCTIVITY

As discussed in previous sections of this document, the Kealakehe property is a large, vacant parcel of land characterized by barren lava flows with pockets of vegetation ranging from sparce grasses to dense thickets of shrubs and undergrowth. Its principal use historically has been for cattle grazing and habitation. As an environmental resource, the value of the land may be defined generally by its open space character and visual attributes. Its environmental value is further enhanced, however, by the fact that the land supports a species of environmentally endangered plant, the uhi uhi, as well as archaeological sites. The endangered status of the uhi uhi is believed to result from a number of factors, including the destruction from grazing animals, range fires that have destroyed large tracts of virgin land, and competition from exotic plants.

Long term use of the property for the purpose of providing affordable housing has been demonstrated in this document to be a critical economic and social issue for the West Hawaii region. The benefits of developing the property for residential use include the productive use of the property to benefit current and future residents of the West Hawaii region, the economic opportunities that will result from its development, and an increase in public lands uses and activities including new schools and recreational areas. The fact that the property is adjacent to existing residential areas and infrastructure increases its value as a potential residential site. Its elevation, cooler climate, and views also render the land an attractive locale for a residential community.

Retention of the property in open space to preserve its scenic value is not considered to be a viable long-term productive use in the face of a critical need for housing and the proximity of the land to an existing urban area. This is especially true when considering the proposed use of the property. Residential development will have a negligible impact upon the lands scenic qualities due to the low-rise character of the proposed development.

Preservation of the property in open space to protect the uhi uhi may not, in itself, accomplish that goal. Despite a possible restriction on cattle grazing, the endangered plants would continue to be exposed to the threat of range fire and competition from exotic plant species. Thus, preservation would have to be accompanied by an aggressive management plant to protect and propagate the species.

Potential short-term uses of the property are limited to the continued grazing of the land. In terms of its environmental value, the continued use of the property for grazing is unacceptable due to its historical impact upon the uhi uhi. Other short term uses of the property, such as a passive recreational area or large archaeological preserve would involve disruption of its existing character due to the need to clear some of the vegetation and develop supportive infrastructure such as roadways, parking areas, or pedestrian paths.

Clearly, there is an opportunity to meet both needs; preservation of the property's environmental resources and productive long-term use of it for social and economic benefits. The preservation of the endangered species in their natural habitat and the preservation of significant archaeological sites is not incompatible with the proposed residential use. Sensitive urban design will ensure that environmental resources are preserved. Development of the property will generate income which can be used to finance the management of environmentally sensitive resources.

2. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Development of the property for residental and residential-related uses would result in the irreversible and irretrievable commitment of certain natural and fiscal resources. Resource commitments include the land, potable water, the capital, the construction materials and the labor and energy needed to implement the project. These commitments should be weighed against the projected socio-economic benefits resulting from the proposed project as opposed to the preservation of the property as vacant open space.

The development of affordable housing, as demonstrated in this document, will require a significant commitment of governmental resources, including project financing and the labor necessary to administer its development. This commitment must be weighed against the project's contribution to tax revenues and its provision of new socio-economic and recreational amenities for the greater West Hawaii region.

3. OFFSETTING CONSIDERATIONS OF GOVERNMENTAL POLICIES

The proposed project has been thoroughly evaluated in terms of the existing system of land use policies, plans, goals, objectives, and controls at the state and county levels of government, and has been demonstrated to be generally consistent with numerous elements of this elaborate regulatory system. Nevertheless, by its very nature, there are inherent conflicts and contridictions within the system itself, and these cannot be avoided. Preservation of open space and the protection of the state's agricultural industry must be resolved in the face of the state's need to

respond to the demands of a growing population and economy. Protection of air quality and minimizing noise impacts cannot be easily resolved in the face of transportation facility improvements.

The proposed project addresses these critical issues by providing socio-economic benefits for the existing and future residents of West Hawaii while effectively mitigating adverse environmental and social impacts. The project has been demonstrated to be generally consistent with the Hawaii State Plan and Functional Plans, the Hawaii County General Plan, the County's Draft Keahole to Kailua Development Plan, and various community plans, goals, objectives and policies concerning the future growth of the West Hawaii region.

4. UNRESOLVED ISSUES

The West Hawaii region is presently the focus of considerable attention by county and state governmental agencies. Existing and proposed resort development along the South Kohala coast and in Keauhou will result in a significant expansion of the region's population and economy. To that end, both the State and County have engaged in the development of regional plans to guide future development. While the State's effort, the West Hawaii Regional Plan, has been completed, the County's Draft Keahole to Kailua Development Plan is presently in its third revision at the writing of this document. In addition to these efforts, major private landowners in the region including the Queen Liliuokalani Trust, Palani Ranch and Lanihau Corporation, and the Nansay Corporation are all proposing the eventual development of their vast land holdings.

The cumulative result of these efforts is an uncertainty at this time about the interrelationship of these plans and their collective impact upon such basic issues as the timing or phasing of regional infrastructure development and the location and phasing of major growth-inducing public and private facilities such as a new landfill, a regional hospital, a university campus, a regional sports center and regional roadways.

Thus, while state, county and private landowner plans are presently unresolved, the public review process of their various plans provides an adequate forum for the discussion and evaluation of the inherent issues. The publication of this environmental impact statement will contribute to the resolution of presently unresolved issues.

CHAPTER IX

CHAPTER IX
PARTIES CONSULTED AND THOSE WHO PARTICIPATED IN THE PREPARATION OF THE EIS

1. CONSULTED PARTIES

The notice of availability of the Environmental Assessment and EIS Preparation Notice for the Kealakehe Planned Community was published in the OEQC Bulletin by the Office of Environmental Quality Control on February 23, 1990. The agencies, organizations and individuals listed below were sent copies of the Environmental Assessment (EA) and were asked to comment on the project. Everyone believed to have an interest in the project or requested consulted party status was included in the mailing. Those who responded with substantive comments are marked with an asterisk (*) and copies of the correspondence with them are reproduced in Chapter VIII. Those who responded that they had no comments are marked with a dot (•). Their response letters are not presented in this document.

Federal Agencies

- Soil Conservation Service, U.S. Department of Agriculture
  Fish and Wildlife Service, U.S. Department of the Interior
* National Park Service, U.S. Department of the Interior
  Geological Survey, Water Resources Division, U.S. Department of the Interior

State Agencies

* Department of Accounting and General Services
* Department of Agriculture
• Department of Business and Economic Development
• Department of Budget and Finance
* Department of Education
  Department of Hawaiian Home Lands
* Department of Health
* Department of Land and Natural Resources
* Department of Transportation
* Office of Environmental Quality Control
  Office of Hawaiian Affairs
• Office of State Planning
* Environmental Center, University of Hawaii at Manoa
  Water Resources Research Center, University of Hawaii at Manoa

State Legislators

Senator Andrew Levin
Senator Malama Solomon
Representative Harvey S. Tajiri
Representative Dwight Takamine
Representative Mike O'Kieffe
Senator Richard M. Matsuura
Representative Jerry L. Chang
• Representative Wayne Metcalf
Representative Virginia Isbell

Hawaii County Agencies

Civil Defense Agency
Department of Parks and Recreations
Department of Research and Development
• Hawaii Redevelopment Agency
Office of Housing and Community Development
* Fire Department
* Department of Public Works
* Department of Water Supply
* Police Department
* Planning Department

Hawaii County Elected Officials

Mayor Bernard Akana
Councilman Takashi Domingo
Councilwoman Lorraine Inouye
Councilman Robert Makuakane
Councilman Spenser Schutte
Councilman Russel Kokubun
* Councilwoman Helene Hale
Councilwoman Merle Lai
Councilman Harry Ruddle
Councilman Stephen Yamashiro

Public Utilities

Hawaiian Telephone Company
* Hawaii Electric Light Company, Inc.
The Gas Company, Hawaii Division

Community Organizations

Alu Like, Inc.
American Lung Association
Big Island Business Council
Hawaii Audubon Society
* Hawaii Conference Foundation
Hawaii Hotel Association, Big Island Chapter
Hawaii Island Board of Realtors
Hawaii Island Chamber of Commerce
Hawaii Island Economic Development Board
Hawaii Island Portuguese Chamber of Commerce
* Hawaii Leeward Planning Conference
Hawaii Visitor's Bureau, Big Island Chapter
Kona-Kohala Chamber of Commerce
Life of the Land, Big Island Chapter
Moku Loa Group, Sierra Club
Na Ala Hele
Native Hawaiian Legal Corporation
Sierra Club Legal Defense Fund

2. ORGANIZATIONS AND INDIVIDUALS WHO ASSISTED IN THE PREPARATION OF THIS EIS

This Environmental Impact Statement was prepared for the States' Housing Finance and Development Corporation by Belt Collins and Associates with input provided by subconsultants. The following were involved:

Belt Collins and Associates

Thomas Papandrew	-	Principal in Charge
Lee William Sichter	-	Project Planner/Author of EIS
Paul Hirota	-	Civil Engineering
Cheryl Palesh	-	Civil Engineering
Aniko Kurczinak	-	Planner
Thomas Nance	-	Hydrologist
Ken Hamilton	-	Printing Coordinator
Audrey Chun	-	Graphic Designer

Subconsultants

Archaeology	-	Paul H. Rosendahl, Ph.D. Inc.
Noise Impacts	-	Y. Ebisu & Associates
Flora	-	Char & Associates
Fauna	-	Phillip L. Bruner
Air Quality	-	Barry Neal,
Fiscal Impacts	-	Ernst & Young
Market Analysis	-	KPMG Peat Marwick
Traffic	-	Pacific Planning & Engineering, Inc.
Social Impact	-	Community Resources, Inc.
Electrical	-	Ron Ho & Associates
Topographic Survey	-	Towill Shigeoka
Urban Design Guidelines	-	Yamasato, Fujiwara, Aoki & Associates
Wastewater Impact Analysis	-	R.M. Towill Corporation

CHAPTER X

CHAPTER X

COMMENTS AND RESPONSES RECEIVED DURING THE EIS PREPARATION NOTICE PERIOD

The agencies and individuals listed in Chapter IX were all sent copies of the Environmental Assessment (EA) and a transmittal letter requesting comments. Those agencies and individuals responding with substantive comments are identified in Chapter IX. Their comment letters and our responses are presented in this chapter. Those agencies and individuals who responded with no substantive comments are identified in Chaper IX. For sake of brevity, their "no comment" letters are not included in this chapter

United States Department of the Interior

NATIONAL PARK SERVICE
PACIFIC AREA OFFICE
300 Ala Moana Blvd., Box 50165
Room 6305
Honolulu, Hawaii 96850

IN REPLY REFER TO:
L76(PAAR)

March 5, 1990

Mr. Lee William Sichter
Belt Collins and Associates
680 Ala Moana Blvd., Suite 200
Honolulu, Hawaii 96813

Dear Mr. Sichter:

From our review of the Environmental Assessment for the Kealakehe Planned Community, we note the following:

- Figure 3, Regional Map, does not show the correct authorized boundaries for Kaloko-Honokohau National Historical Park

- Figure 4, Ownership, does not show either boundaries for the historical park nor the present Federal ownership of the 60-acre Honokohau second parcel.

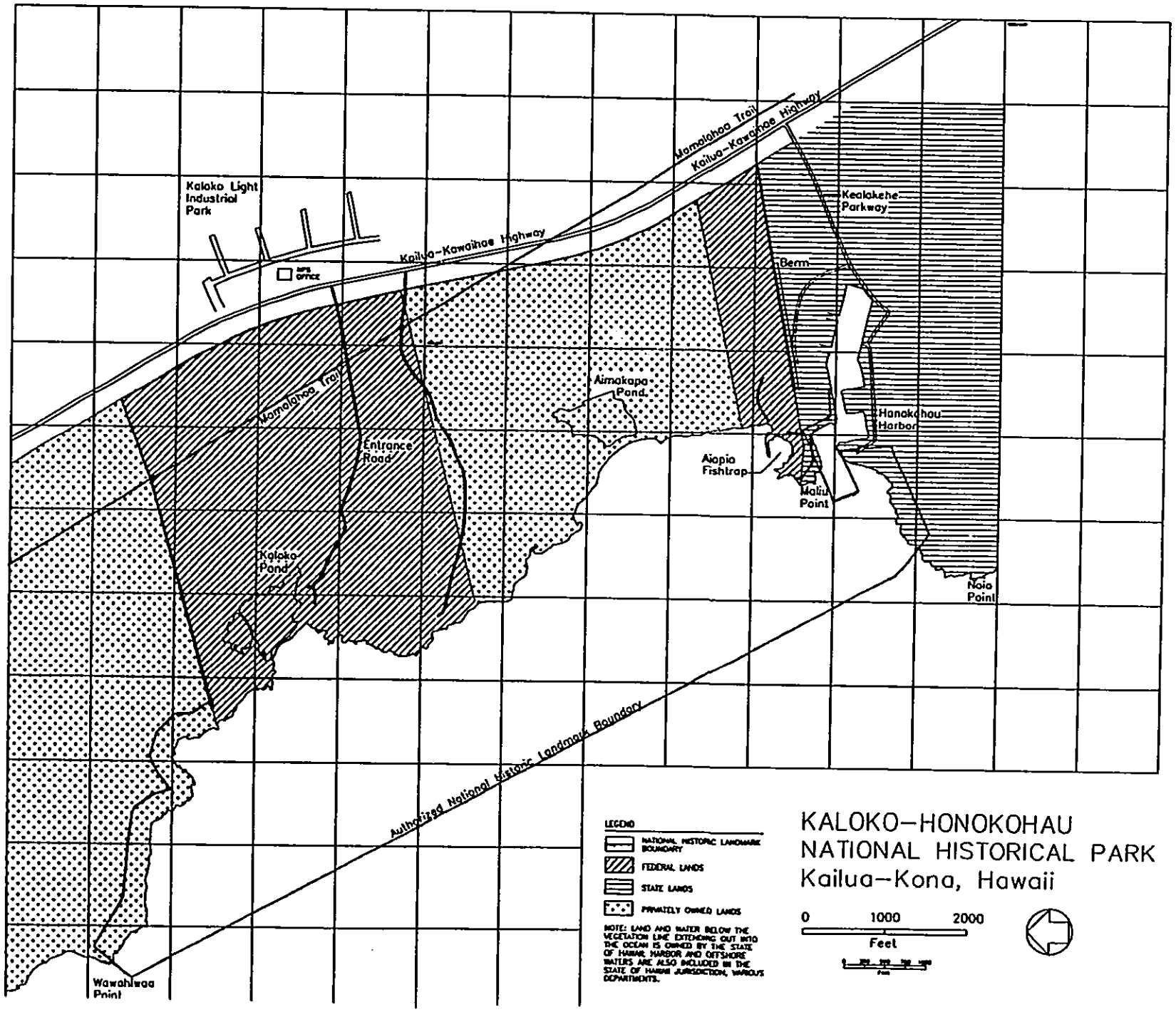
During preparation of the Draft EIS, we hope you will fully assess any impacts the proposed project might have on the considerable cultural and natural resources of the nearby national historical park.

For your use, we have enclosed a copy of the park boundary map showing existing ownership within.

Sincerely yours,

Bryan Harry
Director, Pacific Area

Enclosure


Kaloko Light Industrial Park
NPS OFFICE
Kailua-Kawaihae Highway
Mamalahoa Trail
Kealakehe Parkway
Berm
Aimakapa Pond
Honokohau Harbor
Entrance Road
Mamalahoa Trail
Aiopio Fishtrap
Maliu Point
Kaloko Pond
Noio Point
Authorized National Historic Landmark Boundary
Wawahiwaa Point
LEGEND
NATIONAL HISTORIC LANDMARK BOUNDARY
FEDERAL LANDS
STATE LANDS
PRIVATELY OWNED LANDS
NOTE: LAND AND WATER BELOW THE VEGETATION LINE EXTENDING OUT INTO THE OCEAN IS OWNED BY THE STATE OF HAWAII. HARBOR AND OFFSHORE WATERS ARE ALSO INCLUDED IN THE STATE OF HAWAII JURISDICTION, VARIOUS DEPARTMENTS.
KALOKO-HONOKOHAU
NATIONAL HISTORICAL PARK
Kailua-Kona, Hawaii
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2000
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BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Blvd., Suite 200, Honolulu, Hawaii 96813
Phone: (808) 521-5361, Telex: BELTH 7430474, Fax: (808) 538-7819
Hawaii • Singapore • Australia • Hong Kong • Saipan

May 30, 1990
841.0101/90-660

Mr. Bryan Harry
Director, Pacific Area
National Park Service
United States Department of the Interior
300 Ala Moana Blvd., Room 6305
Box 50165
Honolulu, Hawaii 96850

Dear Mr. Harry:

Kealakehe Planned Community
Environmental Assessment and EIS Preparation Notice

Thank you for your letter of March 5, 1990 concerning the above project. The regional map will be corrected to show the authorized boundaries of the Kaloko-Honokohau National Historical Park. The ownership map will be corrected to show the correct boundaries for the park as well as federal ownership of the 60-acre Honokohau second parcel. The impacts of the proposed project upon the park will be fully addressed in the Draft Environmental Impact Statement.

We will provide you with a copy of the DEIS for your review and comment.

Very truly yours,

Lee William Sichter

cc: HFDC

JOHN WAIHEE
GOVERNOR

RUSSEL S. NAGATA
COMPTROLLER

JAMES H. YASUDA
DEPUTY COMPTROLLER

STATE OF HAWAII
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
DIVISION OF PUBLIC WORKS
P. O. BOX 119, HONOLULU, HAWAII 96810

LETTER NO. (P)1238.0

MAR 22 1990

Mr. Lee William Sichter
Senior Planner
Belt Collins & Associates
680 Ala Moana Boulevard, Suite 200
Honolulu, Hawaii 96813

Dear Mr. Sichter:

Subject: Kealakehe Planned Community
Environmental Assessment

This is in response to your March 2, 1990 transmittal of the subject matter.

DAGS wishes to be a consulted party for the subject project. Our concerns, which we would like to see addressed in the Draft EIS, are as follows:

1. The HFDC Kealakehe plan appears to conflict with Hawaii County's Kailua to Keahole Development Plan because HFDC's golf course and some residential areas are shown at approximately the location of Hawaii County's regional center. Since the County's plan was developed in consultation with the State Planning Office and other State agencies, information should be provided on how this conflict will be resolved.

2. The proposed civic center should not be located close to the County's landfill because of the problems the Police Station is encountering. Perhaps the landfill should be used as part of the golf course.

3. The DAGS proposed West Hawaii civic center which will generate vehicular traffic should be part of the regional center and should be located close to a major intersection with Queen Kaahumanu Highway for convenient vehicular access.

4. The latest estimated civic center land requirements are as follows:

State Civic Center

	Acres
State Office Buildings	5.5
Public Library	1.5
Health Center	1.5
Detention Center	3.5
Judiciary Complex	2.5
Senior Citizens Center	1.5
	16.0
50% Expansion	8.0
	24.0 Acres

5. The first two facilities being programmed for the civic center in the next few years are the Judiciary Complex and the Detention Center.

We appreciate this opportunity to identify key issues for the EIS. Should there be any questions, please have your staff contact Mr. Cedric Takamoto of the Planning Branch at 548-7192.

Very truly yours,

TEUANE TOMINAGA
State Public Works Engineer

CT:em
cc: Mr. Harold Masumoto
Mr. Joseph Conant

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Blvd., Suite 200, Honolulu, Hawaii 96813
Phone: (808) 521-5361, Telex: BELTH 7430474, Fax: (808) 538-7819
Hawaii • Singapore • Australia • Hong Kong • Saipan

May 30, 1990
841.0101/90-679

Mr. Teuane Tominaga
State Public Works Engineer
Division of Public Works
Department of Accounting and General Services
P.O. Box 119
Honolulu, Hawaii 96810

Dear Mr. Tominaga:

Kealakehe Planned Community
Environmental Assessment and EIS Preparation Notice

Thank you for your letter of March 22, 1990 concerning the above project. Following are responses to your concerns.

On March 1, 1990, the Hawaii County Planning Department presented a revision of the Keahole to Kailua Development Plan to the County Planning Commission. The revised plan includes the proposed golf course and depicts the regional center as situated between the golf course and the mid-level roadway. At that meeting the HFDC testified before the Commission that it did not support the location of the regional center on the Kealakehe property. The HFDC is working closely with the County of Hawaii and the Office of State Planning to resolve any differences pertaining to the County's draft development plan.

Although the landfill is presently the source of noxious odors, it is not expected to present a significant problem for the proposed Civic Center. The County proposes to close it shortly and has issued a contract for the removal of recyclable materials. This will result in the eventual elimination of the landfill as a source of air pollution and ultimately its relocation to a new site. The phasing of the proposed project corresponds with the landfill closure. Once the landfill has been relocated, the area is proposed for inclusion in the proposed golf course as a driving range. The landfill issue will be addressed in the Draft EIS.

The matter of traffic impacts and the location of the Civic Center in proximity of a major intersection with Queen Kaahumanu Highway as well as its size will be addressed in the Draft EIS.

We will provide you with a copy of the Draft Environmental Impact Statement for your review and comment.

Very truly yours,

Lee William Sichter

cc: HFDC

JOHN WAIHEE
GOVERNOR

YUKIO KITAGAWA
CHAIRPERSON, BOARD OF AGRICULTURE
SUZANNE D. PETERSON
DEPUTY TO THE CHAIRPERSON

State of Hawaii
DEPARTMENT OF AGRICULTURE
1428 So. King Street
Honolulu, Hawaii 96814-2512

Mailing Address:
P. O. Box 22159
Honolulu, Hawaii 96822-0159

March 30, 1990

Mr. Lee William Sichter
Senior Planner
Belt Collins and Associates
680 Ala Moana Boulevard
Suite 200
Honolulu, Hawaii 96813

Dear Mr. Sichter:

Subject: Environmental Assessment (EA)
Kealakehe Planned Community
Housing Finance and Development Corporation
TMK: 7-4-08: pors. 17, 43
7-4-19: por. 43
Kealakehe, North Kona, Hawaii
Area: approximately 990 acres

The Department of Agriculture has reviewed the subject EA and offers the following comments.

According to the EA, the applicant plans to construct up to 5,000 housing units on the subject site which has approximately equal areas in the Conservation and Agricultural Districts.

Reference to the Soil Conservation Service Soil Survey is correct. The portion of the project site within the Agricultural District has a small section (less than 50 acres) of lands classified "Other Important" according to the Agricultural Lands of Importance to the State of Hawaii (ALISH) system. The remainder of the project site is not classified according to the ALISH system.

The 990-acre property has Land Study Bureau Overall Productivity ratings of "C," "D," and "E." By this method of classification, the mauka (Agricultural District) half of the project site has fair to good productivity potential for grazing, while the makai (Conservation District) half has very marginal agricultural potential. The "C"-rated area which is situated in the northeastern corner of the site has fair to good productivity potential for orchard and grazing uses. The

easternmost edge of the site borders the northernmost extent of the "coffee belt" which follows along the Mamalahoa Highway.

Except for the use of the site for grazing by Palani Ranch, we are not aware of any other agricultural uses on the site. What is meant by the statement in the EA that "... the use of the property for agricultural uses, especially the expansion of livestock operations may be incompatible with existing and proposed uses of neighboring properties" (EA, page 39)? Grazing on unimproved pasture is about the lowest intensity livestock use.

Thank you for the opportunity to comment.

Sincerely,

Yukio Kitagawa

YUKIO KITAGAWA
Chairperson, Board of Agriculture

c: Office of Environmental Quality Control
Office of State Planning (attention: Land Use Division)

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

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May 30, 1990
841.0101/90-1160

Mr. Yukio Kitagawa, Chairperson
Board of Agriculture
State of Hawaii
1428 South King Street
Honolulu, Hawaii 96814-2512

Dear Mr. Kitagawa:

Kealakehe Planned Community
Environmental Assessment and EIS Preparation Notice

Thank you for your letter of March 30, 1990 concerning the above project. The statement in the EA that the use of the property for expansion of livestock operations may be incompatible with existing and proposed uses of neighboring properties was made in recognition of the fact that residential development is often viewed as being incompatible with livestock grazing largely due to odors and associated pests such as flies.

We will provide you with a copy of the Draft Environmental Impact Statement for your review and comment.

Very truly yours,

Lee William Sichter

cc: HFDC

JOHN WAIHEE
GOVERNOR

CHARLES T. TOGUCHI
SUPERINTENDENT

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

OFFICE OF THE SUPERINTENDENT

March 27, 1990

Mr. Lee William Sichter
Senior Planner
Belt, Collins, and Associates
630 Ala Moana Boulevard - 2nd Floor
Honolulu, Hawaii 96813

Dear Mr. Sichter:

SUBJECT: Environmental Assessment
Kealakehe Planned Community
Kealakehe, North Kona, Hawaii

Our review of the subject Environmental Assessment indicates that it may have the following enrollment impact on our area schools based on the planned 5,000 residential units:

SCHOOL	GRADES	PROJECTED STUDENTS
Kealakehe Elementary	K-5	950 - 1050
Kealakehe Intermediate	6-8	400 - 450
Konawaena High	9-12	425 - 475

The schools listed will be assigned to initially accommodate the students from the subject development. A new elementary school and a new high school in the subject development are proposed to accommodate future enrollment increases.

All schools are operating above capacity. The Department of Education cannot assure the availability of classrooms and will require legislative appropriations to accommodate the anticipated student enrollment growth.

The Department of Education has the following additional comments to make:

1) We concur with the size of the elementary school of at least 10 acres and the high school site of a minimum of 30 acres if the slope of the land is within established criteria.

2) It is recommended that the elementary school site be relocated to an area in the early phases of development of the project. The location should not be near the land fill park.

3) Page 36 indicates, "Sites for two elementary schools and a high school are planned, as well as parks and related facilities." However, only one elementary site is shown on the preferred concept map. A second elementary site will be required in the Kealakehe area if additional housing develops.

4) To assure the timely completion of a new elementary school, the infrastructure must be available when school construction commences. Continued cooperation between the Department of Education and the Hawaii Housing Finance and Development Corporation is required to plan and develop all new schools in the area.

5) We anticipate the school sites to be set aside to the Department of Education without cost by Executive Order.

Should there be any questions, please call the Facilities Branch at 737-4743.

Thank you for the opportunity to comment.

Sincerely,

Charles T. Toguchi

Charles T. Toguchi
Superintendent

CTT:jl

cc: E. Imai
A. Garson

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& ASSOCIATES
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May 30, 1990
841.0101/90-1158

Mr. Charles T. Toguchi, Superintendent
Department of Education
State of Hawaii
P.O. Box 2360
Honolulu, Hawaii 96804

Dear Mr. Toguchi:

Kealakehe Planned Community
Environmental Assessment and EIS Preparation Notice

Thank you for your letter of March 27, 1990 concerning the above project. As a result of your comments regarding the location of the proposed elementary school, we have shifted the site so that it may be included in an earlier phase of development. We agree that a second elementary school may be necessary in the Kealakehe area if additional housing is developed. We also agree that infrastructure must be available when school construction commences and will continue to work with your department to ensure its timely completion. Finally, it is anticipated that the school sites will be set aside by Executive Order.

Recent discussions between the DOE and the HFDC have established the development of the high school as the top priority. To this end, the HFDC will be coordinating its efforts with the DOE.

We will provide you with a copy of the Draft Environmental Impact Statement for your review and comment.

Very truly yours,

Lee William Sichter

cc: HFDC

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HAWAII 96801

JOHN C. LEWIN, M.D.
DIRECTOR OF HEALTH

June 14, 1990

In reply, please refer to:
EPHSD
060

Mr. Lee William Sichter, Senior Planner
Belt Collins & Associates
680 Ala Moana Blvd., Suite 200
Honolulu, Hawaii 96813

Dear Mr. Sichter:

Subject: Environmental Assessment for Kealakehe Planned Community
Kailua-Kona, Hawaii
TMK: 7-4-08: por. 17, 43 and 7-4-19: por. 43
(Housing Finance and Development Corporation

Thank you for the opportunity to review and comment on the subject document. We have examined the assessment and have the following comments:

Drinking Water

1. The Assessment does not indicate the estimated demand for potable water. However, it does state that new wells, transmission lines and storage reservoirs will be required.

2. Because each new well will serve 25 or more individuals at least 60 days per year or have a minimum of 15 service connections, the use of each well as a source of drinking water will require compliance with the Department's Administrative Rules, Title 11, Chapter 20, "Potable Water Systems."

3. Section 11-20-29 of Chapter 20 requires that all new sources of potable water serving a public water system be approved by the Director of Health prior to their use. such an approval is based primarily upon the submission of a satisfactory engineering report which addresses the requirements set in Section 11-20-29.

4. Section 11-20-30 of Chapter 20 requires that new or substantially modified distribution systems for public water systems be approved by the Director. However, if the water system is under the jurisdiction of the County of Hawaii the Department of Water Supply will be responsible for the review and approval of the plans.

5. The upper portion of the proposed project site is situated above the Department's Underground Injection Control (UIC) line. Land area located above the UIC line are generally considered to contain underground sources of drinking water. These areas should therefore be protected against all sources of groundwater contamination. It is essential that any proposed well in the this area be designed and constructed to prevent the possibility of groundwater contamination. For example, each well should have a concrete pad and full grouting to prevent seepage or floodwaters from migrating down the well shaft.

6. A public golf course is planned for the project. There are many golf course related activities which might contribute to groundwater contamination. Some of the activities of concern include:

    a. Application of biocides and fertilizers
    b. Storage of fuel for vehicles
    c. Maintenance of vehicles and equipment (cleaning, refueling, lubrication, etc.)

    If any of these activities are planned, mitigative measures to insure that groundwater contamination will not occur must be addressed.

7. The Eight (8) Conditions Applicable To This New Golf Course Development (see attached) should apply to this project. A monitoring system should be installed throughout the golf course, especially in areas downgradient of effluent irrigation and, if any, areas above perennial streams. The type of monitoring system to be used should be tailored to fit site conditions. The monitoring system may consist of monitoring wells, lysimeters, vadose zone monitoring instruments or a combination of the different methods. The design and siting of the monitoring system should be reviewed by the Department of Health.

8. The assessment states that the public golf course will be developed in the sewage treatment plant's effluent disposal area. The potable water systems in this area must be carefully designed and operated to prevent cross-connections and backflow conditions with any non-potable systems.

Wastewater Disposal

We have reviewed the subject assessment and find that the issue of wastewater disposal has not been adequately addressed. The report has sufficiently discussed current conditions and future expansion of Kealakeha Sewage Treatment Plant (STP); however, it fails to properly address what type of temporary sewer system will be used for the subject project prior to connecting to the county sewer system.

The State Department of Health would like to restate its position on the above matter. No individual wastewater systems will be allowed. A centralized wastewater system (treatment and disposal) meeting the requirement of Subchapter 2 of Chapter 11-62 must be constructed.

BRUCE S. ANDERSON, PH.D.

Attachment

STATE OF HAWAII
DEPARTMENT OF HEALTH

April, 1990 (Version 3)

EIGHT (8) CONDITIONS APPLICABLE TO THIS NEW GOLF COURSE DEVELOPMENT

1. The owner/developer and all subsequent owners shall establish a groundwater monitoring plan and system which shall be presented to the State Department of Health for its approval. The groundwater monitoring plan and system shall minimally describe the following components:

   a. A monitoring system tailored to fit site conditions and circumstances. The system shall include, and not be limited to, the use of monitoring wells, lysimeters and vadose zone monitoring technologies. If monitoring wells are used, the monitoring wells shall generally extend 10 to 15 feet below the water table.

   b. A routine groundwater monitoring schedule of at least once every six (6) months and more frequently, as required by the State Department of Health, in the event that the monitoring data indicates a need for more frequent monitoring.

   c. A list of compounds which shall be tested for as agreed to by the State Department of Health. This list may include, but not be limited to the following: total dissolved solids; chlorides; PH; nitrogen; phosphorus; or any other compounds associated with fertilizers, biocides or effluent irrigation.

2. Baseline groundwater/vadose zone water data shall be established as described in this paragraph. Once the monitoring system and list of compounds to be monitored for have been determined and approved by the State Department of Health, the owner/developer shall contract with an independent third-party professional (approved by the State Department of Health) to establish the baseline groundwater/vadose zone water quality and report the findings to the State Department of Health. Testing of the analyses of the groundwater shall be done by a certified laboratory.

3. If the data from the monitoring system indicate the presence of the measured compound and/or the increased level of such compound, the State Department of Health can require the owner/developer or subsequent owner to take immediate mitigating action to stop the cause of the contamination. Subsequently, the developer/owner or subsequent owner shall mitigate any adverse effects caused by the contamination.

4. Owner/developer shall provide sewage disposal by means of connection to the public sewer system; or by means of a wastewater treatment works providing treatment to a secondary level with chlorination. Effluent from this wastewater treatment works may be used for golf course irrigation, subject to Condition #3. The entire system shall be approved by the State Department of Health in conformance with Administrative Rules Title 11, Chapter 62, Wastewater Treatment Systems, effective December 10, 1988.

5. If a wastewater treatment works with effluent reuse becomes the choice of wastewater disposal, then the owner/developer and all subsequent owners shall develop and adhere to a Wastewater Reuse Plan which shall address as a minimum, the following items:

   a. Management Responsibility. The managers of the irrigation system using reclaiming wastewater shall be aware of the possible hazards and shall evaluate their system for public health, safety, and efficiency. They must recognize that contact with the reclaimed wastewater from treated domestic sewage poses potential exposure to pathogenic organisms which commonly cause infections diseases (bacteria, viruses, protozoa, and halminths or worms).

   b. General Recommendations

      1) Irrigated areas should be no closer than 500 feet from potable water wells and reservoirs.

      2) Irrigated areas should be no closer than 200 feet from any private residence.

      3) Application rates should be controlled to minimize ponding. Excess irrigation tailwater in the reclaimed wastewater irrigation area shall be contained and properly disposed. An assessment should be made of the acceptable time and rate of application based on factors such as type of vegetation, soil, topography, climate and seasonal variations.

      4) Effluent holding/mixing ponds shall be designed to prevent the infiltration of the wastewater into the subsurface. The holding/mixing ponds shall be made impervious.

      5) Irrigation shall be scheduled such that the public is not in the vicinity and the soil is sufficiently dry to accept the irrigation water.

      6) Permanent fencing or barriers shall be erected around polishing or holding ponds to prevent public entry or stray feral and tame animals from gaining access to the ponds.

7) Adequate irrigation records shall be maintained. Records should include dates when the fields are irrigated, rate of application, total application and climatic conditions. Records should also include any operational problems, diversions to emergency storage or safe disposal and corrective or preventive action taken.

8) The holding/mixing ponds shall be periodically monitored for the purpose of detecting leakage into the subsurface. If leakage is detected, corrective action shall be immediately taken.

c. Adequate Notice. Appropriate means of notification shall be provided to inform the employees and public that reclaimed wastewater is being used for irrigation on the site.

1) Posting of conspicuous signs with sufficient letter size for clear visibility with proper wording should be distributed around the use areas.

2) Signs shall be securely fastened. Periodic surveillance shall be conducted to assure permanent posting at all times. Immediate replacements shall be made when necessitated by deterioration, vandalism or misuse.

d. Adequate Employee Education. Employees or users should be cautioned and warned of the potential health hazards associated with the ingestion of reclaimed wastewater being used at the site.

1) Employees should be warned that the ingestion of reclaimed wastewater is unsafe.

2) Employees should be protected from direct contact of the reclaimed wastewater. If necessary, protective clothing should be provided.

3) Employees should be informed of the following:

- The irrigation water is unsafe for drinking or washing.
- Avoid contact of the water or soil with any open cuts or wounds.
- Avoid touching the mouth, nose, ear or eyes with soiled hands, clothes or any other contaminated objects.
- Be aware that inanimate objects such as clothes or tools can transport pathogenic organisms.
- Always wear shoes or boots to protect feet from the pathogenic organisms in the soil or irrigation water.

5. Releases from underground storage tanks (USTs) used to store petroleum products for fueling golf carts, maintenance vehicles, and emergency power generators pose potential risks to groundwater.

   Should the owner/developer/operator plan to install USTs that contain petroleum or other regulated substances, the owner/developer/operator must comply with the federal UST technical and financial responsibility requirements set forth in Title 40 of the Code of Federal Regulations Part 280. These federal rules require, among other things, owners and operators of USTs to meet specific requirements in the detection, release response and corrective action. Also, the owner/developer/operator must comply with all State UST rules and regulations pursuant to Chapter 342-L 'Underground Storage Tanks' of the Hawaii Revised Statutes.

   In consideration of the above-mentioned remarks, the Department of Health recommends that the owner/developer/operator implement facility plan alternatives that exclude the installation and operation of UST systems (e.g., the preferential use of electric golf carts, use of above-ground storage of fuel oil for emergency power generators, etc.), or, if USTs are utilized, that secondary containment be considered.

7. Buildings designated to house the fertilizer and biocides shall be bermed to a height sufficient to contain a catastrophic leak of all fluid containers. It is also recommended that the floor of this room be made waterproof so that all leaks can be contained within the structure for cleanup.

8. A golf course maintenance plan and program will be established based on "Best Management Practices (BMP)" in regards to utilization of fertilizers and biocides as well as the irrigation schedule. BMP's will be revised as an ongoing measure. The golf course maintenance plan will be reviewed by the State Department of Health prior to implementation.

If there are any questions regarding the eight (8) conditions mentioned here, please contact Mr. James K. Ikeda at 543-8304. We ask you cooperation in the protection of Hawaii's valuable groundwater resource.

BCA
BELT COLLINS
& ASSOCIATES
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June 20, 1990
841.0101/90-1281

Bruce S. Anderson, Ph.D
Deputy Director of Health
Department of Health
State of Hawaii
P.O. Box 3378
Honolulu, Hawaii 96801

Dear Dr. Anderson:

Kealakehe Planned Community
Environmental Assessment and EIS Preparation Notice

Thank you for your letter of June 14, 1990 concerning the above project. Following are responses to your comments in the order in which they were presented in your letter.

Drinking Water

1. The Environmental Impact Statement (EIS) will include estimates of the project's demand for potable water and a description of the transmission infrastructure that will be required to service the proposed project.

2. We agree that each new well will require compliance with the Department's Administrative Rules, Title 11, Chapter 120, "Potable Water Systems".

3. The Housing Finance and Development Corporation is presently developing alternatives with the Department of Land and Natural Resources and the County's Department of Water Supply. Therefore, it is unclear at this time precisely which agency will be developing the necessary water wells for the project, or whether it will be a joint development effort. Thus, while we agree that approval from the Health Department will be necessary, we can not determine at this time which agency will be seeking said approval.

4. Same as #3.

5. We concur.

6. The public golf course planned for the project will be under the jurisdiction of the County of Hawaii, to whom the land will be transfered by Executive Order of the Governor. The HFDC will not be involved in the operation of the golf course. Therefore, while the HFDC agrees with your concerns, it will not have jurisdiction over the operation of the golf course or the mitigation measures that may be implemented. We respectfully recommend that your concerns be directed to the County of Hawaii.

7. The eight conditions applicable to golf course development will become the responsibility of the County of Hawaii, as landowner, and/or its designated golf course operator. We respectfully recommend that your concerns be directed to the County of Hawaii.

8. The Kealakehe Sewage Treatment Plant and the effluent disposal area are being designed and constructed by the County of Hawaii and its consultant, R. M. Towill Corporation. The HFDC has no jurisdiction over this matter. We respectfully recommend that your concerns be directed to the County of Hawaii.

Wastewater Disposal

A complete discussion of the proposed project's wastewater disposal system, including any temporary system implemented, will be included in the EIS.

We will provide you with a copy of the Draft Environmental Impact Statement for your review and comment. Thank you for participating in the review process.

Very truly yours,

Lee William Sichter

cc: HFDC

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

REF:OCEA-CT

APR 30 1990

File: 90-550
Doc.: 7964E

Mr. Lee William Sichter, Senior Planner
Belt Collins & Associates
680 Ala Moana Blvd.
Suite 200
Honolulu, Hawaii 96813

Dear Mr. Sichter:

Subject: Environmental Assessment for Kealakehe Planned Community
Kealakehe, North Kona, Hawaii

Thank you for giving our Department the opportunity to comment on this matter. We have reviewed the materials you submitted and have the following comments.

The Uhi uhi (Mezoneuron kavaiense) is protected by federal and state endangered species laws. We would expect the draft EIS to address all possible mitigation measures for the protection of the nineteen (19) adult uhi uhi's within the proposed project.

Furthermore, the "taking" of individual trees is not an allowable mitigation measure. At a very minimum, the landscape planning for the "Kealakehe Planned Community" should incorporate all the endangered plant species into a protective environment that will be beneficial to the endangered plants and as an enhancement to the proposed developement for the area.

Additionally, the Environmental Assessment should address the water needs of the development.

Finally, our Historic Preservation Program (HPP) is in the process of reviewing the historic preservation concerns under Chapter 6E, HRS, historic preservation compliance requirements. Thus, at this time HPP will not comment on the Environmental Assessment.

If you have any questions, please call me or Cathy Tilton at our Office of Conservation and Environmental Affairs at 548-7837.

Very truly yours,

WILLIAM W. PATY

BELT COLLINS
& ASSOCIATES

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May 30, 1990
841.0101/90-1166

Mr. William Paty, Chairperson
Board of Land and Natural Resources
State of Hawaii
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Paty:

Kealakehe Planned Community
Environmental Assessment and EIS Preparation Notice

Thank you for your letter of April 30, 1990 concerning the above project. The Draft Environmental Impact Statement for the project will address all possible mitigation measures for the protection of all nineteen adult uhi uhi trees identified on the project site. The State Attorney General's Office has recently issued a recommendation that no federally endangered plant species can be moved or relocated. Thus, we have no intention of moving any of the uhi uhi trees, nor are we considering their relocation as a mitigation measure, unless the State law is specifically amended to permit relocation.

The water needs of the project will be fully addressed in the Draft EIS.

Finally, we have submitted our archaeological inventory survey for the project to your office and are presently awaiting its review and comment. The inventory survey will be included in the Draft EIS.

We will provide you with a copy of the Draft Environmental Impact Statement for your review and comment.

Very truly yours,

Lee William Sichter

cc: HFDC

JOHN WAIHEE
GOVERNOR

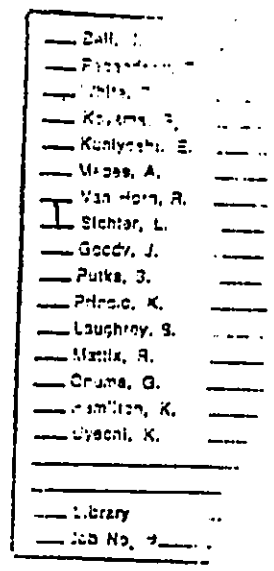
EDWARD Y. HIRATA
DIRECTOR

DEPUTY DIRECTORS
DAN T. KOCHI (PRIMARY)
RONALD N. HIRANO
JEANNE K. SCHULTZ
CALVIN M. TSUDA

IN REPLY REFER TO
HWY-PS
2.1389

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

April 17, 1990



Mr. Lee William Sichter
Senior Planner
Belt Collins and Associates
680 Ala Moana Boulevard, Suite 200
Honolulu, Hawaii 96813

Dear Mr. Sichter:

Environmental Assessment (EA)
Kealakehe Planned Community
Kealakehe, North Kona, Hawaii

Thank you for your letter of March 2, 1990, requesting our review of the subject EA.

We have the following comments:

1. We want you to be aware of our plans to have Queen Kaahumanu Highway serve as a high-speed, limited-access, 4-lane divided freeway facility with frontage roads for that region.

2. Access to the freeway will be allowed only at designated interchange locations. All other roadways will have to access onto a system of frontage roads on both sides of the freeway which will carry local traffic to these interchanges. In this area, we have determined the location of two of these interchanges, one at the Kealakehe Parkway and the other at the Keahole Airport.

3. A Traffic Impact Analysis Report (TIAR) must be submitted for our review and approval. The TIAR shall identify all short-term and long-term improvements needed to mitigate future traffic congestion.

4. All utilities within the Queen Kaahumanu Highway rights-of-way shall be underground and placed outside the edge of pavement at a location approved by the Highways Division. The required future rights-of-way (ROW) width of the highway is 300 feet and extends up to Palani Road. The developer shall dedicate a wide-enough strip of land fronting Queen Kaahumanu Highway to give us a 300-feet wide right-of-way. At the interchange at Kealakehe Parkway, we need a wider right-of-way.

5. This project should be coordinated with other developments in the immediate area. Details of the Keahole Airport Interchange should be coordinated with our Airports Division.

6. Any work within the State highway right-of-way (ROW) will require a permit and submittal of construction plans for our approval. The cost for required roadway related work within the 300-feet ROW width, including the widening of the highway to four lanes and the new interchange, shall be borne by the developer.

Very truly yours,

Edward Y. Hirata
Director of Transportation

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May 30, 1990
841.0101/90-1165

Mr. Edward Hirata
Director of Transporation
State of Hawaii
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

Dear Mr. Hirata:

Kealakehe Planned Community
Environmental Assessment and EIS Preparation Notice

Thank you for your letter of April 17, 1990 concerning the above project. We understand that Queen Kaahumanu is intended to serve as a high-speed limited access, 4-lane divided freeway with frontage roads. This is consistent with our planning efforts to date. We are also planning the location of an interchange at the intersection of Kealakehe Parkway (our mauka-makai roadway) and Queen Kaahumanu Highway, and are presently coordinating our design work with your office.

A complete traffic impact analysis is presently being prepared for the proposed project and will be included in the Draft Environmental Impact Statement.

All utilities proposed within the Queen Kaahumanu Highway right-of-way will be coordinated with your department. We are presently including in our plan a set back for the highway and the proposed interchange which will address your concerns.

The Kealakehe Planned Community is being coordinated with other developments in the area, including those proposed by the Queen Liliuokalani Trust, Palani Ranch, Robert McClean, and the State Department of Transportation's Harbors Division. We have no direct or indirect impact upon the planning and design of the Keahole Airport Interchange.

Finally, all work within State owned rights-of-way will be coordinated with your department and all appropriate permits obtained prior to commencement of construction. With regard to the cost of the improvements, we are confident that an agreement as to the cost of the improvements to be borne by the proposed project can be reached in a timely manner. To this end, a meeting between the DOT and the HFDC was held on April 5, 1990 at the Office of State Planning, to discuss among other things highway improvements and participation in costs.

We will provide you with a copy of the Draft Environmental Impact Statement for your review and comment.

Very truly yours,

Lee William Sichter

cc: HFDC

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
465 SOUTH KING STREET, ROOM 104
HONOLULU, HAWAII 96813

March 19, 1990

Honorable Joseph Conant, Executive Director
Housing Finance and Development Corporation
7 Waterfront Plaza, Suite 300
500 Ala Moana Boulevard
Honolulu, Hawaii 96813

Dear Mr. Conant:

Re: Kealakehe Planned Community

The Office of Environmental Quality Control has reviewed the Environmental Assessment for the Kealakehe Planned Community and have the following comments.

General Comments

The detailed master plan mentioned on page 6 should be included with the draft environmental impact statement in order to understand the layout of the project, planned mitigation measures, and possible impacts.

Traffic

A map of the proposed roadways and intersections should be included with overlays to show their relationship to existing resources such as the endangered uhi uhi and archaeological sites. Widths of roadways should be to scale. Will parking be provided along the roadways in front of residences or with driveways and carports? Will bicycle paths, sidewalks, and crosswalks across roadways for schoolchildren be provided? Will commuter bus service be available to mitigate traffic impacts?

Flora

We would like to note that guava, Christmas berry, lantana, and guinea grass are not native plants as stated on page 25. A complete botanical survey should be done for the draft EIS. Since a substantial percentage of the known population of the endangered mesoneuron kavaiense (uhi uhi) are found on the development site, a recovery plan should be done in conjunction with the U.S. Fish

and Wildlife Service in accordance with the Federal Endangered Species Act and the alignment and scope of the project should be adjusted appropriately.

Fauna

The faunal survey cited on page 25 should be included with the draft EIS.

Archaeology

A complete report should be included in the draft EIS with mitigation measures.

Soils

Where will topsoil come from? Will grass be planted around the residences and schools? If so, how will this affect water usage? What soil stabilization and erosion control measures will be used? A conservation plan should be completed in consultation with the U.S. Soil and Conservation Service prior to grading work and earthmoving.

Potable Water

What water conservation measures will the project use? We suggest the use of low volume toilets and shower heads. The projected need in gallons per day for the project should be estimated. Water credits does not equate into water capacity. What are the expected impacts to existing water supplies and overall water development? Where will new wells be developed? Will agricultural users be impacted?

Noise

What noise impacts will occur to the project from the proposed Honokohau Industrial Park and existing quarrying operations?

Air Quality

Air quality modeling and sampling should be included in the draft EIS. Vog, the burning landfill, increasing traffic, and the inversion layer have combined to impact air quality. School children at Kealakehe School up-slope and policemen stationed near the landfill suffer from eye and respiratory problems now. The burning landfill situation should be resolved to protect residents of this proposed residential community from chronic health problems. The contractor hired by the County to mine the landfill has failed to meet his obligations. We believe that a plan to put out the fires should therefore be included in the draft EIS as a

proposed mitigative measure.

Energy

We suggest that energy conservation measures should be explored and evaluated in the draft EIS. Solar architecture, solar water or heat pump water heaters, and low pressure sodium roadway lighting could be employed. Fluorescent fixtures could be used instead of incandescent fixtures wherever possible. Light colored roofing materials and shrubbery or shade trees provided to reduce the need for air conditioning. Homes should be oriented to take advantage of prevailing breezes and to increase solar water efficiency.

The total energy use for the project should be calculated and its impact on energy production discussed in the draft EIS. Will new power generation be needed? Where will new generating plants be located? What impact will they have on regional air quality? Are existing powerlines and substations sized sufficiently to accommodate the increased load? Will underground lines be put in to protect scenic views?

Socio-economic

The EIS should contain a socio-economic analysis to address questions of the following nature. Where are the new residents expected to come from? Will they have special needs? Will training have to be provided to workers to fill available jobs? Are sufficient hospital, medical care, and other health care facilities available to handle the increase in population that would result from this project?

Sewage

Will the State pay for the expansion of the new STP facility to meet the additional needs required for this project? The sequential batch reactor design of the County's facility is modular and can be expanded very quickly to meet the additional needs of this project without putting in a separate temporary system that might not be compatible later. The State should coordinate with the County of Hawaii Public Works Department to avoid unnecessary costs and delays. Maps showing the locations of the golf courses and proposed leach field design should be included in the draft EIS. Plans should include buffer areas near residences and appropriate spray head design to minimize aerosols. Ultraviolet disinfection of the treated effluent is suggested to kill pathogens and avoid chlorine by products. A clay soil barrier should be considered for placement under the golf courses to minimize transport of nutrients through the highly permeable bedrock. A plume model for the leach field and pan evaporation rates for the site should be included in the draft EIS.

Solid Waste

We suggest that a recycling plan should be done for the project and incorporated into the design of the transfer station. The draft EIS should address visual and odor impacts from the transfer station with appropriate mitigative measures. The transfer station should be fenced to prevent litter problems.

Fire Protection

The draft EIS should discuss whether fire hydrants will be used and whether sufficient pressure can be provided. Fountain grass on the project site should be removed or otherwise controlled to prevent impacts to homes and the endangered uhi uhi tree preserve.

Thank you for the opportunity to make comments on this environmental assessment.

Please contact Steve Holmes, staff planner, if you have any questions.

Sincerely,

Marvin T. Miura, Ph.D., Director
Office of Environmental Quality Control

BELT COLLINS
& ASSOCIATES
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May 30, 1990
841.0101/90-1156

Marvin T. Miura, Ph.D, Director
Office of Environmental Quality Control
465 South King Street, Room 104
Honolulu, Hawaii 96813

Dear Dr. Miura:

Kealakehe Planned Community
Environmental Assessment and EIS Preparation Notice

Thank you for your letter of March 19, 1990 concerning the above project.

General Comments

A detailed master plan of the proposed project will be included in the Draft Environmental Impact Statement (DEIS).

Traffic

Maps of the proposed roadways and major intersections will be included in the DEIS. Analysis of traffic impacts will include a discussion of roadway and parking standards. Concerns about street parking, bicycle paths, sidewalks and crosswalks will be addressed. While the provision of bus service to the residential areas would help to mitigate traffic impacts, its implementation lies under the jurisdiction of the County of Hawaii.

Flora

Corrections to the classification of guava, Christmas berry, lantana, and guinea grass will be made in the DEIS. A complete botanical survey will be included in the DEIS. The U.S. Fish and Wildlife Service has been notified of the existence of Uhi Uhi trees on the subject property. The Hawaii County Public Works Department has requested a biology opinion from the FWS.

Fauna

A complete faunal survey will be included in the DEIS.

Archaeology

A complete archaeological inventory survey will be included in the DEIS.

Soils

The source of topsoil and landscaping plans for the project will be discussed in the DEIS, along with soil stabilization and erosion control measures. Grading and earthmoving for the project will be conducted in a manner consistent with all pertinent regulations and requirements.

Potable Water

Provision of potable water to the proposed project will be fully addressed in the DEIS. Projected demand and conservation measures will also be discussed.

Noise

A noise impact analysis will be included in the DEIS.

Air Quality

An air quality analysis will be included in the DEIS. The closure and mining of the landfill falls under the jurisdiction of the County of Hawaii. Mining the landfill and removing its contents to a new site will likely solve the problem of underground fires. Given the permit processing time and development schedule for the project, the HFDC believes that occupancy of the first phase of the project should coincide with the County's actions to resolve the matter of underground fires.

Energy

Energy sources, projecte use and conservation measures will be addressed in the DEIS.

Socio-economic

The DEIS will include a socioeconomic impact analysis.

Sewage

The necessary expansion of the Kealakehe Sewage Treatment Plant to meet the needs of the planned community will be addressed in the DEIS. The design of the golf course as an effluent disposal area will be generally addressed. However, the actual planning and construction of the golf course/effluent disposal area will be conducted by the County of Hawaii. Although the golf course area is included in the proposed project, the land is to be transferred by Executive Order from the State to the County. Therefore, the HFDC is not in a position to discuss or evaluate the specific design of the facility.

Solid Waste

The County of Hawaii's Department of Public Works is responsible for the operation and day to day maintenance of the existing Kealakehe transfer station. While its current location is appropriate given its proximity to a landfill and relative isolation from residential development, a new alternative location may be appropriate once the area around it is developed for residential and other urban uses. The matter of the transfer station will be addressed in the DEIS.

Fire Protection

Fire hydrants will be utilized for the proposed development and will be discussed in the DEIS. The matter of controlling fountain grass will be discussed in the DEIS.

We will provide you with a copy of the Draft Environmental Impact Statement for your review and comment.

Very truly yours,

Lee William Sichter

cc: HFDC

University of Hawaii at Manoa

Environmental Center
Crawford 317 • 2550 Campus Road
Honolulu, Hawaii 96822
Telephone (808) 948-7361

March 9, 1990
RP:0122

Mr. Joseph K. Conant ✓
Housing Finance and Development Corporation
Department of Budget and Finance
Seven Waterfront Plaza, Suite 300
500 Ala Moana Boulevard
Honolulu, Hawaii 96813

Dear Mr. Conant:

Environmental Impact Statement (EIS) Preparation Notice
Kealakehe Planned Community
Kealakehe, Kailua-Kona, Hawaii

The Environmental Center has no comments on the EIS Preparation Notice, but please refer to our previous comments dated February 6, 1990 on the Environmental Assessment for the Kealakake House Lots III portion of this planned community project. We hope those comments will be helpful and we look forward to reviewing the Draft EIS.

Yours truly,

John T. Harrison
Environmental Coordinator

Enclosure

cc: OEQC
L. Stephen Lau
Carolyn Cook

HFDC 3005 (10/86)

Suspense _____

Rte		Info	Copy	Act	Init
	EXECUTIVE DIRECTOR				
	~~ADMINISTRATIVE SERVICES~~				
	PERSONNEL				
	PURCHASING				
✓	HOUSING DEVELOPMENT			BKC	
	DEVELOPMENT SUPPORT				
	SALES AND COUNSELING				
	HOUSING FINANCE				
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May 30, 1990
841.0101/90-653

Mr. John T. Harrison, Environmental Coordinator
Environmental Center, University of Hawaii at Manoa
Crawford 317, 2550 Campus Road
Honolulu, Hawaii 96822

Dear Mr. Harrison:

Kealakehe Planned Community
Environmental Assessment and EIS Preparation Notice

Thank you for letter of March 9, 1990 commenting on the above project. Your letter included reference to your previous communication (February 6, 1990) which addressed the Housing Finance and Development Corporation's Negative Declaration for a portion of the above project. On February 23, 1990, the Negative Declaration was withdrawn. Nevertheless, your comments are pertinent and timely. Allow me to update you on the status of our studies to date.

With regard to your archaeological concerns, an Archaeological Inventory Survey has been completed for the entire project area and submitted to the Department of Land and Natural Resources's Historic Sites Office. On February 26, 1990, the Historic Sites Office responded to the submittal with the comment, "we believe that this survey has adequately covered the project area...(and) that sufficient information has been gathered to evaluate the significance of the sites...We further agree with the significance evaluations offered." The entire inventory survey will be included in the Draft Environmental Impact Statement (DEIS), together with a general mitigation plan.

Concerning the proposed 300-foot corridor for a region serving mauka-makai roadway, a traffic analysis for the entire project is presently being conducted and will be included in the DEIS together with mitigation measures to address environmental impacts generated by the roadway.

With regard to the endangered Uhi Uhi trees, both the DLNR and the Federal Fish and Wildlife Service are currently reviewing the botanical survey conducted for the project, together with the project proposal, in an effort to determine appropriate mitigation measures to address impacts to the trees by residential development, including the construction and operation of the proposed roadway. The DLNR has already indicated that the trees must be preserved *in situ*. We have proposed the designation of a 5 acre preserve to protect a cluster of eight trees in the mauka portion of the project site. Additional mitigation measures for these and the remaining eleven individual trees scattered throughout the project site will be included in the DEIS along with the botanical survey.

Finally, a complete socioeconomic analysis has been prepared for the project and will also be included in the DEIS. We will provide you with a copy of the DEIS for your review.

Very truly yours,

Lee William Sichter

cc: HFDC

Bernard K. Akana
Mayor
Thomas J. Bello
Fire Chief
Edward Bumatay
Deputy Fire Chief

Fire Department

466 Kinoole Street • Hilo, Hawaii 96720 • (808) 935-2978

March 30, 1990

Mr. Lee William Sichter
Senior Planner
Belt Collins & Associates
680 Ala Moana Boulevard, Suite 200
Honolulu, Hawaii 96813

Dear Mr. Sichter:

Subject: Environmental Assessment for
Kealakehe Planned Community

The Hawaii County Fire Department's primary concern in regards to the Kealakehe Planned Community would be the proposed 5,000 housing units.

The nearest fire protection facility is the Kailua Fire Station. It provides fire, rescue and emergency medical services for approximately 7,313 housing units (1980 census) with an average annual response to 3,573 emergencies. The nearest medical facility is located in Kealakekua, Kona (Kona Hospital).

The fire rescue unit at Kailua Fire Station will be relocated to a new fire facility in Keauhou upon completion in 1993.

Fire service consideration for the Kealakehe Planned Community should include a complete fire station facility with a full complement for station manning which includes one fire apparatus with a minimum staffing of 15 firemen. For emergency medical services, one medic unit and a minimum of 7 medic personnel.

We will be glad to work with you in the planning of the facility if one is considered.

Very truly yours,

THOMAS J. BELLO
FIRE CHIEF

TJB/mo

BELT COLLINS
& ASSOCIATES

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May 30, 1990
841.0101/90-1159

Mr. Thomas J. Bello, Chief
Hawaii County Fire Department
466 Kinoole Street
Hilo, Hawaii 96720

Dear Chief Bello:

Kealakehe Planned Community
Environmental Assessment and EIS Preparation Notice

Thank you for your letter of March 30, 1990 concerning the above project. Included in the project is a 30 acre Civic Center which would serve as an appropriate location for a new fire station to serve the proposed development.

We will provide you with a copy of the Draft Environmental Impact Statement for your review and comment.

Very truly yours,

Lee William Sichter

cc: HFDC

Larry S. Tanimoto
Mayor
Hugh Y. Ono
Chief Engineer
Bruce C. McClure
Deputy Chief Engineer

Department of Public Works

25 Aupuni Street, Rm. 202 • Hilo, Hawaii 96720 • (808) 961-8321 • Fax (808) 969-7138

April 20, 1990

MR LEE WILLIAM SICHTER
SENIOR PLANNER
BELT COLLINS & ASSOCIATES
680 ALA MOANA BLVD SUITE 200
HONOLULU HI 96813

SUBJECT: ENVIRONMENTAL ASSESSMENT
KEALAKEHE PLANNED COMMUNITY
Kealakehe, N. Kona, HI

Thank you for the opportunity to review the subject document. We apologize for our tardy review. Our comments are as follows:

ROADWAYS

We feel that the existing accesses and future development along Queen Kaahumanu Highway, the closeness of Queen Kaahumanu to the makai commercial area on Palani Road, the industrial area at Kaiwi Street and the future commercial area mauka of the Queen Kaahumanu highway will necessitate a bypass in the future. The mid-level road seems to be a good candidate for a bypass if extended to Kuakini extension to the south and Kona Airport to the north. If this is a valid assumption, the mid-level road should be designated a primary arterial and access to it should be by only secondary arterials. The intersection with Palani Road should be grade-separated.

The last paragraph on Page 33 seems to indicate that the mauka-makai connector road is an unsure undertaking at the present time. The commitment to construct a mauka-makai road should be made.

How was the location of the mauka-makai road arrived at? We question whether it would be used by commuters since the existing Palani Road is a more direct route to Kailua. Moreover, the proposed mauka-makai road has a 50% longer distance to Palani Road. To the north is a planned road in close proximity to the mauka-makai road at the Mamalahoa Highway. Commuters traveling to the north would probably take this road instead of the proposed mauka-makai road.

The access to the school should be addressed because the school will be a major destination point for the area residents.

A traffic impact assessment report should be done to determine the impact on existing streets.

LANDFILL

Our Puuanahulu landfill is projected to be in operation by August 1991. The development should consider that the Kealakehe landfill emits fumes that may last for a very long time. An indication of this is that the EPA requires a 30-year monitoring and maintenance period. In order to use the landfill, the refuse would probably have to be dug up and removed.

David Murakami
for ROBERT K. YANABU, Division Chief
Engineering Division

DHM:sah

cc: DPW Traffic Division
Planning Department
Office of Housing & Community Development

BELT COLLINS
& ASSOCIATES
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May 30, 1990
841.0101/90-1164

Mr. Robert K. Yanabu, Division Chief
Engineering Divison
Department of Public Works
County of Hawaii
25 Aupuni Street, Room 202
Hilo, Hawaii 96720

Dear Mr. Yanabu:

Kealakehe Planned Community
Environmental Assessment and EIS Preparation Notice

Thank you for your letter of April 20, 1990 concerning the above project. It is our present understanding that since your letter, the County of Hawaii has eliminated the Queen Kaahumanu Bypass from its Keahole to Kailua Draft Development Plan. The current plan for the Kealakehe Planned Community is consistent with this modification and depicts the mid-level roadway as a secondary arterial which will eventually tie into the mid-level roadway configuration planned by the Queen Liliuokalani Trust across its property.

The HFDC is committed to the construction of the mauka-makai roadway and Belt Collins and Associates are presently working on detailed roadway design plans. The location of the mauka-makai roadway was determined by a Task Force appointed by Governor Waihee and consisting of Harold Matsumoto of the Office of State Planning; Ed Hirata, Director of the Department of Transportation, Joseph Conant, Executive Director of HFDC, Scott Leithead of the County's Office of Housing and Community Development, Duane Kanuha, County Planning Director, Councilman Russell Kokubun and Councilman Harry Ruddle. For all intents and purposes, the location of the roadway should be considered fixed.

Access to the both the elementary and high school proposed in the plan will be provided. HFDC has been advised that the high school is the Department of Education's highest priority and should be implemented as soon as practicable.

A complete traffic impact analysis is presently being prepared for the proposed project and will be included in the Draft Environmental Impact Statement.

With regard to the landfill, one of the reasons contributing to the decision of the Housing Finance and Development Corporation (HFDC) to develop affordable housing at Kealakehe was an understanding that the County would soon be closing the Kealakehe landfill, relocating it to a new site at Puuanahulu, and mining the Kealakehe landfill as a means of recovering recyclable material and extinguishing the fires. It is believed that this timely action will greatly reduce, if not eliminate, the source of the odor problem. Thus, the HFDC feels that odor problems related to the landfill are the responsibility of the operator, in this case the County of Hawaii, and that mitigation measures to address the problem will be undertaken in a timely manner.

We will provide you with a copy of the Draft Environmental Impact Statement for your review and comment.

Very truly yours,

Lee William Sichter

cc: HFDC

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAII
25 AUPUNI STREET • HILO, HAWAII 96720
TELEPHONE (808) 969-1421 • FAX (808) 969-6996

March 8, 1990

Belt Collins & Associates
680 Ala Moana Boulevard, Suite 200
Honolulu, HI 96813

ENVIRONMENTAL ASSESSMENT
KEALAKEHE PLANNED COMMUNITY

Thank you for giving us the opportunity to comment on the environmental assessment.

Water will be available upon completion of the off-site water system improvements being coordinated by the Department of Water Supply and State's Housing Finance and Development Corporation.

H. William Sewake
Manager

CS

BELT COLLINS
& ASSOCIATES
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Landscape Architecture

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May 30, 1990
841.0101/90-657

Mr. H. William Sewake, Manager
Department of Water Supply
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Sewake:

Kealakehe Planned Community
Environmental Assessment and EIS Preparation Notice

Thank you for your letter of March 8, 1990 concerning the above project. We will provide you with a copy of the Draft Environmental Impact Statement for your review and comment.

Very truly yours,

Lee William Sichter

cc: HFDC

RECEIVED
MAR 29 1990
BELT, COLLINS & ASSOCIATES

Bernard K. Akana
Mayor
Victor V. Vierra
Chief of Police
Francis C. DeMorales
Deputy Chief of Police

Police Department

349 Kapiolani Street • Hilo, Hawaii 96720-3998 • (808) 961-2244 • FAX (808) 961-2702

March 27, 1990

Mr. Lee William Sichter
Senior Planner
Belt Collins & Associates
680 Ala Moana Blvd., Suite 200
Honolulu, Hawaii 96813

Subject: Environmental Assessment
Kealakehe Planned Community
Kealakehe, N. Kona, Hawaii

Dear Mr. Sichter:

The above subject matter has been reviewed and the following recommendations are noted for your consideration:

1. Present roadways should be widened and improved in design before the start of construction as they are inadequate for traffic. They are unable to take on further burden without serious consequences.

   a. Queen Kaahumanu Highway widened to four lanes from Hualalai Road intersection to 1/4 mile beyond Keahole Airport in the northerly direction.

   b. An overpass for through traffic on Queen Kaahumanu Highway at the Honokohau Small Boat Harbor entrance with entry, exit, and turn lanes for entry into the project. Side roads under the overpass should have traffic lights to control traffic entry/exit onto Queen Kaahumanu Highway.

   c. The widening of Palani Road from two lanes to four lanes from the main entry of the project to Kealakehe School (Kealakaa) intersection. Traffic signals at Kealakaa and the other two entries into the project area on Palani Road with left turn, acceleration and deacceleration lanes provided at each intersection.

   d. Traffic signals are presently needed at the police station, sewage treatment/Queen Kaahumanu intersection.

e. Police equipment, manpower, and civilian support personnel will have to be addressed from the start of this project rather than after the fact, so that overtime can be minimized, morale kept high, adequate services provided, injuries kept low, vicarious liability suits and other lengthy court litigation kept at a minimum. Without this, the present support to the police provided by this community will diminish.

Thank you for the opportunity to comment.

Sincerely,

VICTOR V. VIERRA
CHIEF OF POLICE

lli

cc: Major Henry Silva

BELT COLLINS
& ASSOCIATES
Engineering • Planning
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May 30, 1990
841.0101/90-1161

Mr. Victor V. Vierra
Chief of Police
County of Hawaii
349 Kapiolani Street
Hilo, Hawaii 96720-3998

Dear Chief Vierra:

Kealakehe Planned Community
Environmental Assessment and EIS Preparation Notice

Thank you for your letter of March 27, 1990 concerning the above project. Following are responses to your specific comments:

Widening of Roadways

While we agree that the proposed project will have an impact on existing roadways, we do not agree that widening roadways before the start of construction is the only solution. A full traffic impact study, together with recommendations for mitigating the impacts of the project will be included in the Draft Environmental Impact Statement.

Queen Kaahumanu Highway

The HFDC agrees that the highway will eventually need to be widened, and is prepared to dedicated up to 300 feet of additional right-of-way for this purpose. The construction of additional lanes should be timed with the phased development of the proposed project.

Overpass at Queen Kaahumanu Highway at the Small Boat Harbor

The HFDC is committed to the development of a new mauka-makai roadway through the subject property and the construction of a grade-separated intersection at its intersection with Queen Kaahumanu Highway. However, discussions with the State Department of Transportation has indicated that the development of the interchange should be done in conjunction with the phased development of the project. Initially, stacking lanes at the existing intersection will be sufficient to accommodate increases in traffic brought on by the project's first phase. Eventually, frontage roads (side roads) will be necessary to improve traffic flow on Queen Kaahumanu. We are advised by the State DOT that traffic lights will not be allowed on the highway due to the DOT's intent to preserve the highway as a high-speed corridor.

Palani Road Widening

We agree that a traffic signal will be needed at the Kealakaa Street intersection and are advised that the HFDC will provide one as part of the major roadway construction. The provision of acceleration and deceleration lanes will depend upon the timely acquisition of additional right-of-way on Palani Road by the County of Hawaii from the Queen Liliuokalani Trust.

At this time, only one additional entry is planned at Palani Road; about 4,200 feet makai of the

Kealakaa Street intersection. Because the residential development adjacent to this intersection is planned as the very last phase of the project (Villages 13 and14), we do not expect the need for intersection improvements within the next 10-15 years. However, upon implementation of the last phase of development appropriate improvements to the intersection will be made.

The third entry to the project to which you refer is the mid-level roadway proposed by the County of Hawaii and reflected on the Kealakehe Planned Community Plan. It is our understanding that the portion of the mid-level roadway intersecting with Palani Road is intended to be constructed as part of the Queen Liliuokalani Trust's development master plan. However, we are unaware of the Trust's development schedule and have not been advised whether the Trust or the County will make the appropriate improvements to the mid-level roadway intersection at Palani Road.

Traffic Signals at Queen Kaahumanu

As discussed above, we are advised by the State DOT that traffic signals will not be allowed on the highway.

We will provide you with a copy of the Draft Environmental Impact Statement for your review and comment.

Very truly yours,

Lee William Sichter

cc: HFDC

Bernard K. Akana
Mayor
Duane Kanuha
Director
William L. Moore
Deputy Director

Planning Department

25 Aupuni Street, Rm. 109 • Hilo, Hawaii 96720 • (808)-961-8288

March 23, 1990

Dr. Marvin T. Miura, Director
Office of Environmental Quality Control
465 South King Street
Kekuanaoa Building, #104
Honolulu, HI 96813

Dear Dr. Miura:

Comments - EISPN Kealakehe Planned Community

We have reviewed the EISPN for the subject project and provide the following comments:

GENERAL

1. The EIS should identify the accepting authority.

2. The EIS should include discussion on the relationship of the proposed action to State and County land use plans, policies and guidelines.

3. The EIS should include all reports of surveys (flora, fauna, archaeology, etc.) conducted for the project, including any mitigation plans.

4. The EIS should include any unresolved issues.

PROJECT DESCRIPTION

5. A conceptual map of the planned community should be included in the EIS. A clearer map of Figure 4 - Land Ownership should be used.

6. It has been our understanding that the master plan will include over-sizing infrastructure through and for the subject property to provide adequate capacity to urbanize the Kealakehe lands below the Queen Kaahumanu Highway. This should be so stated if it is to be part of the master plan.

7. The golf course has been relocated into the area above the Queen Kaahumanu Highway in Kealakehe at the request of the State. This use should be acknowledged since it is within the boundaries of the Kealakehe Planned Community.

LAND USE PLANS

8. The updated County of Hawaii General Plan Land Use Pattern Allocation Guide (LUPAG) Map designates the area as Low Density Urban, Industrial and Urban Expansion. Portions of the project area are also zoned Unplanned by the County. The EIS should reflect these designations.

9. The EIS should address the draft Keahole to Kailua Development Plan which is now under review and discussion with the County Planning Commission for its recommendation to the County Council for adoption as ordinance. This plan should be acknowledged, and any differences between the draft plan and the Kealakehe Planned Community plans should be identified.

ENVIRONMENTAL DESCRIPTION/MITIGATION MEASURES

10. There are conflicting statements of Hualalai's volcanic history on Page 22(EA) and Page 6 & 7(EISPN) which the EIS needs to clarify and include documents to support the statements.

11. The EIS should describe the soil classification in further detail.

12. A clearer discussion on introduced vegetation and native vegetation needs to be made. The EIS should include a list of plants likely to be utilized for landscaping.

13. Should any lava tubes be encountered during planning/design and/or construction, as mitigation measures, the Historic Sites Division of the DLNR should be contacted.

14. Due to recent problems from the Kealakehe landfill at the Police Station, the State Department of Health should be contacted for any available results on air quality concerns, and such description should be included in the EIS.

15. A detailed discussion on the water demand for potable water and non-potable water (if any for landscaping) needs to be included in the EIS. The definition of "credit" needs to be further clarified.

16. The EIS should address noise quality during construction and include any mitigation measures. There are no noise regulations applicable to this project which are intended to minimize impact on surrounding developed areas as described on Page 35.

17. The temporary sewer system should be described in the EIS.

TRANSPORTATION

18. The County General Plan does not provide specific right-of-way dimensions as attributed on Page 17.

19. The State Department of Transportation has indicated to us that all access off the Queen Kaahumanu Highway will be via frontage roads except for interchanges at Keahole Airport and at the Kealakehe access road. This should be included in the EIS.

20. The Keahole to Kailua Development Plan draft indicates other north-south roads which run through Kealakehe, including "Main Street" and "Waena Drive" and an extension of Kealakaa Street. These roadway proposals should be included in the analysis of traffic and circulation impacts of the proposed project.

ALTERNATIVES

21. The land use plan shown in the Keahole to Kailua Development Plan should be discussed and analyzed as an alternative to the proposed Kealakehe land use concept. Since this is a State owned property, the range of uses should extend beyond the immediate interest of the HFDC and should include all feasible development, including the land use pattern proposed in the Keahole to Kailua Development Plan.

Thank you for the opportunity to review and comment on the EISPN for the proposed Kealakehe Planned Community.

Sincerely,

DUANE KANUHA
Planning Director

AK:syw

cc: Mr. Carleton Ching, HFDC
Honorable Bernard K. Akana, Mayor

BELT COLLINS
& ASSOCIATES
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May 30, 1990
841.0101/90-1167

Mr. Duane Kanuha, Planning Director
Hawaii County
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Kanuha:

Kealakehe Planned Community
Environmental Assessment and EIS Preparation Notice

Thank you for your letter of March 23, 1990 concerning the above project. The Draft Environmental Impact Statement will include all those components required by Chapter 343, Hawaii Revised Statutes, including identification of the accepting authority, relationship to State and County plans and policies, all subconsultant reports and mitigation plans, and a discussion of unresolved issues.

A conceptual map of the project configuration will be included in the Draft EIS.

Infrastructure for the proposed project will be oversized to accommodate development makai of the Queen Kaahumanu Highway, although such development is not part of the present project. This is being done to minimize the future costs of infrastructure development.

The HFDC has provided the Hawaii County Department of Public Works a layout of the proposed golf course to be located within the project. The golf course will serve as an effluent disposal area for the County sewage Treatment Plant presently under construction makai of the Queen Kaahumanu Highway.

The Draft EIS will reflect the present State and County land use designations affecting the proposed project area. It will also discuss the Draft Keahole to Kailua Development Plan.

The statements contained in the project's Environmental Assessment (EA) and Environmental Impact Statement Preparation Notice (EISPN) are not in conflict as suggested in your letter. The EA states that the project site consists of lavas from Hualalai from 3 to 5 thousand years old. The EISPN states that the last eruption of Hualalai occurred in 1801. The resultant lava flow, however, does not cross the subject property.

The Draft EIS will discuss the project's soil classifications and vegetation in greater detail. A list of plants likely to be used for landscaping is included in the Flora Survey for the project which will be included in the Draft EIS.

Construction of the project will be conducted according to all appropriate standards of practice. This includes the notification of the Historic Sites Division of the DLNR, should any lava tubes or archaeological features previously unknown be encountered.

An Air Quality study of the proposed project is presently being conducted and will be included in the Draft EIS.

A detailed discussion of the project's water demand and current water commitments or "credits" will be included in the Draft EIS.

A study of noise impacts is presently being conducted and will be included in the Draft EIS. Temporary and permanent sewer systems will also be discussed.

With regard to the matter of right-of-way dimensions discussed in the General Plan, at the time the EA was published, the County's Revised General Plan included a proposed revision reflecting the State DOT's request for additional right-of-way at Queen Kaahumanu Highway. Since the EA publication, the Revised General Plan has been adopted by the County Council. We have contacted your office to request a copy of the Revised Plan but have been told that its publication date is unknown. At this time we are unclear revision concerning additional right-of-way for the Queen Kaahumanu Highway was included in the Final Revised General Plan as adopted by the Council. We will attempt to resolve this matter in the Draft EIS.

The traffic circulation plan for the proposed project will be fully coordinated with the State DOT and will be discussed in the Draft EIS. Major roadways and land uses included in the most current Keahole to Kailua Draft Development Plan will be discussed in the Draft EIS.

Finally, alternatives to the HFDC proposal will be included in the DEIS.

We will provide you with a copy of the Draft Environmental Impact Statement for your review and comment.

Very truly yours,

Lee William Sichter

cc: HFDC

HELENE H. HALE
Councilwoman

COUNTY COUNCIL
County of Hawaii
Hawaii County Building
25 Aupuni Street
Hilo, Hawaii 96720

March 7, 1990

Lee William Sichter, Senior Planner
Belt Collins And Associates
680 Ala Moana Blvd., Suite 200
Honolulu, HI 96813

Dear Mr. Sichter

Thank you for providing me with the Environmental Assessment Kealakehe Planned Community Kealakehe, North Kona, Hawaii project being planned for the state. I hope your EIS addresses adequately the impact on Palani Road during construction; also the impact of the landfill on air quality.

Alternatives could be, no housing constructed until a mauka makai connector road is built starting at Queen Kaahumanu Highway. No housing constructed until the Kailua landfill odor problem are solved or the site moved.

Yours truly,

Helene H. Hale
Councilwoman

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Blvd., Suite 200, Honolulu, Hawaii 96813
Phone: 808-521-5361, Telex: BELTH 7430474, Fax: 808-538-7819
Hawaii • Singapore • Australia • Hong Kong • Saipan

May 30, 1990
841.0101/90-659

The Honorable Helene H. Hale
Councilwoman
County Council
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Councilwoman Hale:

Kealakehe Planned Community
Environmental Assessment and EIS Preparation Notice

Thank you for your letter of March 9, 1990 concerning the above project. The Draft Environmental Impact Statement (DEIS) will address the impact of the project upon Palani Road and will include recommendations to mitigate significant impacts to the roadway.

With regard to the Kealakehe landfill, one of the reasons contributing to the decision of the Housing Finance and Development Corporation (HFDC) to develop affordable housing at Kealakehe was an understanding that the County would soon be closing the Kealakehe landfill, relocating it to a new site at Puuanahulu, and mining the Kealakehe landfill as a means of recovering recyclable material and extinguishing the fires. It is believed that this timely action will greatly reduce, if not eliminate, the source of the odor problem. Thus, the HFDC feels that odor problems related to the landfill are the responsibility of the operator, in this case the County of Hawaii, and that mitigation measures to address the problem will be undertaken in a timely manner.

Please be advised that the HFDC is attempting to construct the mauka-makai connector road simultaneously with the development of the first residential phase. It is hoped that completion of the two projects will coincide. Subsequent development will also be phased in a manner that will forestall residential development in the immediate vicinity of the landfill. Development is intended to begin adjacent to the existing Kealakehe community and move downslope at the rate of approximately 250 units per year. At this rate, residential development in proximity of the landfill should not occur until well after its closure. In addition, the landfill area will be buffered by the proposed golf course as a further means of mitigating the short-term impacts of land fill closure.

We will provide you with a copy of the Draft Environmental Impact Statement for your review and comment.

Very truly yours,

Lee William Sichter

cc: HFDC

HAWAII CONFERENCE FOUNDATION
Telephone 53[illegible]-9516 • 15 Craigside Place • Honolulu, Hawaii 9681[illegible]

March 23, 1990

Mr. Lee William Sichter
Belt Collins & Associates
680 Ala Moana Blvd., Suite 200
Honolulu, Hawaii 96813

Dear Mr. Sichter:

Thank you for sending along the Environmental Assessment for the Kealakehe Planned Community.

From what I can discern, it does not appear that the project will abut any of our church land. The only readily apparent impact that attendees at our local Lailua-Kona churches might sustain could be a greater crowding of the highways, particularly Palani Road.

Thank you for including us in your request for comments.

Very truly yours,

James A. Richards
Executive Secretary

JAR:st

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

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May 30, 1990
841.0101/90-1157

Mr. James A. Richards, Executive Secretary
Hawaii Conference Foundation
15 Craigside Place
Honolulu, Hawaii 96817

Dear Mr. Richards:

Kealakehe Planned Community
Environmental Assessment and EIS Preparation Notice

Thank you for your letter of March 23, 1990 concerning the above project. As proposed, the project will include a new mauka-makai roadway which will help to relieve traffic from Palani Road.

We will provide you with a copy of the Draft Environmental Impact Statement for your review and comment.

Very truly yours,

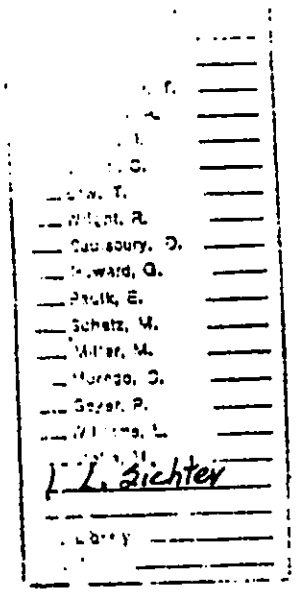
Lee William Sichter

cc: HFDC

Hawaii Electric Light Company, Inc. • PO Box 1027 • Hilo, HI 96721-1027

BELT, COLLINS & ASSOCIATES

April 5, 1990



Belt Collins & Associates
680 Ala Moana Boulevard, Suite 200
Honolulu, Hawaii 96813

Attention: Mr. Lee Sichter

Gentlemen:

Subject: Environmental Assessment
Kealakehe Planned Community
North Kona, Hawaii

Thank you for the opportunity to review the subject Environmental Assessment. The project is in the Kailua-Keahole Development plan proposed by the County of Hawaii Planning Department. Our comments were provided to Duane Kanuha, copy attached, which are relative to the overall project.

The estimated 21,000 KVA demand load for the community will have a major impact on HELCO's system. This load will require new 69KV transmission line(s) from Keahole-Kailua and a major substation. The 12KV distribution systems along Palani Road and Queen Kaahumanu Highway are inadequate to accommodate the load.

HELCO requires that the developer make a contribution for the electrical work:

A. Off-Site Electrical Work:

Participate with other developers in defraying the cost of a new 69KV transmission line and provide a corridor with utility easements from Keahole to Kailua.

B. On-Site Electrical Work:

1. Pay for two (2) 10MVA/12KV substation transformer minimum required to serve the project.

2. Dedicate a substation lot in fee to HELCO.

3. Provide an access road to the substation lot from Palani Road or Queen Kaahumanu Highway constructed in accordance with the State Highway Standards.

4. Contribute to the cost of the new 69KV transmission line drop, substation and 12KV distribution system.

The developer is requested to pay 10% of the project's rough cost estimate 18 months in advance of the projects requirement date for engineering work. This is to allow HELCO sufficient lead time to obtain PUC approval before ordering long lead items and upgrading the off-site facilities to accommodate the new load. Plans showing service locations, estimated KVA load and roadways are required for this work.

We encourage that energy conservation features suitable to reduce peak demand be considered in the planned community. For example, fluorescent lighting should be used in buildings and sodium lighting for parking lots and roadways. Our Administration Department is prepared to assist you in providing rate analysis and other recommendations regarding the heating and cooling needs of the planned community. Contact Tom Goya, Director of Customer and Consumer Service Administration Department at 969-0131.

If there are any questions on this, please call me at 969-0323.

Very truly yours,

Melvin S. Yamaki

Melvin S. Yamaki
Electrical Engineer
Planning Division

MSY:ts

Enclosures

cc: C. Nagata
H. Kamigaki
T. Goya

BELT COLLINS
& ASSOCIATES
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May 30, 1990
841.0101/90-1163

Mr. Melvin S. Yamaki
Planning Division
Hawaii Electric Light Company, Inc.
P.O. Box 1027
Hilo, Hawaii 96721-1027

Dear Mr. Yamaki:

Kealakehe Planned Community
Environmental Assessment and EIS Preparation Notice

Thank you for your letter of April 5, 1990 concerning the above project. We understand that the proposed project will require a new region-serving 69KV transmission line offsite, as well as two 10MVA/12KV substation transformers. HELCO will also require a substation lot dedicated in fee with appropriate access but has not indicated whether it should be located within the project area. Once the master plan for the proposed project has been finalized, representatives of the HFDC will meet with your staff to determine an appropriate location for the substation. The Draft Environmental Impact Statement will include a discussion of energy conservation measures to be utilized in the proposed project.

We will provide you with a copy of the Draft Environmental Impact Statement for your review and comment.

Very truly yours,

Lee William Sichter

cc: HFDC

BELT, COLLINS & ASSOCIATES

HAWAII LEEWARD PLANNING CONFERENCE

P.O. BOX 635 • KAILUA-KONA, HAWAII 96745-0635

March 19, 1990

Lee William Sichter
Senior Planner, Belt Collins & Associates
680 Ala Moana Blvd., Suite 200
Honolulu, HI 96813

Dear Mr. Sichter:

I have reviewed the Environmental Assessment for the Kealakekua Planned Community. In preparing the EIS the major environmental problem in Kealakekua is the sanitary landfill and its on going fire. Major consideration must be given to this issue.

Thank you for this opportunity to comment. Please keep me informed.

Sincerely,

H. Peter L'Orange
President

HPL:sjs

OFFICE: POTTERY TERRACE, ORCHID BLDG. #226, KAILUA-KONA • PHONE 329-2334 • FAX 329-7108

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May 30, 1990
841.0101/90-652

Mr. Peter L'Orange
Hawaii Leeward Planning Conference
P.O. Box 635
Kailua Kona, Hawaii 96745-0635

Dear Mr. L'Orange:

Kealakehe Planned Community
Environmental Assessment and EIS Preparation Notice

Thank you for letter of March 19, 1990 commenting on the above project. We agree that the sanitary landfill at Kealakehe is a major environmental problem. The proposed project takes this into account. Development implementation will be phased in a manner that will forestall residential development in the immediate vicinity of the landfill. Development is intended to begin adjacent to the existing Kealakehe community and move downslope at the rate of approximately 250 units per year. At this rate, residential development in proximity of the landfill should not occur until well after its closure. In addition, the landfill area will be buffered by the proposed golf course as a further means of mitigating the short-term impacts of land fill closure.

One of the reasons contributing to the decision of the Housing Finance and Development Corporation (HFDC) to develop affordable housing at Kealakehe was an understanding that the County would soon be closing the Kealakehe landfill, relocating it to a new site at Puuanahulu, and mining the Kealakehe landfill as a means of recovering recyclable material and extinguishing the fires. It is believed that this timely action will greatly reduce, if not eliminate, the source of the odor problem. Thus, the HFDC feels that odor problems related to the landfill are the responsibility of the operator, in this case the County of Hawaii, and that mitigation measures to address the problem will be undertaken in a timely manner.

We will provide you with a copy of the Draft Environmental Impact Statement for your review and comment. Thank you for participating in the review process.

Very truly yours,

Lee William Sichter

cc: HFDC

CHAPTER XI

CHAPTER XI
REFERENCES

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CHAPTER XII

CHAPTER XII

COMMENTS RECEIVED DURING THE DRAFT EIS COMMENT PERIOD AND RESPONSES

CONSULTED PARTIES

An announcement of the availability of the Draft Environmental Impact Statement (DEIS) for the proposed Kealakehe Planned Community was published in the OEQC Bulletin by the Office of Environmental Quality Control on July 23, 1990. The agencies, organizations, and individuals listed below were sent copies of the DEIS with a request for their comments on the project. Those believed to have an interest in the project or who requested consulted party status were mailed a copy of the report. Parties that replied are marked with an asterisk (*), and these letters are reproduced, along with responses to them, in the following pages.

Federal Agencies

* Soil Conservation Service, U.S. Department of Agriculture
Fish and Wildlife Service, U.S. Department of the Interior
National Park Service, U.S. Department of the Interior
Geological Survey, Water Resources Division, U.S. Department of the Interior
Regional Division, United States Environmental Protection Agency, Region IX
* Facilities Engineer, U.S. Army
* Facilities Engineer, U.S. Navy
U.S. Coast Guard

State Agencies

* Department of Accounting and General Services
* Department of Agriculture
* Department of Business and Economic Development
Department of Business and Economic Development, Library
Department of Budget and Finance
* Department of Defense
Department of Education
Department of Hawaiian Home Lands
Department of Health
* Department of Land and Natural Resources
Department of Land and Natural Resources, State Historic Preservation Officer
Department of Transportation
Office of Environmental Quality Control
* Office of Hawaiian Affairs
Office of State Planning
* Environmental Center, University of Hawaii at Manoa
Water Resources Research Center, University of Hawaii at Manoa

University of Hawaii at Hilo
State Archives
State Energy Office

State Legislators

Senator Andrew Levin
Senator Malama Solomon
Representative Harvey S. Tajiri
Representative Dwight Takamine
Representative Mike O'Kieffe
Senator Richard M. Matsuura
Representative Jerry L. Chang
Representative Wayne Metcalf
* Representative Virginia Isbell

Hawaii County Agencies

Civil Defense Agency
* Department of Parks and Recreations
Department of Research and Development
Hawaii Redevelopment Agency
* Office of Housing and Community Development
Fire Department
* Department of Public Works
* Department of Water Supply
* Police Department (officers)
* Planning Department

Hawaii County Elected Officials

Mayor Larry Tanimoto
Councilman Takashi Domingo
Councilwoman Lorraine Inouye
Councilman Robert Makuakane
Councilman Spenser Schutte
Councilman Russel Kokubun
Councilwoman Helene Hale
Councilwoman Merle Lai
Councilman Harry Ruddle
Councilman Stephen Yamashiro

Public Utilities

Hawaiian Telephone Company
* Hawaii Electric Light Company, Inc.
The Gas Company, Hawaii Division

Community Organizations

Alu Like, Inc.
American Lung Association
Big Island Business Council
Hawaii Audubon Society
Hawaii Conference Foundation
Hawaii Hotel Association, Big Island Chapter
Hawaii Island Board of Realtors
Hawaii Island Chamber of Commerce
Hawaii Island Economic Development Board
Hawaii Island Portuguese Chamber of Commerce
* Hawaii Leeward Planning Conference
Hawaii Visitor's Bureau, Big Island Chapter
Kona-Kohala Chamber of Commerce
Life of the Land, Big Island Chapter
Moku Loa Group, Sierra Club

Na Ala Hele
Native Hawaiian Legal Corporation
Sierra Club Legal Defense Fund

LIBRARIES

University of Hawaii Library, Hawaiian Collection
Legislative Reference Bureau
Kaimuki Regional Library
Kaneohe Regional Library
Pearl City Regional Library
Hilo Regional Library
Wailuku Regional Library
Lihue Regional Library
Holualoa Library
Honokaa Library
Kailua-Kona Library

MEDIA

Honolulu Advertiser
Sun Press
Hawaii Tribune Herald
West Hawaii Today

The following individuals submitted comments based upon an informational meeting held at the Kealakehe Police Station on September 4, 1990.

* John Dawrs
* Daniel J. Minan
* Mellaney L. Bean
* Sherri Kunitomo
* Mrs. Jamie Takimoto
* Blane S. Takamine
* Wendy Butterworth (included petition with 69 names supporting Ms. Butterworth's comments)
* State of Hawaii Organization of Police Officers

DEPARTMENT OF BUSINESS
AND ECONOMIC DEVELOPMENT

JOHN WAIHEE
GOVERNOR
ROGER A. ULVELING
DIRECTOR
BARBARA KIM STANTON
DEPUTY DIRECTOR
LESLIE S. MATSUBARA
DEPUTY DIRECTOR

BETT COLLINS & ASSOCIATES

ENERGY DIVISION, 335 MERCHANT ST., RM 110, HONOLULU, HAWAII 96813 FAX: (808) 531-5243 ENERGY HOTLINE: (808) 548-4080

August 1, 1990

The Honorable John Waihee
Governor, State of Hawaii
c/o Office of Environmental
Quality Control
465 South King Street, Room 104
Honolulu, Hawaii 96813

Dear Governor Waihee:

Subject: Kealakehe Planned Community, Draft Environmental Impact Statement (DEIS)

We have reviewed the above DEIS and found it to contain a very complete treatment of energy impacts, with the exception of the fact that it does not mention the possibility of geothermal-produced electricity as a source of energy for the project. Given the fact that considerable activity is underway to develop geothermal power on the Island of Hawaii, it should be mentioned as a likely source of electricity for the project.

Sincerely,

Roger A. Ulveling

RAU/PE:dki
cc: Housing Finance & Development Corporation
Bett Collins and Associates

Effective July 1, 1990, the department name has been changed to Department of Business, Economic Development & Tourism

BCA
BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

[illegible] Ala Moana Blvd., Suite [illegible] Honolulu, Hawaii [illegible]
Phone: (808) 521-5361, Telex: BELTH [illegible], Fax: (808) [illegible]
Hawaii • Singapore • Australia • Hong Kong • Guam

September 12, 1990
841.0101/1898

Mr. Roger Ulveling, Director
Department of Business, Economic Development and Tourism
State of Hawaii
Energy Division
335 Merchant Street, Room 110
Honolulu, Hawaii 96813

Dear Mr. Ulveling:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for your comments concerning the above project. A discussion of the proposed project's energy impacts is presented in Section 8 of Chapter 6 in the EIS. This discussion focuses on the projected demand for electrical power. It was assumed in the EIS that the future supply of electrical energy on the Big Island may be derived from a number of resources including fossil fuels, biomass, wind energy, geothermal and perhaps even OTEC. The decision to develop these various alternate resources and their implemenation timeframe will be based upon a number of economic, social and political factors which are beyond the control of the proposed project. Thus, the extent of probable energy impacts was defined in terms of the project's ability to influence levels of demand for energy within the property boundaries rather than sources of supply beyond the scope of the proposed development.

The text within Section 8.1 of Chapter 6 of the document has been amended to include your recommendation. Thank you for your comments.

Very truly yours,

Lee William Sichter

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 621
HONOLULU, HAWAII 96809

WILLIAM W. PATY, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
KEITH W. AHUE
MANABU TAGOMORI
RUSSELL N. FUKUMOTO

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

REF:OCEA:JN

FILE NO.: HA-7/9/90-2371
DOCUMENT NO.: 8728E

AUG 2 1990

Mr. Lee Sichter
Belt Collins and Associates
680 Ala Moana Blvd.
Suite 200
Honolulu, Hawaii 96813

Dear Mr. Sichter:

This letter is to acknowledge our receipt of your Draft Environmental Impact Statement (EIS) for Kealakehe Planned Community located at North Kona, Hawaii. In conjunction with the Office of Environmental Quality Control (OEQC), we will be distributing the document in accordance with Chapter 343 HRS and its implementing Administrative Rules; Title 11, Chapter 200, such that the public may have an opportunity to comment on it.

May we request that you maintain close contact with OEQC, such that you will be aware of the proper procedures to be followed in this process.

Should you have any questions, please feel free to contact our Office of Conservation and Environmental Affairs staff at 548-7837.

Very truly yours,

WILLIAM W. PATY

BCA
BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

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September 12, 1990
841.0101/1898

Mr. William W. Paty, Chairman
Board of Land and Natural Resources
State of Hawaii
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Paty:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for your comments concerning the above project. We have had numerous discussions to date with staff of the Office of Environmental Quality Control to ensure compliance with Administrative Rules; Title 11, Chapter 200 and provide for public review of the DEIS.

Very truly yours,

Lee William Sichter

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

August 2, 1990

Engineering Office

Governor, State of Hawaii
c/o OEQC
465 South King Street, Rm 104
Honolulu, Hawaii 96813

Dear Governor Waihee:

Kealakehe Planned Community with Appendix (DEIS)
Kealakene, North Kona, Hawaii

Thank you for providing us the opportunity to review the above subject project.

We have no comments to offer at this time regarding this project.

Sincerely,

Jerry M. Matsuda
Lieutenant Colonel
Hawaii Air National Guard
Contracting and Engineering Officer

cc: State of Hawaii-Housing
Finance & Development Corp.
Belt Collins and Associates
OEQC w/EIS

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

September 12, 1990
841.0101/1898

Lieutenant Colonel Jerry M. Matsuda
Contracting and Engineering Officer
Hawaii Air National Guard
State of Hawaii
3949 Diamond Head Road
Honolulu, Hawaii 96816-4495

Dear Lt. Colonel Matsuda:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for taking the time to review the above project. Should you require any additional information, please feel free to contact me.

Very truly yours,

Lee William Sichter

DEPARTMENT OF THE NAVY
COMMANDER
NAVAL BASE PEARL HARBOR
BOX 110
PEARL HARBOR, HAWAII 96860-5020

RECEIVED
JUL 25 1990
BELT, COLLINS & ASSOCIATES

IN REPLY REFER TO

5090
Ser 00F2/2545
23 JUL 1990

Marvin T. Miura, Ph.D.
Office of Environmental Quality Control
465 S. King St., Room 104
Honolulu, Hawaii 96813

Dear Dr. Miura:

KEALAKEHE PLANNED COMMUNITY

The Draft Environmental Impact Statement (DEIS) for Kealakehe Planned Community, Kealakehe, North Kona, Hawaii, has been reviewed, and we have no comments to offer. Since we have no further use for the DEIS, it is being returned to your office.

Thank you for the opportunity to review the draft.

Sincerely,

D. MASH
[illegible], CEC, U.S. Navy
[illegible] Civil Engineer
By direction of
the Commander

Encl
(1) DEIS

Copy to: (w/o encl)
Housing Finance & Dev. Corp.
✓Belt Collins and Associates

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

September 12, 1990
841.0101/1898

Captain B.J. Nash
Base Civil Engineer
Department of the Navy
Naval Base Pearl Harbor
Box 110
Pearl Harbor, Hawaii 96860-5020

Dear Captain Nash:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for taking the time to review the above project. Should you require any additional information, please feel free to contact me.

Very truly yours,

Lee William Sichter

(P)1587.0

JUL 27 1990

The Honorable John Waihee
Governor
State of Hawaii
c/o Office of Environmental
Quality Control
465 South King Street, Room 104
Honolulu, Hawaii 96813

Dear Governor Waihee:

Subject: Kealakehe Planned Community
Draft EIS

This is in response to the recent Office of Environmental Quality Control's request for comments on the subject document.

Our comments are as follows:

1. North Kona Civic Center. The Department of Accounting and General Services is planning to develop a civic center in the North Kona area. The following are our concerns regarding the impact of the Housing Finance and Development Corporation's (HFDC) Kealakehe Plan on this civic center:

   a. The land requirement has been revised to 30 acres from the 24 acres reported to Belt Collins and Associates on March 22, 1990. Further, the County's needs are not included in the 30 acres. The civic center site shown in the HFDC plan is only 20 acres.

   b. The 20-acre site is adjacent to the County landfill. This would create the potential for pollution problems such as the existing police station is encountering.

   c. Considerable vehicular traffic will be generated by the civic center. The 20-acre site would not have as convenient a vehicular access as one closer to a major traffic intersection.

d. The 20-acre site is relatively isolated from existing and proposed business and commercial areas. The civic center should ideally be in close proximity to such areas.

2. Hawaii County Kailua to Keahole Development Plan. The EIS may want to address the difference between HFDC's plan and the County's Development Plan in the siting of the business and civic center areas.

We appreciate this opportunity to identify key EIS issues. Should there be any questions, please have your staff contact Mr. Cedric Takamoto of the Public Works Division at 548-7192.

Respectfully,

RUSSEL S. NAGATA
State Comptroller

TCT:jk
cc: Housing and Finance Development Corporation
✓Belt Collins and Associates

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

September 12, 1990
841.0101/1898

Mr. Russel S. Nagata, State Comptroller
Department of Accounting and General Services
State of Hawaii
1151 Punchbowl Street
Honolulu, Hawaii 96813

Dear Mr. Nagata:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for your comments concerning the above project. Following are responses to your comments in the order they were presented in your letter.

1a. In order to maximize the use of the Kealakehe property for the development of affordable housing to fulfill the HFDC's mission, non-residential-related land uses within the project area have been minimized wherever possible. Thus, it was determined during the formulation of the master plan that the Civic Center requested by the County and the community would best be located on County land.

Technically, the Civic Center is not part of the Kealakehe Planned Community. It is depicted on the project map as a future land use as a result of comments received from the County and the Kailua-Kona community.

1b. The County of Hawaii is responsible for the closing of the Kealakehe Landfill which has been delayed due to challenges to the County's new proposed landfill site. We are anticipating the County will resolve this problem and that potential pollution problems can be averted by its timely closing.

1c. The Civic Center depicted in the Kealakehe master plan represents approximately one half of a total Civic Center project area. On August 23, 1990, the Liliuokalani Trust published a Draft Environmental Impact Statement concerning the proposed development of its property adjacent to Kealakehe as an urban expansion area to serve the entire West Hawaii region. A 30-acre Civic and Cultural Center is included in the Trust's plan and abuts the County owned property. Thus, the adjoining projects include an area totalling approximately 60 acres for a Civic Center, which will be sufficient to address the long-term development and expansion of such a facility. The entire facility will be accessible by major roadways included in the Trust's plans. The Civic Center is recognized as a transitional land use between the office and commerical land uses proposed on the Trust's land to the south and the public golf course to be developed by the County to the north. Locating a Civic Center closer to the Kealekehe intersection would be inappropriate because it would be relatively isolated from the existing Kailua community and the Trust's proposed urban expansion area.

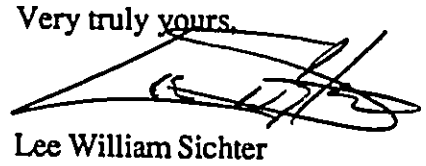
1d. As discussed above, the proposed Civic Center is actually contained within a major urban expansion area for the West Hawaii region. The 20-acre commercial area planned for the

Kealakehe Community is not envisioned as a regional shopping center, but rather as a commercial mall to serve the Kealakehe community. Thus, locating a Civic Center at this location or adjacent to it is not viewed as an appropriate or compatible use. In addition, the development of a Civic Center on State-owned land would reduce the amount of land available for the development of affordable housing which is contrary to the mission of the HFDC. While it might be argued that the proposed commerical center also reduces the amount of available residential land, it should be understood that the commercial area is intended to serve the residential area and income from its development can help to offset the cost of residential development. A Civic Center is a public facility which will provide no direct income.

2. Section 2.5 of Chapter VII specifically addresses the differences between the Kealakehe plan and the draft Keahole to Kailua Development Plan (K-K Plan). The fact that the K-K plan is presently in draft form and will be probably the subject of further revisions is also discussed in Section 4 of Chapter VIII and is identified as an unresolved issue.

Thank you for taking the time to review the above project. Should you have any questions or comments about the project or the matters discussed above, please feel free to contact me.

Very truly yours,



Lee William Sichter

UNITED STATES
DEPARTMENT OF
AGRICULTURE

SOIL
CONSERVATION
SERVICE

P. O. BOX 50004
HONOLULU, HAWAII
96850

August 20, 1990

The Honorable John Waihee
Governor, State of Hawaii
c/o Office of Environmental Quality Control
465 S. King Street, Rm. 104
Honolulu, Hawaii 96813

Dear Governor Waihee:

Subject: Draft Environmental Impact Statement (DEIS) w/ Appendix -
Kealakehe Planned Community, Kealakehe, N. Kona, Hawaii

We have no comments to offer at this time; we would appreciate the opportunity to review the final EIS.

Sincerely,

Warren M Lee

WARREN M. LEE
State Conservationist

cc:
Housing Finance and Development Corporation, State of Hawaii, 7 Waterfront Plaza, Suite 300, 500 Ala Moana Boulevard, Honolulu, Hawaii 96813
Belt Collins and Associates, 680 Ala Moana Blvd., Suite 200, Honolulu, Hawaii 96813
Office of Environmental Quality Control, 465 S. King Street, Rm. 104, Honolulu, Hawaii 96813

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

[illegible] Ala Moana Blvd. Suite [illegible]
Phone [illegible] Telex: BELTH [illegible] Fax: [illegible]
Hawaii • Singapore • Australia • Hong Kong • Guam

September 12, 1990
841.0101/1898

Mr. Warren M. Lee
State Conservationist
Soil Conservation Service
United States Department of Agriculture
Box 50004
Honolulu, Hawaii 96850

Dear Mr. Lee:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for taking the time to review the above project. Should you require any additional information, please feel free to contact me.

Very truly yours,

Lee William Sichter

HAWAII LEEWARD PLANNING CONFERENCE
P O BOX 535 • KAILUA-KONA HAWAII 96745-0535

August 30, 1990

Office of Environmental Quality Control
465 South King Street
Kekuanaoa Building, #104
Honolulu, HI 96813

Dear Sirs:

We have reviewed the draft of the Environmental Impact Statement for the Kealakehe Planned Community. We do not feel that our concern over the resolution of the landfill problem is adequately addressed.

In the document it is stated that the landfill will be moved by the County and we concur that this will have to be done. We are concerned, however, that because of the conflicts between the State, County Administration and a private land owner, that the relocation of the landfill will not take place in a timely fashion. The development of the Kealakehe Planned Community cannot move forward without the relocation of the landfill.

Should you care to discuss this in more detail, please contact me at 329-2334.

Sincerely,

H. Peter L'Orange
President

HPL/mg,

cc: Lee W. Sichter, ✓
Belt Collins & Assoc.

Joseph Conant
Housing Finance & Development Corp.

OFFICE POTTERY TERRACE, ORCHID BLDG #226, KAILUA-KONA • PHONE 329-2334 • FAX 329-7108

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

September 12, 1990
841.0101/1898

Mr. H. Peter L'Orange
Hawaii Leeward Planning Conference
P.O.Box 635
Kailua-Kona, Hawaii 96745-0635

Dear Mr. L'Orange:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for your comments on the above project. As stated near the bottom of page II-20 of the DEIS, "It is recognized that the ultimate disposition of the landfill will determine the actual use and phasing of new construction on the property." While this comment pertains specifically to the disposition of the proposed Civic Center, the text in section 7.3 of Chapter VI on page VI-36 addresses residential development at Kealakehe:

> "...the timely closing of the existing landfill will have a significant effect upon the proposed residential community. Development of homes in the general vicinity of the landfill may be constrained by continuing problems with fumes and odors, and the potential threat of fire. Therefore, phasing of the proposed community has been designed to allow for development of the most mauka villages first, with villages closer to the landfill area being developed after the landfill has been closed and/or removed."

In view of the critical need for affordable housing in West Hawaii, we do not believe it is appropriate to halt the development of the proposed project until the landfill is relocated as you suggest. In order to ensure that homes are available for occupancy within the next 20 months, we must proceed now with the planning and engineering for the project.

The HFDC undertook the proposed project with the understanding that the County of Hawaii would soon be closing the landfill and opening a new landfill facility in West Hawaii. The Kealakehe landfill was not considered to be a permanent constraint on development. The landfill is a temporary use of the County property and does not constitute an irreversible alteration of the land. Therefore, for purposes of long-range planning, it is appropriate to continue with development plans for the proposed project.

As discussed in the consultant's report on Air Quality, the Environmental Protection Agency has determined that the landfill is not toxic. However, in view of the concerns over the landfill, the HFDC supports its closure by May, 1992.

Very truly yours,

Lee William Sichter

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
BUILDING 230
FT. SHAFTER, HAWAII 96858-5440

REPLY TO
ATTENTION OF:
Planning Division

August 31, 1990

Dr. Marvin T. Miura, Director
Office of Environmental Quality Control
465 South King Street, Room 104
Honolulu, Hawaii 96813

Dear Dr. Miura:

We have reviewed the two-volume Draft Environmental Impact Statement for the proposed Kealakehe Planned Community, Kealakehe, North Kona, Hawaii. The following comments are offered:

a. A Department of the Army permit is not required.

b. According to the Flood Insurance Rate Map (Panel 692) dated September 16, 1988, and the Map Index sheet dated July 16, 1990, the property is in Zone X, areas determined to be outside of the 500-year flood plain as designated by the Federal Emergency Management Agency.

Sincerely,

Kisuk Cheung
Director of Engineering

Copies Furnished:

State of Hawaii Housing Finance and
Development Corporation
7 Waterfront Plaza, Suite 300
500 Ala Moana Boulevard
Honolulu, Hawaii 96813

✓Belt Collins and Associates
680 Ala Moana Boulevard, Suite 200
Honolulu, Hawaii 96813

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

September 12, 1990
841.0101/1898

Mr. Kisuk Cheung
Director of Engineering
Department of the Army
U.S. Army Engineer District, Honolulu
Building 230
Fort Shafter, Hawaii 96858-5440

Dear Mr. Cheung:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for taking the time to review the above project. Should you require any additional information, please feel free to contact me.

Very truly yours,

Lee William Sichter

74-5221 Queen Kaahumanu Hwy.
Kailua-Kona, HI 96740

September 5, 1990

Mr. Lee William Sichter
Senior Planner
Belt Collins & Associates
680 Ala Moana Blvd., Suite 200
Honolulu, HI 96813

SUBJECT: Kealakehe Planned Development

Dear Mr. Sichter:

Thank you for your presentation at the Kealakehe Police Station on September 4, 1990.

The layout of your plan is excellent. The only problem is the timetable. My suggestion is that step 1 be the construction of the mauka/makai road (problem solver).

Step 2 should be limited to the relocation of the Kailua Landfill. It is important that the step should be completed prior to any residential construction. Any form of building construction has a large amount of waste product and this should not be added to the Kailua Landfill (problem solver).

Step 3 should be limited to completion of the sewage treatment plant and golf course. We don't need another house in the area until we have a adequate means of sewage disposal (problem solver).

Step 4, only after completion of steps 1 thru 3 should residential construction begin.

I think it's very important that the State of Hawaii look at its affordable housing project and school construction as an improvement to the Kona District. If housing or school construction precedes the moving of the landfill or the completion of the sewage treatment plant and golf course, the State will become part of the problem, not the solution.

I have attached copies of pages from your Environmental Assessment and have made notes on the copies relative to problem areas.

Your consideration of my opinion will be greatly appreciated.

Sincerely,

John E. Dawrs
Kona resident and Police Officer

Attachment

cc: Honorable Governor John Waihee

Environmental Assessment
for

KEALAKEHE PLANNED COMMUNITY

Kailua Kona, Hawaii

Prepared for

STATE OF HAWAII
HOUSING FINANCE AND DEVELOPMENT CORPORATION

by
Belt Collins & Associates

February 14, 1990

and the *ahupua'a* of Honokohau to the north, and Queen Kaahumanu Highway and the makai lands of Kealakehe to the west.

Existing uses on the property include the County of Hawaii Kealakehe landfill and the County Police Substation. The landfill located at the southwestern corner of the project site presently includes two facilities: a rubbish dump which occupies about 15 acres of land, and a solid waste transfer station. Total acreage for the landfill is about 30 acres. The County plans to close the landfill and relocate it to another site in West Hawaii at Puuanahulu. However, it is unclear at this time what the timetable for closing and relocating will be. Relocation will include mining the site for usable heavy metals and salvageable materials. Over a period of time the site would be reclaimed for use by the community. Once the landfill is closed and properly reclaimed, it could be used as open space or a park facility.

Adjacent uses to the project area include a quarry operation to the north on property owned by Robert McClean, and a number of housing projects to the east and mauka of the project site including Kealakehe House Lots Increments I and II; Kealakehe Public Housing; Jack Hall Memorial Housing; Kaimalino Multi-Family Units; La'ilani Multi-Family Rental Housing project, and the Queen Liliuokalani Village south of Palani Road. The subject property is presently vacant and is leased to the Palani Ranch for the grazing of cattle.

1.6 POTENTIAL IMPACTS, MITIGATION MEASURES & ALTERNATIVES

1.6.1 Land Use Impacts

Development of the subject property as a master planned residential community will impact the physical character of the land. The vacant land will be transformed through the development of a variety of urban-related uses including residential units; public facilities and infrastructure; schools; and neighborhood and regional serving recreational uses.

1.6.2 Mitigating Measures

The entire project will be developed according to a detailed master plan. Phasing of the project in a manner consistent with the master plan will ensure that impacts upon the land are minimized through the proper siting and timing of infrastructure development and the landscaping.

← we agree!! Very important.

1.6.3 Traffic Conditions

Traffic volumes will increase for the area. The development of a residential community of up to 5,000 units will result in a significant expansion of the Kailua-Kona area population and a

consisting of a minimum of 1,044 component features have been identified within the project area. Among the sites, 32 consist of single components and the rest consist of two to one hundred and twenty components. The total number of features may be further distributed among eight general functional categories; agriculture (793 features), habitation (21 features), transportation (20 features), markers (32 features), agricultural/habitation (153 features), land division (10 features), possible burial (8 features), and possible ceremonial (5).

The distribution and density of features within the project area indicate that the area was used primarily for relatively intense dry land agriculture. Agriculture complexes are most numerous in the upper portions of the area, at elevations of 500 feet or greater. The most common agricultural features are pahoehoe excavations and rock mounds. These two formal types comprise 66% of all agricultural features, and 57.4% of all identified features. It is likely that additional pahoehoe excavations and mounds are present within the project area. The location of archaeological sites is presented in Figures 11 and 12.

3.1.9 Air Quality — Please tell it like it is !!!

constant

Due to the relative lack of development, air quality in the project area might be expected to be good. However, the Kealakehe landfill located at the southern corner of the project site is a periodic source of noxious odors. County officials have indicated that the landfill will soon be closed and the rubbish mined and removed to a new location offsite. This process is projected to require up to ten years. Once the mining of the rubbish begins, and underground fires which have been smoldering are exposed to air, the volume of emissions from the landfill may actually increase during the short term due to periodic flare-ups.

will

On a regional scale, air quality has been impacted in recent years by the continuing eruptive activity associated with the Puu O'o vent on the southeast slope of Kilauea volcano. Particulate emissions in the Kailua-Kona area are most evident during periods of light trade winds.

What about ~~toxic~~ fumes?

3.1.10 Noise

Fixed source noise is the principal form of noise at the subject property and is directly related to activities at the Kelalakehe Landfill. Traffic noise is associated with Queen Kaahumanu Highway.

3.1.11 Natural Hazards

The subject property may be potentially impacted by two forms of natural hazards;

3.1.14 Sewer

There is no public sewage collection system currently serving the project site. Sewage is presently disposed of in private individual disposal units such as cesspools at the existing developments on the project site (County Police Substation and Landfill). The County is currently undertaking a project to expand the existing sewerage system in Kailua-Kona. This involves the construction of a new sewage treatment plant (STP) makai of Queen Kaahumanu Highway on State owned land in the Kealakehe *ahupua'a*. The proposal includes closing of the existing STP in the Kona Industrial Subdivision once the new plant is completed. The current plans call for construction to commence in February of 1989. The initial plant would occupy a land area of approximately 50 acres with an effluent disposal area of approximately 150 acres. Expansion of the plant's capacity to accommodate the Kealakehe Planned Community is presently being reviewed. Such an expansion would require an increase of 2.0 million gallons of sewage per day over the current design capacity of 2.8mgd. This expansion would require an additional 10 acres of land for the STP facility and an appropriate increase in size of the leaching area (effluent disposal area). The effluent disposal area needed to serve the STP as presently designed is situated within the makai portion of the proposed project and will be developed as a public golf course.

NO CONSTRUCTION UNTIL EXPANSION IS COMPLETED.

The initial phase of development will be serviced by a temporary sewer system which will be eventually integrated into the entire projëct-serving system once the new treatment plant is operable.

3.1.15 Solid Waste

The County of Hawaii Department of Public Works has indicated that a trash transfer station would be required to serve the immediate vicinity including the Kealakehe Planned Community. This transfer station would require a minimum of five acres and could be developed in the vicinity of the present site used for this activity, or it could be located at some other area within the project site. The County has indicated that it prefers a location within the Kealakehe project area.

3.2 SOCIOECONOMIC ENVIRONMENT

3.2.1 Population and Development

Primary economic activities on the island of Hawaii include the visitor industry, sugar, diversified agriculture and the emerging new industries of research and technology. In the near future, economic and demographic growth in West Hawaii is expected to be led principally by visitor-related developments. It is estimated that between 1988 and 2005, about 12,500 new

CHAPTER 9
PARTIES TO BE CONSULTED IN THE PREPARATION OF AN EIS

The following governmental agencies and community organizations will be consulted during preparation of the Environmental Impact Statement:

State of Hawaii
Department of Health
Department of Land and Natural Resources
Department of Labor and Industrial Relations
Department of Business and Economic Development
Hawaii Housing Authority
Department of Transportation
Department of Human Services
Department of Education
Office of State Planning

County of Hawaii
Public Works Department
Office of Housing and Community Development
Police Department
Department of Water Supply
Planning Department
Fire Department
Department of Parks and Recreation

Why didn't you talk to the police officers

Federal Government
Department of Housing and Urban Development
Department of the Interior, Fish and Wildlife Service
National Park Service

Public Utilities
Hawaiian Telephone
Hilo Electric Light Company

Community Organizations
Kona Chamber of Commerce
Leeward Planning Conference
Board of Realtors
Representatives of Kailua Kona Communities

Elected Officials

(1.) Why wasn't the Kona Traffic Safety Committee Consulted?

BELT COLLINS
& ASSOCIATES

Engineering • Planning
Landscape Architecture

September 12, 1990
841.0101/1898

Mr. John E. Dawrs
74-5221 Queen Kaahumanu Highway
Kailua-Kona, Hawaii 96740

Dear Mr. Dawrs:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for your comments on the above project. Following are responses to your comments in the order they are presented in your letter.

1. Construction of the mauka-makai roadway (your Step 1) is proposed as the very first component of development in the project.

2. We agree that relocation of the landfill (your Step 2) is important to the long-term success of the project. Construction of the first increment of homes at the project will require approximately 20 months. We are anticipating the County will close the landfill before the first increment of homes are completed and that landfill operations will be relocated to a new site.

3. Completion of the the sewage treatment plant (your Step 4) is presently projected for October 1991. While the actual development of the golf course will not be completed by then, use of the area for effluent disposal will be necessary to operate the plant. Thus, it is anticipated that the sewage treatment plant will be operational by the time the first phase of residential development at Kealakehe is completed.

4. We disagree that residential construction should not begin until Steps 1 through 3 are completed. Residential construction for the first increment of homes should begin as soon as the land use permitting process has been completed and all necessary approvals have been received. As demonstrated in the discussion above, roadway construction, sewage treatment plant construction, and landfill closure can all occur while the first homes are being built. By the time the first homes are ready for occupancy, the mauka-makai road through Kealakehe should be completed, the sewage treatment plant operational, and the landfill closed. If construction of the first increment of homes were delayed until Steps 1 through 3 are completed, approximately two years will have been lost before home construction could even begin. Demand for affordable housing is steadily increasing in West Hawaii. We feel that it is, therefore, appropriate to time residential construction with the other activities discussed here so that homes can be occupied as soon as practical.

5. School construction is scheduled for completion between 1992 and 1994. Other construction activities should be completed by then.

6. We agree that the landfill is source of constant noxious odors for the police station located next to it.

7. We are unable to determine with any degree of certainty what the consequences of mining

the landfill for recyclable materials and extinguishing the ground fires will be. Therefore, while we believe that the volume of emissions may increase, we can not make a definitive statement that they will increase. The actual process utilized for the mining and extinguishing will determine the volume of emissions. However, it must be recognized that mining the landfill is not the only available alternative. A comprehensive closure plan could be an effective solution to the landfill problem. Once dumping activity at the landfill is terminated, the mound could be vented to neutralize a build-up of landfill gas and mitigate the possibility of spontaneous combustion, covered with approximately three feet topsoil, and a monitoring program implemented to minimize the potential for flare-ups.

8. There is no evidence that the fumes from the landfill are toxic. As discussed on page 26 of the Air Quality Impact Analysis conducted for the project (see DEIS appendix), "...fumes from the facility may be a public nuisance but they do not pose a threat to public health."

9. Police officers were contacted during the course of preparing the Draft EIS.

10. The Kona Traffic Safety Committee was not consulted. We were unaware of this committee's existence at the time the EIS was prepared.

Very truly yours,

Lee William Sichter

Larry S. Tanimoto
Mayor
Bruce C. McClure
Chief Engineer
Richard H. Nishimura
Deputy Chief Engineer

Department of Public Works

25 Aupuni Street, Rm. 202 • Hilo, Hawaii 96720 • (808) 961-8321 • Fax (808) 969-7138

September 5, 1990

HONORABLE JOHN WAIHEE
GOVERNOR STATE OF HAWAII
C/O OFFICE OF ENVIRONMENTAL QUALITY CONTROL
465 SOUTH KING ST ROOM 104
HONOLULU HI 96813

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT
KEALAKEHE PLANNED COMMUNITY

Thank you for the opportunity to review the subject document. Our comments are as follows:

SOLID WASTE

1. Contract to mine landfill has been terminated.

2. Depending upon processing time of the landfill, the County may not be able to move operations until 1992. Should this happen there will be severe impacts on solid waste operations.

3. The 27-42 tons per day generation rate will have severe impacts on transfer station operations. We estimate our refuse trailers are hauling approximately 12 tons of refuse. At the estimated generation rate this will amount to 2.25-3.5 trailer loads per day. Because of the distance between the landfill and the transfer station, this will in all likelihood require 2 new employees and a truck tractor.

   It is felt that this development, coupled with the new landfill, will probably require the development of a new regional type transfer station similar to the transfer station found in Honolulu.

4. Because of the space limitation at the Kealakehe Landfill and the uncertainty in the development of the new West Hawaii Landfill, construction and occupancy must coincide with the opening of the landfill. If this is not possible, alternate means of disposing all wastes, including construction wastes, must be considered.

5. A waste reduction program such as composting and recycling of construction wastes should be considered.

TRAFFIC

1. The proposed Kealakehe Parkway Road, Mid-level Road, and Waena Drive should be coordinated with the County Planning Department to ensure compliance with their long-range plans.

2. The existing grades for the Kealakehe Parkway Road should be studied (especially on the mauka slopes) so that the roadway grades will be in compliance with County and State standards for arterial roadways.

3. The source of funding for the improvements and mitigating measures recommended by this report has not been addressed. For improvements and mitigating measures to be implemented when required, commitments on funding must be identified and agreed upon by the developers and agencies involved. The County may not have funding to do the improvements required on County roadways. Will the developers pay for or contribute to the roadway and intersection improvements?

4. As different phases of the development are implemented, updates on Traffic Impact Studies may be required.

5. Construct traffic signals at the Kealakehe Street-Palani Road intersection.

6. We do not agree with the assumption that with the construction of the Kealakehe Parkway, the traffic along Palani Road will not be significantly affected. The route to Kailua on the Palani Road will have a much shorter travel time. Palani Road should be improved. The intersection with the Queen Kaahumanu Highway should also be improved. At least that portion of Palani Road along this project should be widened to the general plan width and improved with curbs, gutters and sidewalks.

7. We agree that the final alignment of the Kealakehe Parkway cannot be determined until further study is made but before the proposed road is adopted as a given in the traffic analysis, the preliminary alignment should be more thoroughly studied. It should be studied until a determination is made that the alignment is feasible and buildable. The intersection at Mamalahoa Highway will be between two closely spaced major intersections. This area has severe topograhical constraints.

David Murakami

for ROBERT K. YANABU, Division Chief
Engineering Division

DHM:sah

cc: Solid Waste Division
Traffic Division
Engineering Division
Planning Department
Housing Finance and Development Corporation
Belt Collins and Associates

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

September 12, 1990
841.0101/1898

Mr. Robert Yanabu, Division Chief
Engineering Division
Department of Public Works
County of Hawaii
25 Aupuni Street, Room 202
Hilo, Hawaii 96720

Dear Mr. Yanabu:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for your comments on the above project. Following are responses to your comments in the order they appear in your letter.

SOLID WASTE

1. We acknowledge that the contract to mine the landfill has been terminated by the County.

2. We acknowledge that the County may not be able to move operations from the existing landfill until 1992. This is not viewed as a problem for the proposed development because we do not anticipate the first increment of homes to be completed until mid 1992 (approximately 20 months after land use permit approvals are received).

3. The figures presented on page VI-36 pertaining to volumes of solid waste generated by the proposed project are calculated for full build out, which is projected to occur in approximately 20 years. As discussed in the market report for the project, it is anticipated that the market will absorb about 250 units a year. Therefore, new employees and equipment to meet the ultimate demand will not be necessary in the immediate future.

   There is adequate room in the vicinity of the existing transfer station on the County property adjacent to Kealakehe for its conversion to a regional-type transfer station.

4. We have revised the EIS to address your concerns as well as those of the County Planning Department concerning the timing of construction and occupancy of the proposed project with availability of a new landfill. Page VI-35 now states that the proposed closure for the existing landfill may be sometime in 1992. Page VI-36 now includes a statement that should the alternate landfill site not be available to the County, a site selection process for a new landfill area will be initiated. Finally, page VI-37 has beem amended to include the following statement:

   > "Should development of a new landfill site be delayed beyond the occupancy of the first phase of residential development, solid waste generated by the project will be transported by truck from the

transfer station to a landfill in East Hawaii. The expense of this operation would ultimately be borne by the new Kealakehe Community residents."

5. We agree that a waste reduction program should be considered and have included reference to it in Section 7.3 (migitation measures) of Chapter VI.

TRAFFIC

1. The region-serving roadways within the project area will be coordinated with the County Planning Department.

2. Engineering studies for the Kealakehe Parkway are presently being conducted to ensure that roadway grades will be in compliance with government standards for arterial roadways.

3. The cost of development for the Mid-Level Roadway, Waena Drive, and the Kealakehe Parkway within the Kealakehe project area will be borne by project developers. The intersection of Kealakehe Parkway and Queen Kaahumanu Highway will be funded by the proposed project.

4. We agree that the development of subsequent phases of the project may require updates to the Traffic Impact Study.

5. Traffic signals at the Kealakehe Street-Palani Road intersection will be constructed and funded by the project as warranted.

6. We respectfully differ with your views of required improvements for Palani Road. We believe that the key to improving traffic conditions in the Kailua-Kona area is to provide immediate relief to Palani Road in the form of alternative routes. Palani Road is presently operating near capacity. Traffic conditions will exceed capacity in the year 2010 even without the proposed project, as discussed in the EIS on pages VI-10 and 11.

   Palani Road cannot be effectively improved until relief routes are available so that traffic can be diverted from this over crowded roadway. The development of a new mauka-makai road through the Kealakehe property will provide the Kailua-Kona area with an alternative to Palani Road. Although the Palani Route is a shorter distance, traffic conditions along it during peak hours slow travel time to a point where we believe Kealakehe Parkway will present an attractive alternative to commuters. Therefore, in view of the substantial investment in regional infrastructure being undertaken by the Kealakehe project in the form of a new mauka-makai roadway, we believe it inappropriate to expect the project to also contribute to Palani Road improvements.

   As discussed in the Table 6-3 of the EIS, total turning movements (a measure of traffic conditions) will increase from 5,988 to 13,255 during the peak hour without the Kealakehe project. That is equal to an increase of over 120%. With the project, turning movements will increase just over 140% or 20% more than conditions without the project. In other words, the Kealakehe project will be responsible for about one seventh of the total traffic volume in the year 2010.

7. The alignment of the Parkway as shown in the EIS is part of a concept plan. The feasibility of this road has already been determined. The exact alignment of the roadway is presently being finalized along with a detailed engineering analysis that is necessary before

construction can begin. Because it is a concept plan, the specific alignment may change as a result of slope constraints. However, the concept of linking Mamalaohoa Highway with Queen Kaahumanu Highway will not alter.

Very truly yours,

Lee William Sichter

LARRY S. TANIMOTO
Mayor
Duane Kanuha
Director
William L. Moore
Deputy Director

Planning Department

25 Aupuni Street, Rm. 109 • Hilo, Hawaii 96720 • (808) 961-8288

September 6, 1990

Mr. Joseph K. Conant
Executive Director
Housing Finance Development Corporation
Seven Waterfront Plaza, Ste 300
500 Ala Moana Boulevard
Honolulu, HI 96813

Dear Mr. Conant:

Kealakehe Planned Community Draft Environmental Impact Statement

Thank you for the opportunity to comment on the draft EIS for the Kealakehe Planned Community. After a review of the document, we offer the following comments for your consideration:

1) The fiscal impact analysis should be elaborated on in the document or in an appendix. The material presented in the report does not provide sufficient backup in terms of the assumptions used to reach the conclusions stated.

   For an appropriate review of the fiscal impact, the respective State and County revenues and costs should be separated rather than shown as combined into one statement.

   The entirety of County operating costs should also be listed, including costs for General Government, Highways, Recreation, Pensions, etc. Further, the capital costs to the County should likewise be listed, rather than only operating expenses.

   Please review the projected $73.9 million in real property taxes; this number seems very high. By comparison, the projected 1990-91 real property tax collections for the entire island are $57.9 million.

2) The Kealakehe Master Plan shows a Civic Center located on 30 acres of land but does not address the appropriateness of this nor environmental considerations that should be addressed in an EIS. For example, the letter from the Department of Accounting and General Services raises physical issues such as odors and vehicular access which were not addressed in the response. If the Master Plan proposes such uses, it should discuss these factors in the EIS.

3) The commitment to the mauka-makai road is not specific as to the timing of the mauka connection to the Mamalahoa Highway. The EIS states, "The third phase will link the Parkway to Mamalahoa Highway at some future date." (page II-23)

It would be possible then to have three-fourths of the Kealakehe Planned Community developed without a complete mauka-makai connection. This "intermediate" situation should be subjected to a traffic analysis, as it could start in the near future and persist for several years.

4) The EIS needs to be updated as to the handling of solid waste disposal. The EIS notes that "The landfill is rapidly nearing capacity and is proposed for closure sometime in 1991, according to Hawaii County. A new 177 acre sanitary landfill site has been proposed by the County for location at Puu Wa'awa'a in North Kona, approximately 15 miles north of Kealakehe." (page VI-35) However, it now appears that this site may not be available to the county.

The EIS goes on to state, "Development of the proposed planned community will generate a substantial increase in solid waste. Using the County's refuse generation rate of 6.0 pounds per capita per day, it is projected that at buildout, the planned community will generate between 54,000 pounds and 84,000 pounds of refuse per day. This is equivalent to 27 to 42 tons per day, 9,800 to 15,300 tons per year, or approximately 21 to 33% of the new landfill's initial capacity. Because occupancy of the initial phase of Kealakehe homes is not anticipated until early 1992, the project is not expected to create an adverse impact upon solid waste conditions and its implementation should coincide with the County's plans for the opening of a new landfill." (page VI-36) It very likely that the new landfill will not be available by early 1992. The EIS should address appropriate mitigating measures.

Thank you for the opportunity to comment on the draft EIS. If you should have any questions concerning these comments, please do not hesitate to contact us again.

Sincerely,

DUANE KANUHA
Planning Director

KK:aeb

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

September 12, 1990
841.0101/1898

Mr. Duane Kanuha, Director
Planning Department
County of Hawaii
25 Aupuni Street, Room 210
Hilo, Hawaii 96720

Dear Mr. Kanuha:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for your comments on the above project. Following are responses to your comments in the order they appear in your letter.

1. The fiscal impact analysis has been revised to address your concerns.

2. The Civic Center was included in the Draft EIS in response to the County's original plans for a Regional Center on the lower portion of the subject property, as depicted in the Keahole to Kailua Draft Development Plan (K to K Plan, September 1989). It was recognized at that time that the existence of the Kealakehe Police Station on the County-owned property adjacent to the Kealakehe parcel established a reasonable justification for the siting of a Civic Center which was to include State and County office buildings as described on page 3-6 of the K to K Plan.

   The County owned parcel upon which the Civic Center would be located is not included in the area addressed by the EIS. Therefore, an analysis of environmental considerations pertaining to the County property or the appropriateness of the County's plans was not viewed as necessary in the project EIS. As discussed on page II-20 of the EIS, the ultimate disposition of the landfill by the County will determine the actual use and phasing of new construction on the property. The EIS assumes that the landfill will be closed in the immediate future and that the landfill area will be eventually utilized as an open space park. Similarly, the EIS assumed that the County's plans for additional government offices on the site around the existing police station will eventually be implemented.

   Neither the EIS nor the master plan advocate the development of a Civic Center on the County property. Rather, these documents simply reflect County plans. The discussion of the relationship between the Kealakehe Plan and the County's K to K Plan on page VII-31 of the DEIS clarifies this. The DEIS states,

   > "The proposed project includes a 30 acre Civic Center located in the vicinity of the County police substation on County property. This location was selected in response to the County's desire to expand public facilities around the police station and was consistent with earlier drafts of the K-K Plan. At this time it is assumed that the County intends to retain the police station at its present location. Whether the surrounding area will be developed with additional public uses is unknown. However, for planning purposes it is appropriate to include the Civic Center in the location shown

in the Kealakehe Master Plan in order to maximize development options and ensure adequate sizing of infrastructure."

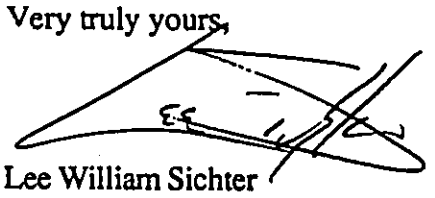
It is further assumed that the development of a Civic Center by the County would follow the initial phase of development at Kealakehe and would be the subject of its own environmental impact statement, since it will utilize County property and County funds. Once the County's plans have been clarified, the HFDC will be able to comment on their relationship to the Kealakehe Planned Community.

3. It is our understanding the the State Department of Transportation has already received funds for preliminary planning and engineering for the mauka connection of the Parkway to Mamalahoa Highway. Development of the entire roadway as an alternative route to Palani Road is a matter of considerable urgency and every effort is being made to implement the project in a timely manner. We do not agree that an "intermediate" situation will persist for "several years". Therefore, we do not believe that an additional traffic analysis is necessary.

4. We have updated the EIS in accordance with your comments. Page VI-35 now states that the proposed closure for the existing landfill may be sometime in 1992. Page VI-36 now includes a statement that should the alternate landfill site not be available to the County, a site selection process for a new landfill area will be initiated. Finally, page VI-37 has been amended to include the following statement:

"Should development of a new landfill site be delayed beyond the occupancy of the first phase of residential development, solid waste generated by the project will be transported by truck from the transfer station to a landfill in East Hawaii. The expense of this operation would ultimately be borne by the new Kealakehe Community residents."

Very truly yours,



Lee William Sichter

Larry S. Tanimoto
Mayor
George Yoshida
Director
Juliette M. Tulang
Deputy Director

Department of Parks and Recreation

25 Aupuni Street, Rm. 210 • Hilo, Hawaii 96720 • (808) 961-8311

September 6, 1990

Honorable John Waihee
Governor, State of Hawaii
c/o Office of Environmental Quality Control
465 So. King Street, Room 104
Honolulu, Hawaii 96813

Subject: Kealakehe Planned Community, North Kona, Hawaii
Draft Environmental Impact Statement

Dear Governor Waihee:

The following comments are offered for your consideration:

1) The proposed 1,254 multi-family and 2,904 single family units would generate a population of 2,633 and 8,944 persons respectively. Based on a desired 5 acres of park per 1,000 population, approximately 57.9 acres of park is needed.

2) The development of community parks (4-8 acres in size) should be considered as an alternative to neighborhood parks (4 acres in size)

For your information, proposals for development and operation of the Kona municipal golf course will be received on September 28, 1990.

Thank you for the opportunity to review the subject document.

Sincerely,

George Yoshida
Director

cc: Larry S. Tanimoto, Mayor
State of Hawaii - HFDC
Belt Collins & Assoc. fax # 538-7819

BELT COLLINS
& ASSOCIATES
Engineering • Planning
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[illegible] Ala Moana Blvd., Suite [illegible]
[illegible] 521-5361 Telex: BELTH [illegible] Fax: [illegible]
Hawaii • Singapore • Australia • [illegible]

September 12, 1990
841.0101/1898

Mr. George Yoshida, Director
Department of Parks and Recreation
County of Hawaii
25 Aupuni Street, Room 210
Hilo, Hawaii 96720

Dear Mr. Yoshida:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for your comments on the above project. As presented in the Draft EIS, the proposed development contains three neighborhood parks totaling 12 acres, a 27 acre archaeological preserve, and a 5 acre plant preserve as well as a 3 acre recreation center. This is a total of 47 acres of active and passive recreation area. In addition, the plan includes a 195 acre public golf course. Once the Kealakehe landfill is closed and the site is restored, it is proposed that the area could be utilized as a 15 acre park area. Thus, it is felt that the overall plan includes adequate park area for the proposed development.

We appreciate your concern about the availability of community parks from 4 to 8 acres in size. The HFDC will consider expansion of the neighborhood parks located near the proposed high school and Palani Road.

Very truly yours,

Lee William Sichter

COPY

BELT, COLLINS & ASSOCIATES

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAII
25 AUPUNI STREET • HILO, HAWAII 96720
TELEPHONE (808) 969-1421 • FAX (808) 969-6996

September 7, 1990

Honorable John Waihee, Governor
State of Hawaii
c/o Office of Environmental Quality Control
465 South King Street, Room 104
Honolulu, HI 96813

ENVIRONMENTAL IMPACT STATEMENT
KEALAKEHE PLANNED COMMUNITY

Thank you for giving us the opportunity to comment on the Draft Environmental Impact Statement. The engineering report adequately covers our concerns. The development of sources and the improvement of existing transmission facilities are needed before water may be available to each phase of the development of Kealakehe.

H. William Sewake
Manager

CS

cc - State Housing Finance & Development Corporation
Belt Collins and Associates

BELT COLLINS
& ASSOCIATES
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[illegible] Ala Moana Blvd., Suite [illegible] Honolulu, Hawaii [illegible]
Phone: (808) 521-5361 Telex: BELTH [illegible] Fax: (808) [illegible]
Honolulu • Singapore • Australia • Hong Kong • Saipan

September 12, 1990
841.0101/1898

Mr. William Sewake, Manager
Department of Water Supply
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Sewake:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for your comments on the above project. We concur that development of sources and the improvement of existing transmission facilities are needed before water may be available to each phase of the development of Kealakehe.

Very truly yours,

Lee William Sichter

University of Hawaii at Manoa

Environmental Center
Crawford 317 • 2550 Campus Road
Honolulu, Hawaii 96822
Telephone (808) 948-7361

September 7, 1990
RE:0559

Governor, State of Hawaii
c/o Office of Environmental Quality Control
465 South King Street, Room 104
Honolulu, Hawaii 96813

Dear Sir:

Environmental Impact Statement (EIS)
Kealakehe Planned Community
Kealakehe, Kailua-Kona, Hawai'i

The above referenced document describes impacts associated with a 960 acre project on the western slope of Mt. Hualalai composed of 4,158 housing units (60 percent of which are priced in the affordable category) as well as the following features: a 195 acre golf course (proposed for transfer to the County of Hawai'i for use as an effluent disposal area for a nearby County sewage treatment plant); 3 parks; an archaeological preserve; a nature preserve for 8 of 19 endangered uhi uhi trees on the project site; an elementary school and high school; 2 church/day care sites; and 3 separate commercial areas.

Our review was prepared with the assistance of Michael Graves, Anthropology; and Robert Irwin, Environmental Center. Due to an incorrect deadline date printed on the transmittal memo that accompanied our copies of the Draft EIS, we were not able to get comments from all of our reviewers in time for the true deadline which was recently called to our attention. We regret this mishap, but will forward further comments as they become available to us.

Archaeology

Our reviewers, noting that the general quality of individual site reporting, assessment, and recommendations was good, nevertheless take substantial objection to the lack of cumulative impact assessment both in the discussion in the main body of the Draft EIS and in the appended archaeological inventory survey. Nowhere is the significance of all or a

portion of the sites assessed. This is necessary since the project area is large enough to include many components of an entire settlement system (e.g., habitation, burial, agricultural, and ceremonial structures). Thus, not only should the sites be evaluated in isolation from each other, but groups of sites also should be assessed by the same set of criteria. Not doing so may result in a skewing of the array and distribution of sites to be preserved. In other words, the current approach (with its narrow focus on individual site assessment) may preserve scattered and individually appropriate sites at the cost of groups of sites which were formerly socially and behaviorally linked.

Three questions about the criteria used to assign significance were raised by our reviewers:

(1) Why are only ceremonial and burial features of cultural value to Hawaiians? Where has it been established that Hawaiians attached no value to habitation or agricultural features?

(2) How has it been determined that, where sites are only significant for their information content, it is preferable to retrieve information immediately? The conclusion is drawn that this is the preference of the archaeological community. This conclusion is unwarranted. Furthermore, there is good reason to preserve a sample of sites which are significant for their information value for data recovery in the future when archaeological means for recovering and documenting data will have improved. Preserving these sites will also allow time for disagreements on site specific significance criteria to be resolved as knowledge of specific archaeological regions increases and is subjected to consideration by the archaeological community at large.

(3) Why were domains, which were identified in the archaeological inventory, not considered with the significance criteria for individual sites? The criteria for contextualizing sites within archaeological and historical research domains have been developed in some detail at the federal level.

We thank you for the opportunity to have reviewed this document and look forward to your response to our comments.

Yours truly,

John T. Harrison, Ph.D.
Environmental Coordinator

cc: Housing Finance
& Development Corp.
Belt Collins & Assoc. ✓
Roger Fujioka
Michael Graves
Robert Irwin

BCA
BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

September 12, 1990
841.0101/1898

Mr. John T. Harrison, Ph.D.
Environmental Coordinator
Environmental Center
University of Hawaii at Manoa
Crawford 317
2550 Campus Road
Honolulu, Hawaii 96822

Dear Mr. Harrison:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for your comments on the above project. We have seriously considered your comments and have asked our consulting archaeologist, Paul H. Rosendahl, to review them. Dr. Rosendahl subsequently discussed your comments with Mr. Ross Cordy of the State's Historic Preservation Program. As a result of these discussions, we cannot agree with your objection about the lack of cumulative impact assessment.

Dr. Rosendahl is a very well qualified archaeologist who has extensive experience in the field and has conducted numerous studies that have been accepted by the State's Historic Preservation Program. Dr. Rosendahl's study was submitted to the State for approval in early 1990.

The Department of Land and Natural Resources-Historic Preservation Program/State Historic Preservation Office (DLNR-HPP/SHPO) has reviewed the archaeologist's report as contained in the environmental impact statement. The DLNR-HPP/SHPO has found the study to be adequate and has found that it meets the requirements of Chapter 6E Historic Preservation (Hawaii Revised Statutes). Further, they have concurred with the site significance assessments and with the recommended general mitigation plans.

Dr. Rosendahl and Mr. Cordy both recommend that if the Environmental Center wishes any clarification of these findings or the process by which they were reached, that the inquiry be directed to the Historic Preservation Program. As a participant in the process, the HFDC would also like to be made a party to these discussions.

Very truly yours,

Lee William Sichter

STATE OF HAWAII
OFFICE OF HAWAIIAN AFFAIRS
1600 KAPIOLANI BLVD., SUITE 1500
HONOLULU, HAWAII 96814
(808) 548-8960
(808) 946-2642

September 7, 1990
HAND DELIVERED

The Honorable John Waihee
Governor, State of Hawaii
c/o Office of Environmental Quality Control
465 South King Street, Room 104
Honolulu, Hawaii 96813

Dear Governor Waihee:

Re: Kealakehe Planned Community With Appendix (DEIS)

Thank you for the opportunity to review the above-referenced draft environmental statement. The Office of Hawaiian Affairs has the following concerns and comments.

1. The report makes no comment of the fact that the property on which the proposed project will be located is 5(b) ceded land. The Office of Hawaiian Affairs and Department of Hawaiian Homes Lands entitlements from the ceded lands are currently the subject of discussions between this office and members of your staff. Our specific concerns are known in this area and are only noted here.

2. We commend the plan for preserving and incorporating many of the archaeological features found on the property into the plan. However, a monitoring and explicit managment system must be planned to insure against future possible harm or desecration.

3. The plan to establish an escrow fund for long-term preservation of endangered and candidate endangered species through propagation is an excellent idea. However, we strongly disagree with any plan which would allow relocation of an endangered or candidate endangered species on the basis that such species is protected and/or preserved by proprogation in a "nursery" setting. When an endangered species, whether plant or animal is removed from its natural surrounding we loose knowledge, understanding and meaning. We strongly caution against creating a "zoo" like atmosphere where endangered plants can be propogated, thus allowing those found in natural settings to be moved and potentially killed.

All of the endangered trees in this project area should remain in place since the report indicates that the number of trees is small and can be accomodated in the design. An adequate buffer zone should also be provided. In addition, the report indicates that Uhi uhi trees have not previously been found at this elevation, making them not only endangered but unique.

Thank you again for the opportunity to comment on this project. We have no other comments at this time.

Sincerely

Stanley H. L. Lum

STANLEY H. L. LUM
Deputy Administrator

cc: State of Hawaii - Housing Finance & Development Corporation
Belt Collins and Associates

BCA
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& ASSOCIATES
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680 Ala Moana Blvd., Suite 2[illegible] Honolulu, Hawaii 9[illegible]
Phone: [illegible] Telex: 8[illegible] Fax: [illegible]
Hawaii • Singapore • Australia • Hong Kong • Guam

September 12, 1990
841.0101/1898

Mr. Stanley H.L. Lum
Deputy Administrator
Office of Hawaiian Affairs
State of Hawaii
1600 Kapiolani Boulevard
Suite 1500
Honolulu, Hawaii 96814

Dear Mr. Lum:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for your comments on the above project. Following are responses to your comments in the order they appear in your letter.

1. The Kealakehe portion of the proposed project is 5(b) ceded land. Pages IV-28 and IV-29 of the EIS text have been revised to include a statement to this effect.

2. A monitoring program and management system for those archaeological sites to be preserved will be addressed in an Historic Sites Mitigation Plan which is required by the State's Historic Sites Office.

3. As discussed on page IV-23 of the EIS, Hawaii state law does not permit the relocation of endangered plants. Thus, the endangered plants identified within the project area cannot be moved or relocated unless the law is amended to explicitly permit it.

Very truly yours,

Lee William Sichter

SHOPO

STATE OF HAWAII ORGANIZATION OF POLICE OFFICERS

September 6, 1990

Mr. Lee Sichter, Senior Planner
Belt Collins & Associates
680 Ala Moana Blvd., Suite 200
Honolulu, HI 96813

Dear Mr. Sichter:

The State of Hawaii Organization of Police Officers (SHOPO) would like to go on record with our concerns of the Kona Dump and its impact on the health and welfare of our members who must work at the adjacent Kona Police Station. Our records indicate that this has been an on-going problem since the Kona Police Station opened its doors in 1988.

As an organization, we have filed an official complaint with the Department of Labor (Division of Safety and Health), expressed our concerns about the safety and health of our members with the Chief of Police and at County Council hearings, and have discussed these matters with State Legislators. At several County hearings, we have heard discussions about stopping the dumping at this particular site and problems with attempts to cover and bury the existing garbage. Nothing seems to be sufficient to resolve the problems with noxious fumes and underground fires. Our members continue to complain about the stench and fires of the neighboring dump.

We understand that you are doing a study for the State of Hawaii on the possibilities of developing affordable housing projects within the near vicinity. Have you reached any conclusions as to whether the Kona Dump can be properly covered and what you foresee as a feasible time frame for the physical covering of the site or its possible relocation? With your knowledge of the area and the problems, is it reasonable to request that the County of Hawaii relocate the Kona Police Station to another temporary location until the Kona Dump site is properly handled?

We would appreciate your opinion on these matters as we continue to voice our concerns on the problems our Officers face with their daily working conditions at the Kona Police Station. We realize that this is a very complex problem but would appreciate any information you could give us which would help us persuade the County to resolve this problem as expeditiously as possible.

Thank you for your attention to these matters. Should you have any questions or need information contained in our files, we would be happy to share them with you.

Very truly yours,

John E. Woo

JOHN E. WOO
President

GVA jmo
cc: Paul Silva, Hawaii Chapter Chairman; Representative Virginia Isbell

1717 Hoe Street, Honolulu, HI 96819 Telephone: 847-4676

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

September 12, 1990
841.0101/1898

Mr. John E. Woo, President
State of Hawaii Organization of Police Officers
1717 Hoe Street
Honolulu, Hawaii 96819

Dear Mr. Woo:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for your inquiry about the above project. The proposed project consists of approximately 4,158 residential units to be developed on property just north of the Kealakehe Landfill and the County Police Station. The Housing Finance and Development Corporation was originally advised by the County of Hawaii that the landfill would be closed in 1991. Planning for the residential project has proceeded based upon this assumption. Within the past two weeks, the County has revised its projected date of landfill closure to sometime in 1992.

Because the landfill is located on County property and is under the jurisdiction of the County of Hawaii, an analysis of how and when it should be closed was not conducted as part of our planning efforts for the Kealakehe project. However, we are aware that landfills can be successfully closed and converted to usable land areas and have indicated in our plan that the landfill site should be considered for eventual development as an open-space park area and that the adjacent land, including the police station, be developed as a Civic Center for the West Hawaii region.

A detailed Air Quality analysis was conducted for our project and it concluded the following:

"Potential impacts on the project from landfill emissions will be lessened but may not be eliminated with the closure of the landfill. Recurring subsurface fires could continue to persist even after landfill operations cease. The analysis of potential impacts on the project from emissions emanating from the Kailua Landfill suggests that further study of this problem is warranted before drawing any definite conclusions."

Although relocating the Police Station to a temporary location until the landfill site is "properly handled" is a matter of County policy and is clearly beyond the jurisdiction of the State's Housing Finance and Development Corporation, it is a reasonable action given the officers' concern over the landfill. However, we continue to support the development of a Civic Center in the area of the police station once the landfill has been closed.

We are unable to determine with any degree of certainty what the consequences of mining the landfill for recyclable materials and extinguishing the ground fires will be. Therefore, while we believe that the volume of emissions may actually increase, we can not make a definitive statement that they will increase. The actual process utilized for the mining and extinguishing will determine the volume of emissions. However, it must be recognized that mining the landfill is not the only available alternative. A comprehensive closure plan could be an effective solution to the landfill problem. Once dumping activity at the landfill is terminated, the mound could be vented to

neutralize a build-up of landfill gas and mitigate the possibility of spontaneous combustion, covered with approximately three feet topsoil, and a monitoring program implemented to minimize the potential for flare-ups.

Thus, a determination as to whether the Police Station should be temporarily located should be based upon a finding that the existing situation is unacceptable and will further deteriorate. Relocation may be a good idea, however, its costs and benefits must be weighed very carefully. The County is clearly in the best position to make such a determination.

Very truly yours,

Lee William Sichter

P.O Box 2075
Kailua Kona, Hawaii 96745 .

September 6, 1990

Mr. Lee William SICHTER
Senior Planner
Belt Collins & Associates
680 Ala Moana Blvd., Suite 200

SUBJECT: Kealakehe Planned Development

Dear Mr. SICHTER:

As a resident of Kona Iam of the opinion that there should be no construction started on the Kealakehe Planned Community Project. Until the problems with Kailua Landfill have benn completly resolved. This should include the mining of the (DUMP).

yõur consideration of my opinion will be greatly appreciated.

Daniel J. MINAN

Environmental Assessment
for

KEALAKEHE PLANNED COMMUNITY

Kailua Kona, Hawaii

Prepared for

STATE OF HAWAII
HOUSING FINANCE AND DEVELOPMENT CORPORATION

by
Belt Collins & Associates

February 14, 1990

CHAPTER 9
PARTIES TO BE CONSULTED IN THE PREPARATION OF AN EIS

The following governmental agencies and community organizations will be consulted during preparation of the Environmental Impact Statement:

State of Hawaii
Department of Health
Department of Land and Natural Resources
Department of Labor and Industrial Relations
Department of Business and Economic Development
Hawaii Housing Authority
Department of Transportation
Department of Human Services
Department of Education
Office of State Planning

County of Hawaii
Public Works Department
Office of Housing and Community Development
Police Department
Department of Water Supply
Planning Department
Fire Department
Department of Parks and Recreation

Federal Government
Department of Housing and Urban Development
Department of the Interior, Fish and Wildlife Service
National Park Service

Public Utilities
Hawaiian Telephone
Hilo Electric Light Company

Community Organizations
Kona Chamber of Commerce
Leeward Planning Conference
Board of Realtors
Representatives of Kailua Kona Communities

Elected Officials

WERE ANY PUBLIC HEARINGS HELD?

consisting of a minimum of 1,044 component features have been identified within the project area. Among the sites, 32 consist of single components and the rest consist of two to one hundred and twenty components. The total number of features may be further distributed among eight general functional categories; agriculture (793 features), habitation (21 features), transportation (20 features), markers (32 features), agricultural/habitation (153 features), land division (10 features), possible burial (8 features), and possible ceremonial (5).

The distribution and density of features within the project area indicate that the area was used primarily for relatively intense dry land agriculture. Agriculture complexes are most numerous in the upper portions of the area, at elevations of 500 feet or greater. The most common agricultural features are pahoehoe excavations and rock mounds. These two formal types comprise 66% of all agricultural features, and 57.4% of all identified features. It is likely that additional pahoehoe excavations and mounds are present within the project area. The location of archaeological sites is presented in Figures 11 and 12.

3.1.9 Air Quality

Due to the relative lack of development, air quality in the project area might be expected to be good. However, the Kealakehe landfill located at the southern corner of the project site is a periodic source of noxious odors. County officials have indicated that the landfill will soon be closed and the rubbish mined and removed to a new location offsite. This process is projected to require up to ten years. Once the mining of the rubbish begins, and underground fires which have been smoldering are exposed to air, the volume of emissions from the landfill may actually increase during the short term due to periodic flare-ups. ANY ADDITIONAL CONST. AT THIS TIME WILL ONLY CREAT MORE PROBLEMS

On a regional scale, air quality has been impacted in recent years by the continuing eruptive activity associated with the Puu O'o vent on the southeast slope of Kilauea volcano. Particulate emissions in the Kailua-Kona area are most evident during periods of light trade winds.

3.1.10 Noise

Fixed source noise is the principal form of noise at the subject property and is directly related to activities at the Kelalakehe Landfill. Traffic noise is associated with Queen Kaahumanu Highway.

3.1.11 Natural Hazards

The subject property may be potentially impacted by two forms of natural hazards;

and the *ahupua'a* of Honokohau to the north, and Queen Kaahumanu Highway and the makai lands of Kealakehe to the west.

Existing uses on the property include the County of Hawaii Kealakehe landfill and the County Police Substation. The landfill located at the southwestern corner of the project site presently includes two facilities: a rubbish dump which occupies about 15 acres of land, and a solid waste transfer station. Total acreage for the landfill is about 30 acres. The County plans to close the landfill and relocate it to another site in West Hawaii at Puuanahulu. However, it is unclear at this time what the timetable for closing and relocating will be. Relocation will include mining the site for usable heavy metals and salvageable materials. Over a period of time the site would be reclaimed for use by the community. Once the landfill is closed and properly reclaimed, it could be used as open space or a park facility. LETS GET THE LAND FILL CLOSED & RECLAIMED BEFORE ANY ADDITIONAL CONSTRUCTION

Adjacent uses to the project area include a quarry operation to the north on property owned by Robert McClean, and a number of housing projects to the east and mauka of the project site including Kealakehe House Lots Increments I and II; Kealakehe Public Housing; Jack Hall Memorial Housing; Kaimalino Multi-Family Units; La'ilani Multi-Family Rental Housing project, and the Queen Liliuokalani Village south of Palani Road. The subject property is presently vacant and is leased to the Palani Ranch for the grazing of cattle.

1.6 POTENTIAL IMPACTS, MITIGATION MEASURES & ALTERNATIVES

1.6.1 Land Use Impacts

Development of the subject property as a master planned residential community will impact the physical character of the land. The vacant land will be transformed through the development of a variety of urban-related uses including residential units; public facilities and infrastructure; schools; and neighborhood and regional serving recreational uses.

1.6.2 Mitigating Measures

The entire project will be developed according to a detailed master plan. Phasing of the project in a manner consistent with the master plan will ensure that impacts upon the land are minimized through the proper siting and timing of infrastructure development and the landscaping.

1.6.3 Traffic Conditions

Traffic volumes will increase for the area. The development of a residential community of up to 5,000 units will result in a significant expansion of the Kailua-Kona area population and a

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& ASSOCIATES

Engineering • Planning
Landscape Architecture

September 12, 1990
841.0101/1898

Mr. Daniel J. Minan
P.O.Box 2075
Kailua-Kona, Hawaii 96745

Dear Mr. Minan:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for your comments on the above project. In view of the critical need for affordable housing in West Hawaii, we do not believe it is appropriate to halt the development of the proposed project until the landfill is closed and mined as you suggest. In order to ensure that homes are available for occupancy within the next 20 months, we must proceed now with the planning and engineering for the project.

The Housing Finance and Development Corporation undertook the proposed project with the understanding that the County of Hawaii would soon be closing the landfill and opening a new landfill facility in West Hawaii. The Kealakehe landfill was not considered to be a permanent constraint on development. The landfill is a temporary use of the County property and does not constitute an irreversible alteration of the land. Therefore, for purposes of long-range planning, it is appropriate to continue with development plans for the proposed project.

As discussed in the consultant's report on Air Quality, the Environmental Protection Agency has determined that the landfill is not toxic. However, in view of the concerns over the landfill, the HFDC supports its closure by May, 1992. Construction of the first increment of homes at the project will require approximately 20 months. We are anticipating the County will close the landfill before the first increment of homes are completed and that landfill operations will be relocated to a new site. If construction of the first increment of homes were delayed until the landfill is closed and mined, two or more years will have been lost before home construction could even begin. Demand for affordable housing is steadily increasing in West Hawaii. We feel that it is, therefore, appropriate to time residential construction with the landfill closing so that homes can be occupied as soon as practical.

No public hearings have been held in conjunction with the Kealakehe project.

Very truly yours,

Lee William Sichter

September 7, 1990

Mr. Lee William Sichter
Senior Planner
Belt Collins & Associates
680 Ala Moana Blvd., Suite 200
Honolulu, Hawaii 96813

Subject: Kealakehe Planned Community

Dear Mr. Sichter:

This letter is in response to the development proposed for the Kealakehe area located near the Kailua-Kona Landfill. I am an employee of the Hawaii County Police Department and I am not a police officer, but a civilian employee.

I am most grateful for having a brand new police station, but I must say that it is totally ridiculous to be situated right next to this dump and put up with this smell and unhealthy atmosphere. I am more fortunate than the other clerical staff, because my job does not have me sit at my desk all day making it impossible to leave this place. Thank God I still have work at the old station which allows me to leave once and awhile. But what about the people that can't leave and have to be here all the time like the secretaries and the dispatchers?

I am an Evidence Custodian. I not only store murder weapons, and drugs for court, but I also store personal belongings from victims of thefts, buglaries, and yes traffic fatalities. Do you know what it's like to give directions to the police station to the parents of their deceased children in order to pick up their belongings? Half of the time, these people are from the mainland and the nearest landmark "is" the dump. Needless to say, the already sensitive situation is made more uncomfortable by the present stench and unsightlyness of the landfill across the street.

My point is, the people that work in this station aren't the only ones to have to tolerate these surroundings, but the local people, the tourists, and the public in general. Therefore, I can't see constructing anything new in this area including the sewage plant until the landfill is closed and cleaned up. As a planner you appear to have a job that requires foresight in order to create what you do. You gather facts and work from what you create. Well I'm the person that lives and works here and speaks from doing and living. I am not a thought on a piece of paper that someone else may have to live with.

Wouldn't progressing be the resolve of the present problems such as the landfill before you go around constructing new things? I wouldn't get a new dress and put it on my 9 month old daughter if I knew she was wearing a diaper with "dump" in it. I'd clean it up first!

Respectfully,

Mellaney L. Bean

Mellaney L. Bean
Evidence Custodian

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Hawaii • Singapore • Australia • Hong Kong • Saipan

September 12, 1990
841.0101/1898

Ms. Mellaney L. Bean
P.O.Box 1797
Kealakekua, Hawaii 96750

Dear Ms. Bean:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for your comments on the above project. In view of the critical need for affordable housing in West Hawaii, we do not believe it is appropriate to halt the development of the proposed project until the landfill is closed. In order to ensure that homes are available for occupancy within the next 20 months, we must proceed now with the planning and engineering for the project.

The Housing Finance and Development Corporation undertook the proposed project with the understanding that the County of Hawaii would soon be closing the landfill and opening a new landfill facility in West Hawaii. The Kealakehe landfill was not considered to be a permanent constraint on development. The landfill is a temporary use of the County property and does not constitute an irreversible alteration of the land. Therefore, for purposes of long-range planning, it is appropriate to continue with development plans for the proposed project.

The HFDC supports the landfill's closure by May, 1992. Construction of the first increment of homes at the project will require approximately 20 months. We are anticipating the County will close the landfill before the first increment of homes are completed and that landfill operations will be relocated to a new site. If construction of the first increment of homes were delayed until the landfill is closed, two or more years will have been lost before home construction could even begin. Demand for affordable housing is steadily increasing in West Hawaii. We feel that it is, therefore, appropriate to time residential construction with the landfill closing so that homes can be occupied as soon as practical.

Very truly yours,

Lee William Sichter

P.O. Box 1994
Kealakekua, HI 96750

September 6, 1990

Mr. Lee William Sichter
Senior Planner
Belt Collins & Associates
680 Ala Moana Blvd., Suite 200
Honolulu, HI 96813

Dear Mr. Sichter:

I am a resident of Kona and an employee of the Hawaii County Police Department, Kona Police Station, which is located next to the Kailua Landfill.

I think that before there is any further development in the Kealakehe area, the problems involving the Kailua Landfill should be dealt with first. There are too many existing problems and further development in the Kealakehe area, or any other area, would only add to the problems.

Thank you for your consideration in this matter.

Sincerely,

Sherri Kunitomo

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September 12, 1990
841.0101/1898

Ms. Sherri Kunimoto
P.O.Box 1994
Kealakekua, Hawaii 96750

Dear Ms. Kunimoto:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for your comments on the above project. In view of the critical need for affordable housing in West Hawaii, we do not believe it is appropriate to halt the development of the proposed project until the landfill is closed. In order to ensure that homes are available for occupancy within the next 20 months, we must proceed now with the planning and engineering for the project.

The Housing Finance and Development Corporation undertook the proposed project with the understanding that the County of Hawaii would soon be closing the landfill and opening a new landfill facility in West Hawaii. The Kealakehe landfill was not considered to be a permanent constraint on development. The landfill is a temporary use of the County property and does not constitute an irreversible alteration of the land. Therefore, for purposes of long-range planning, it is appropriate to continue with development plans for the proposed project.

The HFDC supports the landfill's closure by May, 1992. Construction of the first increment of homes at the project will require approximately 20 months. We are anticipating the County will close the landfill before the first increment of homes are completed and that landfill operations will be relocated to a new site. If construction of the first increment of homes were delayed until the landfill is closed, two or more years will have been lost before home construction could even begin. Demand for affordable housing is steadily increasing in West Hawaii. We feel that it is, therefore, appropriate to time residential construction with the landfill closing so that homes can be occupied as soon as practical.

Very truly yours,

Lee William Sichter

P.O. Box 97
Captain Cook, HI 96704
September 6, 1990

Mr. Lee W. Sichter
Belt Collins & Associates
680 Ala Moana Blvd., Suite 200
Honolulu, Hawaii 96813

Dear Mr. Sichter:

Thank you for coming to the Kona Police Station to meet with several employees of the Hawaii Police Department.

Many of us at the meeting had no idea of the reality of anyone considering developing the land near the landfill prior to its removal so soon. The plans for the development took some of us by surprise.

I feel that the noxious fumes emanating from the landfill is a major concern to us as well as the residents of your project.

It's obvious that the removal of the landfill is taking longer than anticipated. Meanwhile, the residents as well as those of us that work near the landfill must breathe these noxious fumes on a daily basis. Our building have been equipped with special airfilters in the airconditioner system as well as other devices helps a little to bear the fumes, but not by much. We're praying that the fumes from the landfill won't have a long term effect on our health on all of us that reside or work in the area.

Please reconsider the adverse effects that should the construction/completion of the proposed project begin prior to the removal and mining of the landfill, more serious health related problems could occur to the residents of your project. We understand that it will take several years before the problems of the landfill can be resolved.

I realize that the solution to the landfill problem is not in the interest of your company. Any advice you can render as far as other avenues we could pursue will be greatly appreciated.

Thank you for your time.

Sincerely,

Jamie Takimoto

Mrs. Jamie Takimoto

xc: Rep. Virginia Isbell

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& ASSOCIATES
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September 12, 1990
841.0101/1898

Mrs. Jamie Takimoto
P.O.Box 97
Captain Cook, Hawaii 96704

Dear Mrs. Takimoto:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for your comments on the above project. In view of the critical need for affordable housing in West Hawaii, we do not believe it is appropriate to halt the development of the proposed project until the landfill is closed. In order to ensure that homes are available for occupancy within the next 20 months, we must proceed now with the planning and engineering for the project.

The Housing Finance and Development Corporation undertook the proposed project with the understanding that the County of Hawaii would soon be closing the landfill and opening a new landfill facility in West Hawaii. The Kealakehe landfill was not considered to be a permanent constraint on development. The landfill is a temporary use of the County property and does not constitute an irreversible alteration of the land. Therefore, for purposes of long-range planning, it is appropriate to continue with development plans for the proposed project.

The HFDC supports the landfill's closure by May, 1992. Construction of the first increment of homes at the project will require approximately 20 months. We are anticipating the County will close the landfill before the first increment of homes are completed and that landfill operations will be relocated to a new site. If construction of the first increment of homes were delayed until the landfill is closed, two or more years will have been lost before home construction could even begin. Demand for affordable housing is steadily increasing in West Hawaii. We feel that it is, therefore, appropriate to time residential construction with the landfill closing so that homes can be occupied as soon as practical.

We expect that the closing of the landfill would eliminate any potential health hazards. Landfill sites have been successfully closed and converted to other uses in jurisdictions on the mainland. We are not aware of any health hazards posed by a landfill that has been properly closed.

Very truly yours,

Lee William Sichter

Mr. Lee William Sichter
Senior Planner
Belt Collins and Associates
680 Ala Moana Blvd Suite 200
Honolulu, Hawaii 96813

September 6, 1990

Dear Mr. Sichter,

As a resident of the Kealakehe area and employee at the Hawaii County Police Station at Kealakehe, I would first like to express my appreciation for taking the time to meet with us in Kona.

There are several concerns that I would like to have addressed in regards to the proposed Kealakehe Development. The concerns are directly related to the Kealakehe Landfill problem that has plagued the Police personnel since occupying the new facility in October of 1988. These problems that we have been experiencing could affect the Kealakehe Development.

The Kealakehe Landfill has had the problem of the underground fire for years. Periodically it has flared to the surface and caused the closing of the Police facility and nearby Kealakehe School. My concern is that the proposed development of the Kealakehe area would be closer to the landfill than the Kealakehe school, thereby placing it in the range of the landfill problem.

My second concern is the stench and noxious fumes from the landfill has plagued the Police Personnel and would further affect the project area.

A third concern is in regards to hazardous wastes that may be buried in the landfill. Although we have been told that air quality checks found no evidence of toxic fumes or materials being emitted from the landfill, noone knows what is buried in the site. Although nothing has been detected as yet, what is burning today can be something totally different from what will be burning tomorrow. There could be anything in the landfill including petroleum products, pesticides, other chemicals and even the possibility of asbestos.

The fourth concern is the plan to mine the landfill in order to put the "fire" out. During this process the fumes and stench could be many times worse than what we now experience. This concern is also an issue with the third concern, the fact that hazardous wastes and toxic materials may be contained in the landfill and the mining could cause a serious health problem over a wide area.

The fifth concern is that continued development projects produce additional garbage which further adds to the current landfill problem of its capacity nearing its maximum. The County of Hawaii is further expanding the landfill by extending it in the makai direction which may soon affect us even more than now.

In line with concern number five, the County has not been able to resolve the dump problem. The planned replacement landfill site at Puuanahulu has been delayed and argued for such a time period that the earliest possible date of it being readied for use is 1992, and even that date seems unrealistic. I feel that development is necessary but we need to address the concerns and problems that are caused by the development which in this case is the Kealakehe Landfill.

To summarize the five concerns that I have listed can be listed as follows:

1. The Kealakehe Landfill is within the range of the Kealakehe Development and problems from the landfill will affect the deveopment area.

2. The stench, noxious fumes, and possible hazardous and toxic materials may also affect the development area.

3. The big question is "WHAT IS BURIED IN THE KEALAKEHE LANDFILL". Questions raised by this thought are: Are there toxic and hazardous materials in the landfill??

4. The continuous underground fire presents a problem with the only solution being to mine the dump and put out the fires. A big question here which relates to concerns 2 and 3, is "WHAT IS GOING TO HAPPEN DURING THE MINING". It is expected that the stench and fumes will greatly increase during this time. The Kealakehe Development would be in the range of being affected.

5. More development only creates more garbage and further aggravates the situation with the Kealakehe Landfill. With the landfill being a maximum capacity, and further expanding the landfill and further affecting the area and personnel working in the area. The infrastructure needs to be looked at including landfills with more development.

I would like to again express my appreciation for your time to meet with us and explaining the entire process.

I fully agree that the Kealakehe Development of affordable housing is a much needed project for the Kona area, but we need to take a serious look at the current problems which will affect the Kealakehe Development.

SINCERELY YOURS

Blane S. Takamine
P.O. Box 4093
Kailua-Kona, Hawaii
PH: 326-4204

cc
Govenor John Waihee

BELT COLLINS
& ASSOCIATES
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September 12, 1990
841.0101/1898

Detective Sergeant Blane S. Takamine
P.O.Box 4093
Kailua-Kona, Hawaii 96745

Dear Detective Sergeant Takamine:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for your comments on the above project. Following are responses to your concerns in the order they are presented in your letter.

1. A comprehensive closure plan could be an effective solution to the landfill problem. Once dumping activity at the landfill is terminated, the mound could be vented to neutralize a build-up of landfill gas and mitigate the possibility of spontaneous combustion, covered with approximately three feet topsoil, and a monitoring program implemented to minimize the potential for flare-ups.

2. A comprehensive closure plan that is properly implemented should help to greatly reduce the noxious odors from the landfill.

3. The matter of toxic wastes is an issue of considerable concern. However, there is no evidence to suggest that the fumes emanating from the landfill are toxic. The monitoring program discussed above would certainly help public health officials determine the existence of toxic emissions from the landfill after it is closed.

4. The Housing Finance and Development Corporation advocates the closure of the landfill by 1992. We are concerned that mining may result in an increase of emissions, and therefore, support a comprehensive closure plan as suggested above.

5. The opening of a new landfill is an important issue for the proposed project. Should the County be unable to develop a new landfill site by the time the first increment of homes in the Kealakehe project are available for occupancy, solid waste from the project would most likely have to be trucked to landfills in East Hawaii at the expense of the new Kealakehe residents.

Very truly yours,

Lee William Sichter

September 05, 1990

Mr. Lee William Sichter
Senior Planner
Belt Collins & Associates
680 Ala Moana Blvd., Suite 200
Honolulu, Hawaii 96813

Subject: Kealakehe Planned Community

Dear Mr. Sichter:

This letter is in regards to the Kailua-Kona Landfill located in the Kealakehe Area. We as residents of Kona, as well as employees of the Hawaii County Police Department, wish to express our concerns on the future development of the Kealakehe District.

The Landfill has been an overwhelming problem for years now. Everyone knows how awful the smell is from a rubbish dump. Having to work next door to it makes us experts on this topic. Whenever there is a fire at the dump, it poses hazardous conditions to it's surroundings. Depending on the wind direction, the vehicles on the main highway are affected and the housing development as well as Kealakehe School are also affected. Whether or not there are toxic fumes is still a major question. Every construction site in Kona disposes their waste at this landfill. There has been complaints by the residents of Kealakehe about the smell even when the dump is not on fire.

The promises and proposals are very misleading. Giving everyone hope that the problem will be solved. What is the real truth and why is it taking so long? Major projects can be planned and built in no time so why is the time span so long on this one?

It is also degrading to our Political System when we have to give directions to anyone telling them that the Main Police Station is next to the dump and it will also be near the Sewage Treatment Plant in the near future. On top of that, they plan to build a Civic Center. I always thought of County and State buildings as prestigious.

More Development in this area will only cause more problems. Unless the dump is moved and mined before the Proposals become a reality, there will be massive amounts of garbage to be added to the now existing overload.

Also, the people that move into this area will be prone to health problems everytime the dump gives off fumes or catches on fire.

Thank you for your time.

Wendy Butterworth

Wendy BUTTERWORTH

cc: John Waihee, Governor, State of Hawaii
Larry Tanimoto, Mayor, County of Hawaii
Virginia Isbell, House of Representatives

see attached:

This attached letter are names of employees of the Hawaii County Police Department who share the same viewpoints that are noted in my letter. Please take into consideration that each name has as much to say and are as concerned as I am.

	PRINT	SIGN
1.	Kenneth N. Uyeda #146	
2.	SAM KAWAMOTO	
3.	Jamie Takimoto	
4.	ERNEST SALDUA	
5.	Blane Takamine	
6.	Raymond W. Correa	
7.	Calvin M Okahara	
8.	LIONEL C LINCOLN, JR	#59
9.	Sherri Kunitomo	
10.	Palecho Domingo	
11.	Mellaney L. Bean	
12.	JULIAN H. SHIROMA	
13.	GILBERT M. GASPAR JR #2683	
14.	Robert Foster #278	
15.	DANIEL J. MINAN	

	PRINT	SIGN	
16.	Perry H. KEAWEHA		S.S. No.
17.	Whitney D. JENKINS		
18.	Joseph K. Hing		
19.	Jamie M. Kawauchi	Jamie M. Kawauchi	575-54-7297
20.	Errol M. Ishimine		
21.	DARYL K. PICADURA		575-62-572
22.	John E. Dawes	JOHN E. DAWES	576-48-4231
23.	Guy Kaniho	GUY KANIHO	575 84 0619
24.		DAVID A. KAWAUCHI	575-52-0240
25.	LOIS KAWAMOTO		
26.	Rudy EMBERNATE		
27.	DON WATSON		553-92-9045
28.	Charles KELIIPIO		549-02-5191
29.	Ron Paul		576-90-9943
30.	Kelvin Freita		515-72-4466

	PRINT	SIGN
31.	Gregorio ANTOLIN Jr.	Gregorio Antolin Jr.
32.	Michael M. Adamas	
33.	LINDA K. HIRAI	Linda K. Hirai
34.	H. J. Silva	H. J. Silva
35.	Patrick MENINO Jr.	Patrick Menino Jr.
36.	BH Ballesteros	
37.	Sharon Kennelly	Sharon Kennelly
38.	Kenneth BUGADO Jr.	Kenneth Bugado Jr.
39.	Kelley K. MATSUMOTO	Kelley K. Matsumoto
40.	Kelly K. KAAUMOANA	Kelly K. Kaaumoana
41.	Leroy D. VICTORINO	Leroy D. Victorino
42.	Mark OHATA	Mark Ohata
43.	Wayne T. MITSUNAGA	Wayne T. Mitsunaga
44.	M. A. Spalding	M. A. Spalding
45.	ROBERT P. HICKCOX	Robert P. Hickcox

	PRINT	SIGN
46.	Charlie N Adams	
47.	Belinda L. Kahiwa	Belinda L Kahiwa
48.	Jim Fenney	
49.	Wayne Young	Wayne K. Young
50.	Dorothy V. Kennell	Dorothy V. Kennell
51.	Thomas Hickcox	Thomas D. Hickcox
52.	Gregory K N Trinidad	Gregory K.N. Trinidad
53.	Walter Allman	Walter Allman III

This attached letter are names of residents of the Hawaii County : who share the same viewpoints that are noted in my letter. Please take into consideration that each name has as much to say and are as concerned as I am.

	PRINT		SIGN
1.	Kathleen Becker	73-1082 Ahikawa KK 96740	Kathleen Becker
	HARRIET P. BROWN		
2.	Harriet P. Brown	76-6220 Lehua Rd. Kailua-Kona, Hi 96740	
	LUANNE S. TREVENA		
3.	Luanne Trevena	P.O. 8228 Kealakekua, Hi	
	SUSAN McCOURT		
4.	Susan McCourt	POBox 2447 Kailua-Kona HI 96745	Susan McCourt
5.	Deborah A. Wiley	PO Box 228 Kealakekua Hi. 96750	Deborah A. Wiley
	LORELEI T. McGUIRE		
6.	Lorlei T. McGuire	P.O. Box 1306 Kealakekua HI 96750	Lorlei T McGuire
	VALERIE M. KOS		
7.	Valerie M. Kos	P.O. Box 799 Honaunau HI 96726	Valerie M. Kos
8.	RONALD M. IWAI	PO Box 1665 KEALAKEKUA HI 96750	R. Iwai
9.	Jeffrey N Timos	Box 1323 Kealakekua HI 96750	Timos.
10.	Alva Sachs	74-946 LANIA Pl. Kailua Kona 96740	Alva Sachs
11.	Cathy R Lewis	P.O. Box 1993 Kealakekua, HI. 96750	Cathy R. Lewis
12.	Sharon Ikeda	P.O. Box 1160, Kealakekua 96750	Sharon Ikeda
13.	JOSEPHINE L. PA	P.O. Box 359 Kealakekua, Hi 96750	Josephine L. Pa
14.	S Sears	PO Box 290040 Kea-H 96739	S P Sears
	HYAKO MACISAAC		
15.	Hyako Macisaac	Bx 703 Kailua Kona 96745	
	WARREN E RAPOZO (Police Officer)		
	Warren E Rapozo	76-6277 Plumeria Rd., Kailua-Kona Hi	

BELT COLLINS
& ASSOCIATES

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September 12, 1990
841.0101/1898

Ms. Wendy Butterworth
c/o Kona Police Department
74-5221 Queen Kaahumanu Highway
Kailua-Kona, Hawaii 96740

Dear Ms. Butterworth:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for your comments on the above project and for the petition you enclosed with your letter. In view of the critical need for affordable housing in West Hawaii, we do not believe it is appropriate to halt the development of the proposed project until the landfill is closed. In order to ensure that homes are available for occupancy within the next 20 months, we must proceed now with the planning and engineering for the project.

The Housing Finance and Development Corporation undertook the proposed project with the understanding that the County of Hawaii would soon be closing the landfill and opening a new landfill facility in West Hawaii. The Kealakehe landfill was not considered to be a permanent constraint on development. The landfill is a temporary use of the County property and does not constitute an irreversible alteration of the land. Therefore, for purposes of long-range planning, it is appropriate to continue with development plans for the proposed project.

The HFDC supports the landfill's closure by May, 1992. Construction of the first increment of homes at the project will require approximately 20 months. We are anticipating the County will close the landfill before the first increment of homes are completed and that landfill operations will be relocated to a new site. If construction of the first increment of homes were delayed until the landfill is closed, two or more years will have been lost before home construction could even begin. Demand for affordable housing is steadily increasing in West Hawaii. We feel that it is, therefore, appropriate to time residential construction with the landfill closing so that homes can be occupied as soon as practical.

We expect that the closing of the landfill would eliminate any potential health hazards. Landfill sites have been successfully closed and converted to other uses in jurisdictions on the mainland. We are not aware of any health hazards posed by a landfill that has been properly closed.

We are unable to comment on why the closing of the landfill has taken as long as it has.

Very truly yours,

Lee William Sichter

Hawaii Electric Light Company, Inc. • P.O. Box 1027 • Hilo, Hawaii 96721-1027

September 7, 1990

Housing Finance and Development Corporation
State of Hawaii
7 Waterfront Plaza, Suite 300
500 Ala Moana Boulevard
Honolulu, Hawaii 96813

Gentlemen:

Subject: Draft Environmental Impact Statement
Kealakehe Planned Community

Thank you for allowing us the opportunity to review the draft Environmental Impact Statement (EIS) for the subject project. Our comments are as follows:

1. A power factor of 58% was used in the report to convert 14,350 KVA to 8,285 kilowatts. This power factor seems low and we question the validity of using such a figure. Please provide backup as to why this power conversion factor was utilized.

2. The development will require offsite electrical improvements to service the anticipated load. Installation of a 69KV transmission line from the Keahole Switching Station will be required together with a substation capable of serving the proposed community.

3. It should be emphasized that the routing of the transmission line along roadways will be subject to obtaining necessary governmental approvals or private easements.

Should you have any questions regarding our comments, please do not hestitate to contact us.

Sincerely,

For Clyde H. Nagata, Manager
Engineering Department

CHN:DK:ts

cc: Mr. Lee William Sichter, Belt Collins and Associates
D. Kiyosaki
M. Yamaki

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Blvd. Suite 2[illegible], Honolulu, Hawaii 9681[illegible]
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September 12, 1990
841.0101/1898

Mr. Clyde H. Nagata, Manager
Engineering Department
Hawaii Electric Light Company, Inc.
P.O.Box 1027
Hilo, Hawaii 96721-1027

Dear Mr. Nagata:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for your comments on the above project. We agree that the power factor of 58% is a conservative figure used for converting KVA to KW. As a result of a discussion with Donna Kayosaki of your staff, we have revised the document to reflect a power factor of 75%. Page VI-38 of the DEIS has been amended to reflect a revised figure of 10,762 Kilowatts or 10.76 Megawatts, based upon the new power factor.

You are correct that the development will require offsite electrical improvements to service the anticipated load including a 69 KV transmission line from the Keahole Switching Station and a substation capable of serving the proposed community. Page VI-38 of the EIS affirms this. Finally, the same page has been amended to emphasize that the routing of the transmission line along roadways will be subject to obtaining the necessary governmental approvals or private easements.

Very truly yours,

Lee William Sichter

Office of Housing
and Community Development
50 Wailuku Drive • Hilo, Hawaii 96720 • (808) 961-8379 • Fax (808) 935-4725

Larry S. Tanimoto
Mayor
A. Scott Leithead
Housing Administrator

FILE COPY

SEP 1 • 1990

September 11, 1990

Mr. Joseph K. Conant
Executive Director
Housing Finance and Development Corporation
Seven Waterfront Plaza, Suite 300
500 Ala Moana Blvd.
Honolulu, HI 96813

SUBJECT: Draft Environmental Impact Statement (EIS)
Kealakehe Planned Community

Thank you for this opportunity to comment on the draft EIS for the Kealakehe Planned Community. After a review of the document, we have the following comments to offer for your consideration:

1. The discussion regarding residential uses on page II-16 requires clarification. The description of affordable and market units does not appear to be consistent with the "lower cost housing" definition contained in HFDC Rules, Chapter 15-73A.

   Another example of this appears in Table 2-2, Land Use Summary, which describe market units being in the 120% - 140% category. A precise description of the affordable housing target groups would be helpful.

2. The proposed development phasing and recommended annual production rates presented in Table 5-6 appears to ignore the tremendous pent-up demand reflected in Table 5-5. In addition, the pent-up demand figures should be increasing since affordable housing production continues to lag behind demand. By the time the production of affordable units actually gets under way, the production rates, particularly during the first five-year time frame, should be increased substantially. Based on the foregoing, the overall developmental time frame could be shortened considerably.

EQUAL HOUSING OPPORTUNITY

3. We share the concerns expressed by the Planning Department and Public Works regarding the traffic and solid waste issues. These issues have been at the forefront of community concerns and need to be addressed.

Thank you for the opportunity to comment on the draft EIS. Should you have any questions concerning these comments, please do not hesitate to contact us.

A. Scott Leithead
Administrator

BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

September 12, 1990
841.0101/1898

Mr. Scott Leithead, Administrator
Office of Housing and Community Development
50 Wailuku Drive
Hilo, Hawaii 96720

Dear Mr. Leithead:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for your comments on the above project. Following are responses to your comments in the order they appear in your letter.

1. An administrative decision was made by the Housing Finance and Development Corporation to focus housing development at Kealakehe for the affordable housing target group consisting of individuals and families with income of 120% of median income and below. HFDC regulations permit the definition of the target group to be extended up to the 140% income level. However, the HFDC feels that because of the greater need for affordable housing among the lower income group in Kailua-Kona, the downward revision of its target group is justified.

   We believe the clarification you requested is presented on pages II-9 and II-10 of the EIS.

2. Recommended unit production for the Kealakehe project is based on a number of factors, including demand for various housing products, financial resources available to the HFDC, and investment risk. The County's position that substantial pentup demand exists in the West Hawaii region is understood. However this does not necessarily mean that Kealakehe production levels should be increased, for the following reason: Kealakehe is not intended to satisfy all housing need in the region. We recognize that additional action to meet affordable housing needs at other locations will be required of HFDC, OHCD and private developers, among others.

   In short, we are pleased to receive OHCD's concurrence that sufficient demand could emerge for the Kealakehe project. HFDC would also be in a position to accelerate production levels in the event of strong consumer response to Kealakehe, if financial resources are available.

3. We have addressed the concerns of the Planning Department and Public Works Department regarding the traffic and solid waste issues and have revised the EIS to reflect our comments where necessary.

Very truly yours,

Lee William Sichter

HOUSE OF REPRESENTATIVES
THE FIFTEENTH LEGISLATURE

STATE OF HAWAII
STATE CAPITOL
HONOLULU, HAWAII 96813

September 4, 1990

Lee W. Sichter
Belt Collins & Associates
680 Ala Moana Blvd., Suite 200
Honolulu, Hi. 96813

Re: Kealakehe Planned Community DEIS

Dear Mr. Sichter:

Thank you for this opportunity to comment on the Draft EIS for the Kealakehe Planned Community. I do have several concerns as follows:

1) Landfill - The landfill has toxic substances which have been dumped over the years from batteries to paints to poison residues (left over from households and farmers). The fact that no toxic gasses were evident during EPA tests does not preclude the knowledge that when underground fires hit these toxins they will emit toxic gasses.

The Police Department has 24-hour employees who are well aware of the odors and sickening side effects from landfill gasses. Some employees have been assigned elsewhere because of illness.

Whether the landfill takes two or ten years to remove, the toxins which have leeched into the ground will still be there. What is their effect? Would it not be better to place the Civic Center more toward the north and put the golf course in its place? Golfers move around; civic center employees stay in place for hours. Also, the STP just below the proposed civic center makes it less than ideal should there be a malfunction of the STP.

Until the landfill is recycled, the police building should be considered for only day-time employees such as state offices (DLNR, DOA, DOH, etc.) In the meantime the police should be accomodated at a different site. This could be a tradeoff with the state constructing a temporary police headquarters to the north. The most logical place would be mauka of Honokohau Harbar near the entrance, makai of the Queen Kaahumanu Highway.

2) STP - Is the STP going to be able to accomodate the Kealakehe Development? If it has to be enlarged, shouldn't this be done now while the construction of the STP is underway?

The leechfield for the STP appears to be the "public" golf course mauka. Doesn't it make more sense for the golf course to be around the STP rather than pump the affluent uphill?

3) Roadway - The new roadway appears to have no connection to Mamalahoa Highway in the near future. If the entire road is not part of this masterplan, then very little pressure is taken off Palani Road. The road, in its entirety, should be planned for in concert with the planned community and high school.

I hope these suggestions will be of help to you in developing the final plans for the Kealakehe Development.

Yours very truly,

Virginia Isbell
Representative - Kona

evr

BCA
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September 12, 1990
841.0101/1898

Honorable Virginia Isbell
Representative - 5th District
State Capitol
Honolulu, Hawaii 96813

Dear Representative Isbell:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for your comments on the above project and for the opportunity to meet with you to discuss the project on September 4th. Following are responses to your comments in the order they appear in your letter.

1. We appreciate your concerns about the landfill and its potential impact upon the proposed Civic Center. The proposed Civic Center is envisioned as being located immediately makai of the landfill, in the area presently occupied by the police station, and the AmFac distribution center and the West Hawaii Humane Society. As depicted in the project's Concept Plan on page II-14 of the EIS, the site of the landfill is proposed to remain in open space and is designated as a "landfill park".

   Concerning the leeching of toxins from the landfill and their long-range impact, we believe that this matter must be addressed by the County at the time it proposes any new development on the site. The entire County parcel is presently designated as Conservation District by the State Land Use Commission. The landfill, the police station, and other uses at the site were approved subject to Conservation District Use Permits. Should the County propose redevelopment of the site, it must either seek a new permit or petition the State Land Use Commission to amend the land use designation from Conservation to Urban. Either one of these actions will require detailed study of the proposed use and may result in the need for a full environmental impact statement to be prepared. We believe that the issue of leeching and related environmental concerns such as toxicity would be addressed as part of that undertaking. Because the County property is not part of the Kealakehe Planned Community, and the proposed Civic Center is simply a designation for the site consistent with the original draft of the Keahole to Kailua Draft Development Plan, environmental studies for the future development of the landfill site were not deemed necessary for the project at hand.

   The Kealakehe STP is just under a mile downslope from the landfill. We do not believe that a malfunction at the STP would impact the landfill.

   We agree that a temporary relocation of the County police station may be appropriate if the landfill is recycled. However, the decision to relocate the police station and the choice of a new site rests with the County of Hawaii rather than the State. The site you recommend for relocation is presently being proposed for development by the Harbors Division of the State Department of Transportation as a light industrial support area for Honokohau Harbor. The County should contact the

Harbors Division if it identifies that site as the preferred location for a temporary police station.

2. The STP is not presently designed to accomodate the Kealakehe Planned Community. However, it is intended that the STP will be expanded to service the new development. Once the project receives Land Use Commission approval, planning and engineering for the necessary expansion can begin. It would be premature to commit resources to the expansion until the project is actually given the signal to move forward.

   The County has already designated the golf course area as the effluent disposal area and is presently seeking a developer for the project. It was determined over two years ago that the effluent disposal area would be located mauka of the Queen Kaahumanu highway. Locating a golf course around the STP might, in fact, constrain future expansion of the facility beyond its present boundaries, should it be deemed necessary.

3) The entire mauka-makai roadway is being planned for implementation. That portion of the roadway located on State land is being undertaken as a first phase. In the meantime, the State Department of Transportation has already received funds from the State Legislature to begin planning and engineering to link the roadway to Mamalahoa Highway.

Very truly yours,

Lee William Sichter

JOHN WAIHEE
GOVERNOR

YUKIO KITAGAWA
CHAIRPERSON, BOARD OF AGRICULTURE

SUZANNE D. PETERSON
DEPUTY TO THE CHAIRPERSON

State of Hawaii
DEPARTMENT OF AGRICULTURE
1428 So. King Street
Honolulu, Hawaii 96814-2512

FAX: 548-6100

Mailing Address:
P. O. Box 22159
Honolulu, Hawaii 96822-0159

September 7, 1990

To: Office of Environmental Quality Control

From: Yukio Kitagawa, Chairperson
Board of Agriculture

Subject: Draft Environmental Impact Statement (DEIS) for
Kealakehe Planned Community
Housing and Finance Development Corporation
TMK: 7-4-08: pors. 17, 43
7-4-19: por. 43
Kealakehe, North Kona, Hawaii
Area: approximately 990 acres

The Department of Agriculture has reviewed the subject document and offers the following comments.

The reference to the Agricultural Lands of Importance to the State of Hawaii (ALISH) should be corrected to indicate that the classified portion of the project site within the Agricultural District is called "Other Important" agricultural land and not "Important Agricultural Land."

Regarding the importation of supplemental soil from other sites to the project site (DEIS, page IV-9), every effort should be made to mine soil from non-agricultural sites and where its removal will not result in erosion or increased likelihood of flooding.

Thank you for the opportunity to comment.

c: HFDC
Belt Collins and Associates

BCA
BELT COLLINS
& ASSOCIATES
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September 12, 1990
841.0101/90-1898

Mr. Yukio Kitagawa, Chairperson
Board of Agriculture
State of Hawaii
1428 South King Street
Honolulu, Hawaii 96814-2512

Dear Mr. Kitagawa:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for your comments on the above project. The reference to Agricultural Lands of Importance to the State of Hawaii (ALISH) has been corrected in response to your comment. Your comment concerning the source of imported soil is noted. Every effort will be made to mine soil from non-agricultural sites and to minimize erosion or potential flooding.

Very truly yours,

Lee William Sichter

JOHN WAIHEE
GOVERNOR

YUKIO KITAGAWA
CHAIRPERSON, BOARD OF AGRICULTURE

SUZANNE D. PETERSON
DEPUTY TO THE CHAIRPERSON

State of Hawaii
DEPARTMENT OF AGRICULTURE
1428 So. King Street
Honolulu, Hawaii 96814-2512

FAX: 548-6100

Mailing Address:
P. O. Box 22159
Honolulu, Hawaii 96822-0159

September 7, 1990

To: Office of Environmental Quality Control

From: Yukio Kitagawa, Chairperson
Board of Agriculture

Subject: Draft Environmental Impact Statement (DEIS) for
Kealakehe Planned Community
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Thank you for the opportunity to comment.

c: HFDC
Belt Collins and Associates

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September 12, 1990
841.0101/90-1898

Mr. Yukio Kitagawa, Chairperson
Board of Agriculture
State of Hawaii
1428 South King Street
Honolulu, Hawaii 96814-2512

Dear Mr. Kitagawa:

Kealakehe Planned Community
Draft Environmental Impact Statement

Thank you for your comments on the above project. The reference to Agricultural Lands of Importance to the State of Hawaii (ALISH) has been corrected in response to your comment. Your comment concerning the source of imported soil is noted. Every effort will be made to mine soil from non-agricultural sites and to minimize erosion or potential flooding.

Very truly yours,

Lee William Sichter

APPENDIX

KEALAKEHE PLANNED COMMUNITY

Kealakehe, North Kona, Hawaii

FINAL ENVIRONMENTAL IMPACT STATEMENT

PROPOSING AGENCY:
STATE OF HAWAII
HOUSING FINANCE AND DEVELOPMENT CORPORATION

PREPARED BY:
BELT COLLINS AND ASSOCIATES
SEPTEMBER 1990

CHAPTER XIII
APPENDIX

The following reports are included in this Appendix to the Environmental Impact Statement for the Kealakehe Planned Community.

Archaeology	-	Paul H. Rosendahl, Ph.D. Inc.
Botanical Survey	-	Char & Associates
Fauna Survey	-	Phillip L. Bruner
Noise Impacts	-	Y. Ebisu & Associates
Social Impacts	-	Community Resources, Inc.
Traffic Impacts	-	Pacific Planning & Engineering, Inc.
Air Quality Impacts	-	Barry Neal
Market Analysis	-	KPMG Peat Marwick
Public Revenues/Costs	-	Ernst & Young

ARCHAEOLOGY REPORT

Report 652-010890

Archaeological Inventory Survey
Kealakehe Planned Community
Project Area

Lands of Kealakehe and Keahuolu
North Kona District
Island of Hawaii

PHRI

Paul H. Rosendahl, Ph.D., Inc.

Archaeological • Historical • Cultural Resource Management Studies & Services

305 Mohouli Street • Hilo, Hawaii 96720 • (808) 969-1763 • FAX (808) 961-6998

Report 652-010890

Archaeological Inventory Survey
Kealakehe Planned Community
Project Area

Lands of Kealakehe and Keahuolu
North Kona District
Island of Hawaii

by

Theresa K. Donham, M.A.
Supervisory Archaeologist

Prepared for

State of Hawaii
c/o Belt, Collins & Associates
680 Ala Moana Blvd., Suite 200
Honolulu, Hawaii 96813

January 1990

PHRI

Paul H. Rosendahl, Ph.D., Inc.
Archaeological • Historical • Cultural Resource Management Studies & Services
305 Mohouli Street • Hilo, Hawaii 96720 • (808) 969-1763 • FAX (808) 961-6998

SUMMARY

At the request of Mr. Lee Sichter of Belt, Collins and Associates, on behalf of their client, the State of Hawaii, Paul H. Rosendahl, Ph.D. Inc. (PHRI) conducted an archaeological inventory survey of the c. 950-acre proposed Kealakehe Planned Community project area, located in the Lands of Kealakehe and Keahuolu, North Kona District, Island of Hawaii (TMK:7-04-08:17,Por.12). The survey field work was conducted September 5-October 13, 1989 and consisted of a 100%-coverage pedestrian survey, augmented with an aerial reconnaissance survey. During the survey, 78 sites were newly identified and four previously identified sites were relocated. Two of the previously identified sites had already been assigned State Inventory of Historic Places (SIHP) site numbers (Site 00002* [Mamalahoa Trail] and Site 05011 [ahupua'a boundary wall]).

The predominant feature types present in the project area are rock mounds and pahoehoe excavations, which together comprise 72.3% of the 840 identified features. The predominance of these and other features such as modified outcrops, terraces, small enclosures and low mounded walls indicates relatively intensive use of the area for agricultural purposes.

Among the 82 sites identified within the project area, 21 are assessed as having information value that has been mitigated during this survey, and no further work is determined necessary for these 21 sites. Further data collection only is recommended for 42 sites, which appear to have value only for information content. Ten sites are recommended for interpretive development, following further data collection, and five are recommended for provisional interpretive development, pending results of further data collection. Four features at four sites are recommended for provisional preservation "as is," pending the identification of human skeletal remains in or under these features.

In addition to the above recommendations, it is recommended that a systematic sampling program be designed and implemented during the data collection phase. Such a program should provide a more workable and accurate means of documenting the project area's numerous features.

---

*State Inventory of Historic Places (SIHP) site designation system: all five-digit site numbers prefixed by 50-10-25 or -27 (50=State of Hawaii, 10=Island of Hawaii, 25 or 27=USGS 7.5'series quad map ["Kailua" or "Keahole, Hawaii"]).

CONTENTS

ILLUSTRATIONS

Figure

ILLUSTRATIONS (cont.)

Figure

TABLES

Table

INTRODUCTION

BACKGROUND

This report presents the results of an archaeological inventory survey conducted at the proposed Kealakehe Planned Community project area, located in the Lands of Kealakehe and Keahuolu, North Kona District, Island of Hawaii (TMK:7-04-08:17,Por.12). The survey was conducted by Paul H. Rosendahl, Ph.D., Inc. (PHRI) at the request of Mr. Lee Sichter of Belt, Collins & Associates, on behalf of their client, the State of Hawaii. The overall purpose of the survey was to provide information appropriate to and sufficient for the preparation of an Environmental Impact Statement (EIS) and Master Plan being developed for the project.

The survey field work was conducted September 5-October 13, 1989. The field crew consisted of four to eight persons under the direction of Supervisory Archaeologist Theresa K. Donham, M.A., with field supervision by Supervisory Field Archaeologist Amy Dunn and Field Archaeologist Keala Kauhi. Approximately 1,380 man-hours of labor were expended conducting the field work portion of the survey.

This report is the Final Report for the present project. Due to new information derived from data compilation and analysis, this report includes minor modifications to the findings and recommendations presented in the Interim Report on the project (Donham 1989).

SCOPE OF WORK

Prior to carrying out the field work, a general scope of work and specific field tasks were discussed with Dr. Ross H. Cordy, chief archaeologist in the Hawaii Department of Land and Natural Resources-Historic Sites Section/State Historic Preservation Office (DLNR-HSS/SHPO). Based on a preliminary review of available background literature and records, and based on discussions with Mr. Sichter and the appropriate DLNR-HSS/SHPO personnel, the following specific tasks were determined to constitute an adequate scope of work for the current project:

1. Conduct archaeological background and historical documentary research involving review and evaluation of readily available archaeological and historical literature, historic documents and records, and cartographic sources relevant to the immediate project area;

2. Conduct a 100% coverage, low-level (30-50 ft altitude) aerial survey (helicopter) of the entire project area, with special emphasis on (a) following out any foot trails present and plotting them on aerial photographs and/or maps, (b) identifying all sites observed, and (c) identifying areas devoid of sites (e.g., relatively recent lava flows and mechanically altered lands);

3. Conduct variable-coverage (partial to 100%), variable-intensity (30-90 ft intervals) ground survey of the project area, with the actual extent and intensity of coverage determined on the basis of the aerial survey;

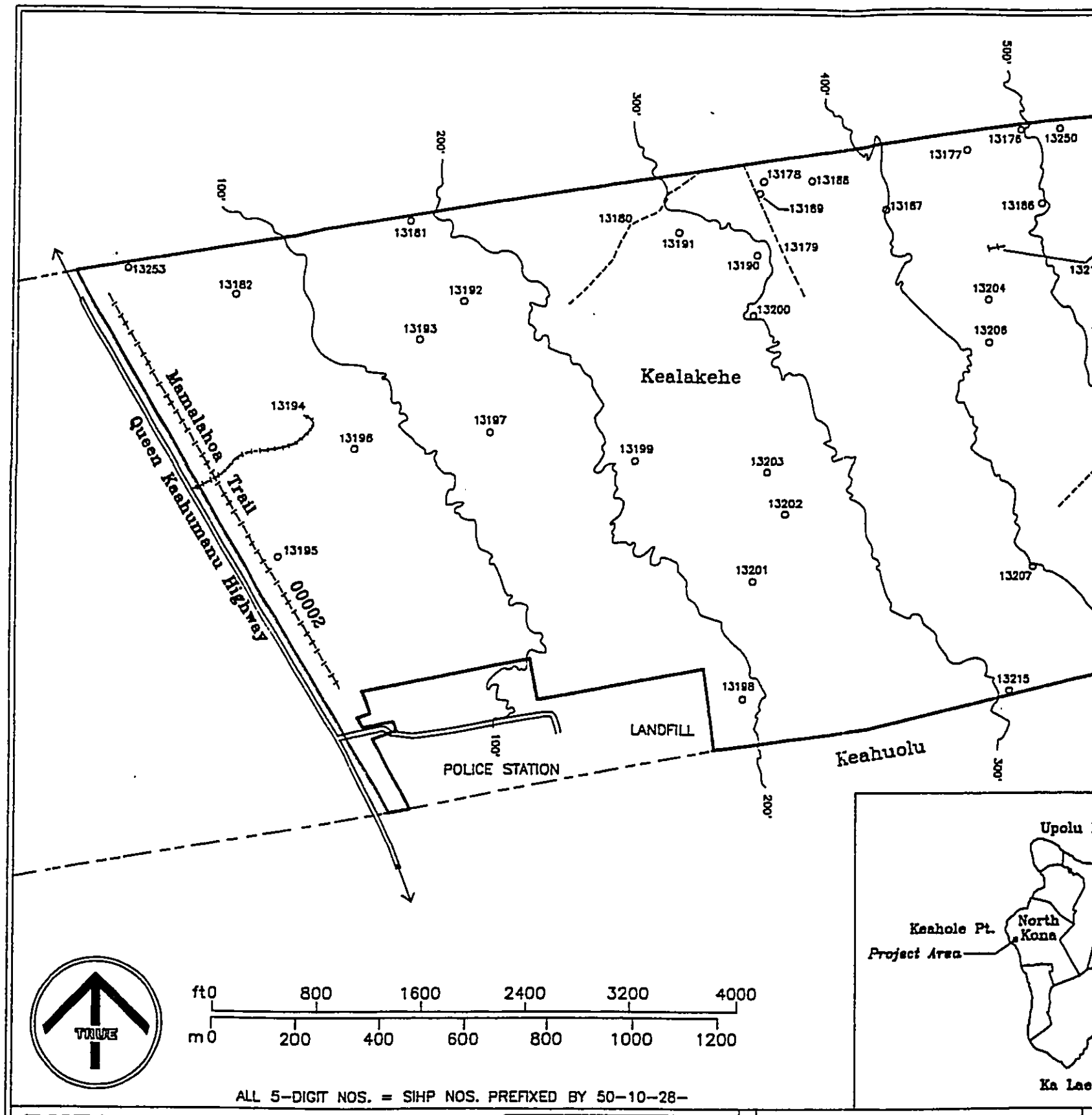
4. Conduct limited subsurface reconnaissance testing of selected sites and features identified within the project area (a) to determine the presence or absence of potentially significant buried cultural features or deposits, and (b) to obtain suitable samples for age determination analyses; and

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

The significance of all archaeological remains identified within the project area was to be assessed in terms of the National Register criteria contained in the Code of Federal Regulations (36 CFR Part 60) and the criteria for evaluation of traditional cultural values prepared by the national Advisory Council on Historic Preservation (ACHP). These criteria are currently used by the DLNR-HHS/SHPO for the evaluation of cultural resources.

PROJECT AREA DESCRIPTION

The project area consists of two adjacent parcels which together comprise approximately 950 acres (Figure 1). The larger of the two parcels (c. 800 acres) consists of all undeveloped land in Kealakehe ahupua'a between Queen Kaahumanu Highway and Kealakaha Road. The smaller parcel (c. 150 acres) is located in Keahuolu ahupua'a, and is bounded on the south and east sides by Palani Road. The west side of the parcel is contiguous with the eastern boundary of a previously established survey area for a proposed Queen Liliuokalani Trust Estate development (PHRI Project 89-596). According to the property developers, the boundary of the Keahuolu parcel may be modified



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PHRI PAUL H. ROSENDAHL, Ph.D., INC
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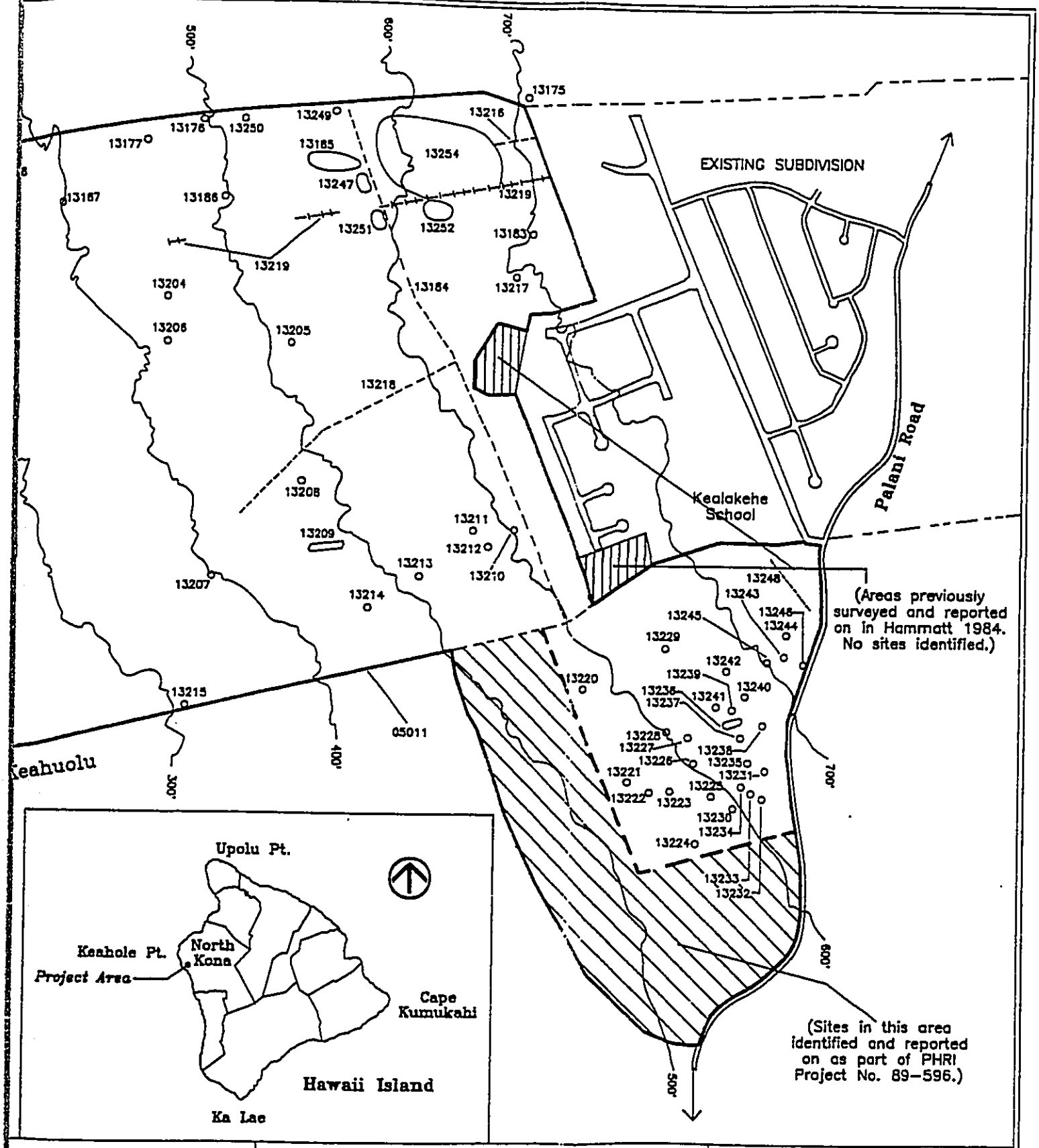
(808) 969-1763, 961-6998(FAX)

LEGEND
- WALL
- AHUPUAA BOUNDARY
- TRAIL
- PROJECT AREA BOUNDARY



Kealakehe Planned Community
Inventory Survey
PHRI Project No. 89-652

FIGURE 1.
Project Area and
Site Location Map

during the course of development planning. If this happens, the findings and recommendations for the parcel will be modified to reflect the changes. For example, if recent suggested modifications in the western boundary of the Keahuolu parcel were to be effected, at least 34 additional archaeological sites would be added to the present project area site count.

Kealakehe and Keahuolu ahupua'a are situated along the western slope of Hualalai volcano, where Pleistocene to recent Hualalai Series flows form the surface mantle. These flows are comprised primarily of alkalic olivine basalt, and are both aa and pahoehoe types (Macdonald, Abbott, and Peterson 1983:366). The topography in the ahupua'a consists of pahoehoe flats, fissures, upthrusts, collapsed blisters and tubes, interspersed variously with fingers of aa that are generally oriented east-west. Although the topography is somewhat rough in places, its overall aspect is a gradual slope (drop of approximately 0.06 m per linear meter) from east to west. Elevation in the project area ranges from 90-750 ft AMSL. The lower portion of the project area, along Queen Kaahumanu Highway, is 2.3 km inland of the coast. The upper portion of the project area is approximately 5.7 km from the coast.

Annual median rainfall within the project area ranges from approximately 750 mm (30 inches) in the lower elevations to 1,000 mm (40 inches) in the upper elevations. In general, vegetation in the project area increases in density with increasing elevation and rainfall. Vegetation is extremely dense above 500 ft AMSL (above mean sea level); there is little to no surface visibility in much of this area, particularly in the Keahuolu portion.

Predominant tree species within the project area are kiawe (*Prosopis pallida* [Humb. and Bonp. ex Willd.] HBK), koa-haole (*Leucaena leucocephala* [Lam.] de Wit), alahe'e (*Canthium odoratum* [Frost.] Seem.), and Christmas-berry (*Schinus terebinthifolius* Raddi.). Understory plants consist predominantly of lantana (*Lantana camara* L.), klu (*Acasia farnesiana* [L.] Willd.), 'ilima (*Sida fallax* Walp.), fountain grass (*Pennisetum setaceum* [Forsk.] Chiov.), California grass, (*Brachiaria mutica* [Forsk.] Stapf, Jamaica vervain (*Stachytarpheta jamaicensis* [L.] Vahl), and air plant (*Bryophyllum pinnatum* [Lam.] Kurz).

In addition to the common plants listed above, several species are represented by scattered individuals or small clusters. These include kukui (*Aleurites moluccana* L. Willd.), ti (*Cordyline terminalis* L. Kunth), guava (*Psidium guajava* L.), mango (*Mangifera indica* L.), day flower or Wandering Jew (*Commelina diffusa* Burm. f.), sisal (*Agave sisalina* [Engelm.] Perrine), and uhiuhi (*Mezoneuron kauaiense* [Mann] Hbd.).

A major section of the project area is currently used for cattle grazing. This area is located between the north and south Kealakehe ahupua'a boundaries at c. 200-600 ft AMSL. The eastern, mauka (inland) boundary of the grazing land is the Site 13184 wall. It is likely that the grazing land has been used for cattle and other livestock for about 100 years (see Historical Background section). In addition to having been affected by livestock, the land evidences bulldozer grubbing and vegetation clearing, the latter perhaps by way of chain dragging. Surface feature disturbance and destruction was observed throughout this area, and it is expected that a considerable portion of the original archaeological remains in the area has been obliterated.

Bulldozer grubbing has also occurred in the upper and lower portions of the project area, particularly along the boundaries of existing subdivisions (upper area) and industrial developments (lower area).

Isolated instances of current plant cultivation (mango trees and herbaceous plants) were observed in the upper portion of the project area, in both Kealakehe and Keahuolu. Surface features in current use for cultivation include enclosures, modified outcrops, pahoehoe excavations, low curvilinear walls, and cleared areas with associated rock mounds. These features were recorded as recent. It should be noted that some of the agricultural features currently used are indistinguishable from the numerous ones assumed to be pre-contact or early historic—it is possible the ones used are earlier features which have been minimally modified. Likewise, it is also likely that some abandoned features of modern construction were not identified as such, due to construction form and lack of diagnostic artifacts.

HISTORIC BACKGROUND AND SUMMARY OF HISTORICAL DOCUMENTARY RESEARCH

The area of North Kona between Kailua Bay and Keauhou Bay to the south is generally recognized as the population core and fertile agricultural district of North Kona (Kirch 1985:166, Kelly 1983). To the north of Kailua Bay, beginning at Honokohau, is the relatively dry Kekaha District of North Kona, with its barren lava inlands and coastal fishponds (Springer 1986:121). Kealakehe is situated in the transition zone between these two constrasting environmental districts. This land might therefore possess a unique history of adaptation and use not readily characterized by the general patterns of either Kailua or Kekaha.

There is little historic information concerning traditional Hawaiian land use for the inland area of Kealakehe. Historical

documentary research by Silva (1987) and more recently by Wong (Appendix B) failed to locate observer references to subsistence or settlement specific to the project area. Ellis, during his 1822 tour of Hawaii Island, described an area he referred to as the "suburbs of Kailua," which may have included lower Keahuolu and possibly lower Kealakehe. According to Ellis:

> The environs were cultivated to a considerable extent; small gardens were seen among the barren rocks on which the houses are built, wherever soil could be found sufficient to nourish the sweet potatoe [sic], the watermelon, or even a few plants of tobacco, and in many places these seemed to be growing literally in the fragments of lava, collected in small heaps around their roots (Ellis 1963:31).

Nineteenth century descriptions of inland Kealakehe and Keahuolu by government surveyors tend to reflect land assessment values that were not necessarily reflective of traditional Hawaiian land values. Their descriptions of Kealakehe present an environment more like Kekaha than the Kona agricultural lands. In Hammatt et al. (1987) there is a summary of three of these descriptions:

> It is worth noting that historical descriptions of the land makai [seaward] of the "government road" (Mamalahoa Highway), in the vicinity of the present project area (immediately east of this project area), tend to discount its productivity. The 1865 roster of government lands describes this area as including some land "which will do for goat pasture, balance nothing but rocks." Emerson in 1882, discounted the entire ahupua'a of Kealakehe as "of comparatively small value." McDougall in 1893 describes the land as "worthless" or at best as "of very little value". In that same year the Government Surveyor recommended that the land not be sold for less than about 33 cents an acre, a low price even for the time (Hammatt et al. 1987:67-68).

As indicated by Hammatt et al., the archaeological record of their study area in Kealakehe (immediately east of this project area) reflects that "in fact this land was utilized far more than historical records suggest" (1987:68).

During Emerson's 1880 Government Survey of North Kona, he identified the lower (makai [seaward]) edge of a forest zone, which he described as "lava covered with scattering forest and dense masses of ki root" (Kelly 1983:58). The land below this forest edge was described as "rocks covered with long grass" (Kelly 1983:58). According to Kelly's estimations, the forest edge occurred at an average elevation of 550 to 650 ft around Kailua and to the south (1983:58). However, it appears that the forest edge was somewhere between 750 and 800 ft elevation in Kealakehe (see reproduction of Emerson's map in Kelly 1983:59). This approximation places the nineteenth century forest edge very close to the eastern boundary of the project area. According to Emerson's documentation of nineteenth century vegetation, the project area would be within the kula zone.

At the time of the Mahele, Kealakehe was designated Government Land, and Keahuolu was granted to Ane Keohokalole (see Appendix B for background information on Keohokalole). Eleven kuleana land grants, which together constitute 45.46 acres, were registered for Kealakehe. The average award was 4.1 acres (See Appendix B). This average for Kealakehe is considerably greater than the average size of kuleana awards in the Kona agricultural district, which Kelly estimates to be around 2.3 acres (Kelly 1983:68). The average size of kuleana land claims, however, was 7.51 acres (Kelly 1983:68). Thus, it appears that residents in Kealakehe were awarded a closer approximation to their actual land claims than residents in other North Kona ahupua'a to the south.

All recorded kuleana LCA awards in Kealakehe are located to the east of the project area, between 1,000 and 1,500 ft AMSL (See Emerson survey map reproduced in Silva 1987). The patterning of kuleana awards in Kealakehe (within the forested zone as defined by Emerson) is very similar to the overall pattern of kuleana awards for the North Kona agricultural district. As noted by Kelly:

> Although there is ample evidence in the registered claims and other documents—as well as in the remnants of agricultural activity found on the ground—that Hawaiian farmers were cultivating kula lands in the 1840s, no kuleana gardens were awarded in that zone. The kula was given by the Board of Commissioners to the konohiki, the owner of the ahupuaa...The kula became the land in which the konohiki could graze their cattle and horses. This left the common farmer without access to grazing areas for their animals, or to garden lands that they had cultivated in the kula zone (Kelly 1983:67).

It was shortly after the systematic delineation of kula lands as grazing land that Kuakini Wall was constructed. This wall extends from Kahaluu Bay to the southern portion of Keahuolu, at an average distance of 1.6 km from the coastline. At the northern end in Keahuolu, the wall is at an

elevation of 220 ft; further to the south, it is at an average elevation of 160 ft. The purpose of the wall was to keep the kula livestock contained and out of the coastal settlements. Kuakini Wall does not cross Kealakehe, and it is likely that the grazing zone here extended makai at least as far as Mamalahoa Trail, which is 2.3 km from the coastline at Honokohau.

According to an 1893 testimonial from McDougall, there appears to have been no major pasture demarcations in Kealakehe between the homesteads (c. 800 ft elevation) and the seashore (see Appendix B). McDougall offered $300 for c. 1,600 acres of Kealakehe land, which was valuable to him because he owned land on both sides, noting "..it would take more than all it is worth to fence it in" (Interior Dept. 3/9/1893).

Between 1895 and 1915, at least twenty homestead grants were awarded in Kealakehe. These grants were all located in the same general zone as the kuleana, at an elevation of between 800 and 1,500 ft. According to a partial listing of homestead grants in Silva (1987), awarded parcels averaged 20.7 acres. The homestead area was bounded on the east by the upper Government Road (Mamalahoa Highway) and on the west by a surveyed line, which is shown on the 1924 USGS Topographic map, between 750 and 800 ft elevation. This line appears to have been very close to the existing Kealakehe Road alignment, and correlates with the location of Emerson's forest edge boundary.

Historical evidence indicates that there would have been few to no residencies within the kula zone of Kealakehe during the nineteenth century, and that the zone was mostly given over to ranching. A possible exception to this pattern is indicated, but not yet documented, by historic records. Sometime during the late 1890s, a sisal mill was established in Keahuolu along the old Palani Road corridor. The location of this mill is shown on the 1924 USGS topographic map, and its location has been tentatively identified in the field (within the PHRI 89-596 project area). In conjunction with the mill was a 500-acre tract of sisal cultivation, referred to as the McWayne sisal tract (Kelly 1983:89). The location of the tract is yet to be determined; however, if it extended into Kealakehe, this industrial endeavor would have certainly left some type of agricultural surface features. There are scattered clumps of sisal within the project area, and a very concentrated growth in Keahuolu, near the hypothesized mill location. The mill ceased operations sometime before 1920, when the demand for sisal hemp by sailing vessels diminished.

As indicated above, a major portion of the project area (between 200 and 600 ft AMSL) appears to have been used for cattle grazing for about a century. The upper boundary of the grazing lands is about 0.6 km west of and 200 ft below the homestead/kuleana area boundary. Nearly all of the land between these two historic use area boundaries has been grubbed or recently developed for housing. A parcel at the northeastern corner of the project area (approximately 600 m N-S by 400 m E-W) remains undeveloped. On the basis of feature preservation in this area, it does not appear to have been intensively used for grazing land. It does appear to have been intensively used for agriculture, and may well have been in such use during the nineteenth and early twentieth century.

PREVIOUS ARCHAEOLOGICAL WORK

Coastal Areas

The earliest archaeological field investigations in Kealakehe and Keahuolu focused on the major sites located along the coastline. In his study of Hawaiian heiau, Stokes (1919) described three coastal heiau sites in Keahuolu (Halepau, Kawaluna, and Palihiolo). Halepua was reported as a small fishing heiau, whereas Kawaluna and Palihiolo were described by informants as former sites of human sacrifice. Stokes' narrative description of Palihiolo Heiau is given in Appendix B.

In 1930, Reinecke located 13 sites in Keahuolu (Sites 12-24) and 12 sites in Kealakehe (Sites 24-35) during a reconnaissance survey of coastal North Kona (Reinecke 1930:5-10). These sites consisted of platforms and house yards and were generally residential in nature. Two heiau were identified in Kealakehe, Hale o Lono (Site 33), and an unidentified heiau (Site 35).

Several of Reinecke's sites were relocated and were assigned B.P. Bishop Museum site numbers by Emory and Soehren in 1961, during their reconnaissance survey of coastal Koloko, Honokohau, and Kealakehe (Emory and Soehren 1971). During this study, which preceded development of Honokohau Harbor, 27 sites were identified in Kealakehe. These included ten house sites, ten burial sites, three enclosures, two heiau (Makaopio, Reinecke's Site 35, and Haleokane, Reinecke's Hale o Lono), and two indeterminate sites (Emory and Soehren 1971:3). Three of the Kealakehe sites, including the two heiau and a cluster of three house platforms, were recommended for preservation by Emory and Soehren. These sites are in the northern portion of Kealakehe, along the Alula Bay shoreline.

In the wake of development in and around the Honokohau Harbor area, excavation was conducted at three of the Kealakehe sites identified by Emory and Soehren (Ladd 1968, Sekido 1968). These included a house platform and burial site (Ladd 1968), and a habitation cave (Sekido 1968). Later expansion of the harbor area to the east prompted a 100-acre reconnaissance survey by Sinoto (1975a). During this survey three sites were relocated, and no further archaeological work was recommended for the area (Sinoto 1975a:3).

In 1980, Soehren examined a 40-acre parcel and an access road corridor in coastal Kealakehe, at the site of a proposed wastewater treatment plant (Soehren 1980). A single trail (SIHP Site 7704) was identified. According to Soehren, this trail connected Aimakapa Pond in Honokohau with a small settlement at Pawai Bay in northern Keahuolu (Soehren 1980).

The following year, Soehren surveyed a proposed pipeline corridor associated with the treatment plant. Three previously identified sites were relocated (SIHP Sites 1888-1890), and no further work was recommended (Soehren 1981).

Coastal reconnaissance in Keahuolu was conducted by Bevacqua in 1972. During this survey, nine sites were identified (Bevacqua 1972). Three years later, Sinoto surveyed a road corridor through coastal Keahuolu, during which seven sites were identified (Sinoto 1975b:1). All sites were described as being "small, semi-permanent or temporary structures associated with coastal, probably marine activities" (Sinoto 1975:3).

A series of reconnaissance survey reports were completed between 1973 and 1980 in conjunction with development of the old Kona Airport State Park along the shoreline in Keahuolu (Neighbor Island Consultants 1973, Fuke and Goldstein 1978, Estioko-Griffin and Lovelace 1980, and Neller 1980). Estioko-Griffin and Lovelace's survey relocated sites previously identified within the 89.7 acre parcel, and located additional sites, for a total of 35 sites. The majority of identified sites (28) were concentrated in an area just north of the old runway, along the shoreline at Pawai Bay. The most frequently identified site types included caves (11), petroglyphs (7), burials (5), and house sites (3) (Estioko-Griffin and Lovelace 1980:iii).

In 1978, Ching conducted a reconnaissance survey of all Keahuolu lands between the shoreline and Queen Kaahumanu Highway (987 acres). Ching's survey identified 59 sites with 140 component features, including the sites previously identified by Bevacqua and Sinoto. The most frequently occurring features were reported to be salt pans (29), cave shelters (25), pavings (21), and cairns (21) (Ching 1978:32).

A reconnaissance and testing survey was conducted in selected coastal Keahuolu parcels by Folk in 1980 (Folk 1980). Folk conducted a reconnaissance survey of a c. 20-acre proposed building site (current location of the Queen Liliuokalani Children's Education Center), wherein no sites were identified. He also conducted intensive-level mapping and recording of 21 sites in three kipuka, located near the shoreline, north of the old Kona Airport. Test excavations were also conducted in the center of the kipuka in order to determine if buried cultural deposits were present. During his study, Folk documented seven pavements, three caves, two platforms, four historic/recent campsites, a burial or shrine, a historic period animal enclosure, and three habitation areas (Folk 1980:21-22).

Inland Areas

Reports of archaeological work in inland portions of Kealakehe and Keahuolu generally post-date construction of Queen Kaahumanu Highway, c. 1974. Shortly after highway completion, Soehren conducted a reconnaissance survey of Honokohau II lands along the Honokohau/Kealakehe boundary. In his report, Soehren identified a trail (Site 1) that began at Aimakapa Pond and crossed into Kealakehe, where it terminated at "a series of burials at the base of the (aa) flow" (Soehren 1975:2). Soehren identified eight burials in Kealakehe on his project area map, but did not present descriptive information, as this site was outside of his project area. The features interpreted by Soehren as burials were relocated during this survey (SIHP Site 12975; 11 features identified). In addition to this site, Soehren located 12 burial sites, a house enclosure, two lava tubes and a C-shape within the 99.5 acre survey area (Soehren 1975:3-5).

In 1975, Sinoto conducted a reconnaissance survey of two proposed development parcels immediately east of Queen Kaahumanu Highway in Kealakehe (Sinoto 1977). Area A was located along the south boundary of Kealakehe, between the refuse disposal facility and Queen Kaahumanu Highway. Area B consisted of a parcel north of Area A; the parcel measured c. 275 m E-W by 400 m N-S and fronted the highway. Area B has not been developed to date; major portions of the area, however, have been grubbed and leveled. Undisturbed portions of Area B were reexamined during this survey. Sinoto located four sites, including the Kealakehe/Keahuolu Ahupua'a boundary wall in Area A (SIHP Site 5011), and three lava tube caves in Area B (Sites

5012-5014). Only one of these caves exhibited possible evidence of human occupation (5013). It could not be relocated during this survey and was apparently destroyed by bulldozing. The ahupua'a wall was relocated during this survey (SIHP Site 05011).

Sinoto examined a third small Kealakehe development parcel fronting Queen Kaahumanu Highway in 1983. This 6.9 acre area consisted of a narrow strip between the prior survey areas A and B. No sites were located in this area (Sinoto 1983:2).

In 1984, Hammatt conducted a reconnaissance survey of a 24-acre subdivision parcel located along the south boundary of Kealakehe, immediately west of Kealakehe School (Hammatt 1984). This parcel is located along the eastern boundary of the current survey area in Kealakehe, and the northern boundary of the Keahuolu portion of the current survey area. This area had apparently undergone prior land modification for cattle grazing, and by bulldozer grubbing. Hammatt located no sites in this area.

Three years later, Hammatt surveyed a 15-acre planned subdivision parcel along the northern boundary of Kealakehe, immediately east of the eastern boundary of the current survey area (Hammatt 1987). Eighteeen sites were located in this parcel, and further documentation and testing was recommended (Hammatt 1987:14).

Hammatt, Shideler, and Borthwick (Hammatt et al. 1987) returned to the 15-acre parcel in 1987 for intensive survey and testing. This study represents the first incidence of subsurface testing and intensive-level site recording in inland Kealakehe. During their study, Hammatt et al. produced scaled maps of all features within the project area and conducted excavations at 17 of 32 identified features. Twenty-five of the identified features were interpreted as agricultural; the remainder were interpreted as habitation features (Hammatt et al. 1987:65-69). Hammatt et al excavated eight of 11 faced mounds that had been determined to be possible burials; all of these tested features were redefined as clearing mounds, based on findings of test excavations (Hammatt et al. 1987:65).

In addition to 11 clearing mounds, Hammatt et al. identified agricultural features such as kuaiwi walls (4), enclosures (3), a modified outcrop, a terrace, a planting area, and a mound complex. The analysts note that "[w]hile this project area lies within the 'Kona Field System,' the modification of the land here bears little similarity to the original description of the system" (Hammatt et al. 1987:66).

Among the six habitation features tested by Hammatt et al., three (Sites 1, 14, and 14A) were interpreted as probable temporary "field hale" type features associated with agriculture in the area. Two features (Sites 9 and 11) were interpreted as work areas associated with Site 12, which was interpreted as a habitation site (Hammatt et al. 1987:69). Site 12 was actually located outside of the Hammatt et al. survey area, and was relocated during this survey (SIHP Site 13183). The site was remapped, but no further test excavations were conducted.

A single charcoal sample collected by Hammatt et al., from a hearth at Site 11, was assayed for radiometric age. A calendric range of AD 1645-1950 was determined for this sample (Hammatt et al. 1987:60). The date is interpreted as representing late pre-contact occupation of the area. According to Hammatt et al.:

> This age is consistent with other radiocarbon dates for later development of the Kona Field System and is appropriately late for an area which would have been of marginal productivity (Hammatt et al. 1987:60).

On the basis of their findings, Hammatt et al. concluded that "[t]he extensive agricultural utilization of the project area...suggests that this land was utilized far more than historical records suggest" (1987:68). According to their interpretation, the parcel studied lies within the traditional kula agricultural/vegetation zone. A second conclusion, based on their investigations, is that "...the project area was more closely integrated with upland settlements than with coastal residences" (Hammatt et al. 1987:70).

A second study conducted in 1987—a reconnaissance survey of a 28,800 sq ft proposed reservoir site in Kealakehe located 300 ft east of Palani Road—was conducted by PHRI (Walker and Haun 1987). A single complex with eight component features was identified within the survey area. Identified features included a wall network with associated linear wall sections, three terraces, two enclosures, a C-shape, and a rock mound (Walker and Haun 1987:5-6). The complex was interpreted as having agricultural features and possible animal pens in addition to habitation features. Additional data recovery was recommended (Walker and Haun 1987).

The same year, Bonk conducted a walk-through field inspection of undeveloped portions of Kealakehe between Kealakehe School and the shoreline (Bonk 1987). Bonk indicated that there were sites present in the upper portion of

the area examined, and along the coast, where prior surveys had been conducted. He located only historic ranching features in the area between the coastal and upper elevation zones (Bonk 1987:11).

Reconnaissance surveys conducted in inland portions of Keahuolu include two studies conducted by PHRI between 1983 and the present. In 1983, Rosendahl surveyed three separate parcels—one consisting of 100 acres situated west of Queen Kaahumanu Highway, along the southern boundary of Keahuolu (Area 1), another consisting of 100 acres situated east of the highway and along the south side of Palani Road (Area 2), and another consisting of 12 acres situated along the southern edge of Keahuolu and the northern side of Palani Road (Area 3)(Rosendahl 1983). Rosendahl located five sites in Area 1, two large complexes and five additional sites in Area 2, and a large complex in Area 3. The Area 3 complex was interpreted as a probable continuation of the Area 2 complex. No SIHP numbers were assigned during this survey.

Rosendahl relocated two sites previously identified by Ching (1978) in Area 1, and identified the northern end and a possible east-west portion of Kuakini Wall (SIHP Site 7276), which crossed through survey Areas 2 and 3. Recommendations included intensive survey of all areas, preservation of Kuakini Wall, and preservation of portions of the Site E complex, identified as an extensive area (260 by 315 m) of numerous habitation and other features (Rosendahl 1983:13).

In 1989, PHRI conducted an inventory survey of undeveloped Keahuolu lands between the old Kona Airport and Palani Road, with the exception of the 150-acre parcel that was included in the current survey area. Analysis of survey findings is pending at this time. Preliminary findings indicate that 239 sites with at least 1,746 component features were identified. The majority of identified features are agricultural, and include pahoehoe excavations, rock mounds, terraces, and modified outcrops.

Keahuolu was included in a regional historic overview compiled by Kelly (1983), in conjunction with the Kuakini Highway Realignment Corridor mitigation study. This overview included approximately 30 ahupua'a between Keahuolu and Keokea to the south. Kelly summarizes early historic and traditional Hawaiian agriculture as it was practiced in the dry mid-slope inland areas (kula) of Kona (Kelly 1983:55-75). She also provides background for the historic processes that led to abandonment of kula farming by Hawaiians during the nineteenth century.

Archaeological field work along the Kuakini Highway Realignment Corridor was conducted 1980-83 by B.P. Bishop Museum (Schilt 1984). The corridor crossed 24 ahupua'a located between Palani Road and Kilohana Subdivision to the south. The northern end of the 4.96 km-long corridor was in Keahuolu. A total of 134 sites (455 features) were identified along the corridor; two sites were located in Keahuolu. These included a cairn and a modified outcrop.

Twenty-two radiocarbon dates were determined from samples collected during the Kuakini mitigation project (Schilt 1984:262). On the basis of the dated samples, their contexts, and other information, Schilt postulated that agricultural use of the kula was probably not intensive until after AD 1400-1500. Schilt suggests that erosional deposition of soil from agricultural areas located upslope was probably a major factor in permitting such use of the kula (Schilt 1984:274). She also suggests that due to differences in rainfall patterns, initial exploitation of the kula zone at the north end of the project area (Keahuolu) occurred later (c. AD 1550-1650) than use of this zone at the southern end (c. AD 1400-1650; 1983:274).

RESEARCH PROBLEMS AND APPROACH

Environment and Land Use

Kealakehe and Keahuolu are situated at the northern edge of an extensive traditional Hawaiian agricultural district known as the Kona Field System (Newman n.d.). The Kona Field System was characterized by Newman primarily on the basis of field configurations in the area above Kealakekua Bay. The definition of the field system has since been expanded to include a wide range of intensive agriculture landscaping patterns that occur in a continuous belt from Kealakekua Bay to Kailua Bay, an area of roughly 139 sq km (Kirch 1985:225). Knowledge of the northern margins of the field system is currently very scant, due to a lack of archaeological investigations in this area.

The rainfall and vegetation gradients, which generally follow elevational change within the Kona Field System, create distinctive ecological variation, which has implications for potential land use patterns. Kelly (1983) and Schilt (1984) outline four subzones along the ecological gradient which correlate with traditional Hawaiian cultivation zones, as identified in historic sources and in kuleana land claim descriptions (Kelly 1983:47-64, Schilt 1984:3-11). The four subzones and their estimated elevational ranges are:

(1) the kula, from 0 to c. 500 ft AMSL; (2) the kaluulu, or breadfruit zone, from c. 500 to 1,000 ft AMSL; (3) the apaa, from c. 1,000 to 2,500 ft AMSL; and (4) the amau, or upland jungle, from c. 2,500 to 4,000 ft AMSL (Schilt:1984:6). Potentially, the project area might therefore encompass portions of the kula and kaluulu subzones.

As indicated by Schilt, the elevational ranges of specific subzones appear to vary on a north to south gradient, along with variation in rainfall patterns. The upper extent of the kula zone should therefore be at a higher elevation in the northern reaches of the agricultural district, where rainfall isohyets swing inland, away from the coast. A higher elevation for the kula/kaluulu transition in Kealakehe is also supported by cartographic data from two primary sources. Emerson's survey map (discussed above) places the forest edge at approximately 750-800 ft in Kealakehe. In addition, the western boundary of both kuleana awards and homestead grants is at approximately 800 ft. However, the mauka extent of grazing lands in Kealakehe is at 600 ft.

Kelly and Schilt's environmental/land use models are both based on the premise that the boundaries of the traditional kula and kaluulu subzones coincided with nineteenth century general land use areas. Thus, the kula/kaluulu transition would coincide with the inland boundary of the grazing land, which coincides with the makai extent of the kuleana and homestead grants, which were confined to the kaluulu zone. For Kealakehe, this model does not work due to the disparity between the mauka boundary of the historic kula grazing land and the area designated for Native claims. It appears that in this case, archaeological data may provide a more accurate reflection of the traditional environmental/ cultivation subzones than nineteenth century land use patterns.

Evidence provided in a prior Kealakehe study by Hammatt et al. (1987) indicates intensive agricultural land use between 700 and 800 ft AMSL. Hammatt et al. maintain that their study area is within the kula zone. This assumption appears to be based on the fact that their survey area was makai of the designated boundary for Native land awards. It may therefore not reflect the traditional subzone designation.

One of the research goals of further study in Kealakehe is to develop a more refined model of land use variability, using the elevational gradient and archaeological data. The inventory survey data could be used as a baseline for developing a formal typology of agricultural features and complexes that will permit comparison of feature occurrence and density along the elevational gradient. Ideally, specific functions (i.e., likely cultigens) and possible temporal patterns will eventually be suggested for the various feature types. These interpretations will be based on more systematic data collection and analysis to be conducted during the data collection phase.

Chronology

On the basis of prior analyses of archaeological data and age determinations of charcoal samples recovered in and around Kealakehe (discussed above), it is reasonable to expect that most of the inland habitation and agricultural features within the project area post-date AD 1300-1400. In order to test this assumption, and to better determine the culture history of the project area, it is important to locate and collect datable charcoal samples and to identify any variance in formal or functional types that may reflect temporal change.

One of the goals of field reconnaissance during this survey was to locate deposits in caves or other sites that had potential for containing carbonized material for dating, and to collect dating samples. Such deposits were located at only two sites; however, it is expected that buried deposits of carbonized material will be located during further data collection.

In the absence of numerous features with associated absolute dates, the determination of period of use through formal attributes becomes more crucial. It was hoped that minimally, certain types of agricultural and other features used during the nineteenth and/or twentieth century would be distinguishable from certain pre-contact period features.

FIELD PROCEDURES

Aerial reconnaissance of the project area indicated that cultural features occurred on all lava types present, and that much of the surface was not visible from the air due to heavy vegetation. Therefore, the pedestrian survey maintained a uniformly high-intensity level (c. 10.00 m [30 ft] intervals) for the entire project area. The survey crew consisted of four to five individuals, who traveled in parallel sweeps oriented north-south across the project area. Survey transects were flagged in order to ensure complete coverage, and all identified features were marked with PHRI temporary site numbers and plotted on a 1":200 ft scale aerial photograph. A total of 96 temporary site numbers were assigned during the reconnaissance. Subsequently, sites were assigned permanent State Inventory of Historic Places site numbers, as indicated in Table 1.

After completion of the pedestrian sweeps, a crew of four to eight individuals returned to all flagged sites for

recording purposes. At this time, sites were tagged with metal site tags and were photographed, measured, and described; in certain cases, sites were cleared and mapped. An attempt was made to define as accurately as possible the boundaries of sites; overall site areas were measured along two perpendicular axes. In some areas, surface visibility affected the accuracy of site boundary definition. Further field work, particularly clearing, in some areas may indicate that some sites are parts of the same continuous complex. It was not possible to measure and describe every observed feature within the large agricultural complexes. An attempt was made to obtain an accurate count of the various agricultural feature types within a specific measured area of these large sites so that feature density could be estimated. Features counted, but not individually recorded in all cases, include rock mounds, pahoehoe excavations, and modified outcrops.

In general, surface visibility was such that all or nearly all surface features could be located with persons spaced c. 10.00 m apart on the sweep line. Surface visibility was very limited in the Keahuolu parcel and in the northern portion of the upper Kealakehe parcel. In these areas, it is therefore likely that not all features were observed during the pedestrian sweep, or during the recording phase. There are undoubtedly additional rock mounds, pahoehoe excavations, and other minor agricultural features that have not been enumerated here.

Among the 96 temporary site numbers assigned, six were combined with other temporary sites during the recording phase (Table 1). An additional four sites were found to be beyond the project area boundaries and were recorded as part of an adjacent survey project (PHRI Project 89-694). Five of the temporary sites, upon further inspection, were found to be noncultural.

Subsurface testing was conducted at Site 13188, where two 1.00 by 1.00 m sq units were excavated. All excavated soil was screened through 1/8" mesh, and all shell, lithic, botanical and faunal materials were collected. Recovered samples were returned to the Hilo laboratory for systematic sorting. A single charcoal sample was collected at Site 13188. This sample was sent to Beta Analytic, Coral Gables, Florida, for radiometric age determination.

Table 1.

CORRELATION OF SITE NUMBERS

SIHP Site Number	PHRI Temporary Site Number	SIHP Site Number	PHRI Temporary Site Number
00002	Mamalahoa Trail	13214	T-43
05011	T-94	13215	T-44
13175	T- 1	13216	T-45
13176	T- 2	13217	T-46
13177	T- 3	13218	T-47
13178	T- 4	13219	T-48
13179	T- 5	13220	T-55
13180	T- 6,18	13221	T-56,57
13181	T- 7	13222	T-58
13182	T- 8	13223	T-59
13183	T- 9*	13224	T-60
13184	T-10	13225	T-61
13185	T-11	13226	T-63,64
13186	T-12	13227	T-65
13187	T-13	13228	T-66
13188	T-14#	13229	T-67
13189	T-15	13230	T-68
13190	T-16	13231	T-69
13191	T-17	13232	T-70
13192	T-19	13233	T-71
13193	T-20	13234	T-72
13194	T-21	13235	T-73,74
13195	T-22	13236	T-75,77
13196	T-23	13237	T-76
13197	T-24	13238	T-78
13198	T-25	13239	T-79
13199	T-26	13240	T-80
13200	T-27	13241	T-81
13201	T-28	13242	T-82
13202	T-29	13243	T-83
13203	T-30	13244	T-85
13204	T-31	13245	T-86
13205	T-32	13246	T-87
13206	T-33	13247	T-88
13207	T-35	13248	T-89
13208	T-36	13249	T-90
13209	T-37,38	13250	T-91
13210	T-39	13251	T-92
13211	T-40	13252	T-93
13212	T-41	13253	T-96
13213	T-42	13254	T-95

* Identified as Site 12 in Hammatt, Shideler, and Borthwick (1987)
\# Identified as Site 1 in Soehren (1975)

FINDINGS

During the present project, 182 sites consisting of 840 component features were identified in the project area (Table 2, at end). Descriptive information is given for each site and recorded feature in Appendix A. Four of the sites (14 features) had been previously identified. Two of the previously identified sites had been listed on the State Inventory of Historic Places (SIHP). These are Mamalahoa Trail (SIHP Site 00002) and the Kealakehe/Keahuolu ahupua'a boundary wall (Site 5011). Other sites previously identified are Site 13188, a habitation cave (Hammatt et al. 1987), and Site 13253, a terrace complex interpreted by Soehren (1975) as a burial site. Both of these sites had been identified during reconnaissance surveys conducted in properties adjacent to the project area.

Among the 82 identified sites, 53 are in Kealakehe, 28 are in Keahuolu, and one (the ahupua'a boundary wall) is between the two lands. Overall site density is greater in the Keahuolu parcel, where 34% of the identified sites and 60% of the features occur on 16% of the total project area acreage. It is suspected that the higher site density in Keahuolu is a reflection of the generally higher elevation of that parcel (550-750 ft AMSL) and the lower incidence of bulldozer grubbing in that parcel, and possibly, the parcel's location farther south. Nearly half of the Kealakehe parcel is below 300 ft AMSL; only 22% of the identified sites and 8% of the total features occur at 300 ft AMSL or lower.

Twenty-nine of the identified sites consist of a single feature. These sites are primarily walls, trails, enclosures, and cairns. Multiple-feature sites consist of up to 120 features. Ten complexes contain 30 or more features; six of these complexes are in Keahuolu. All of the large complexes are predominantly agricultural features (discussed below).

The identified features represent 17 different formal categories (Table 3).

Formal Feature Types

Feature frequencies by formal types clearly indicate the predominance of pahoehoe excavations and rock mounds, which together comprise 72.3% of all features. Nearly half of the categories (8) are represented by less than 1% of the identified features. Features represented in the various formal categories are summarized below.

Cairns - With one exception, the cairns identified may be characterized as generally small, informal stacks, or loose conical piles of slabs and cobbles with no core filling or faced sides. A single cairn was located which has core filling and faced sides. This feature has been disturbed, and currently has two partial sides (one corner) intact. It was found at a Keahuolu agricultural complex consisting of 32 additional features (Site 13239, Feature B).

Table 3.

FEATURE COUNTS BY FORMAL CATEGORY

Formal Type	Count	Percent	Formal Type	Count	Percent
Cairn	26	3.1	Pavement	5	0.6
Cave	3	0.4	Platform	16	1.9
C-shape	1	0.1	Roadbed	1	0.1
Enclosure	22	2.6	Rock mound	350	41.7
Hearth	2	0.2	Stpst. trail	11	1.3
Kerbst. trail	5	0.6	Terrace	73	8.7
Midden scatter	1	0.1	Trail	2	0.2
Modified outcrop	46	5.5	Wall	18	2.1
Phh. excavation	258	30.7			
Subtotal:	**364**	**43.3**	**Total:**	**840**	**99.9**

At least six of the identified cairns are probably of recent construction and appear to delineate grubbing area perimeters. These are all located in the lower elevations of Kealakehe. Two cairns are definitely associated with a trail (Site 13202); all others are marking indeterminate features, places, or events. Among these remaining 19 features, two are in Keahuolu and 17 are in Kealakehe. Average height of the nonrecent unfaced cairns is 0.7 m; they are constructed of four to ten rocks stacked in a conical formation.

Caves - Three cave shelters were identified, two in Kealakehe (13183 and 13188) and one in Keahuolu (13230). The two Kealakehe caves have associated agricultural features, whereas Site 13230 is relatively isolated. This latter cave exhibits a partially walled entrance and has no midden deposit. Deposits are present in the two Kealakehe caves; both have been tested.

Site 13183 was tested by Hammatt et al. in 1987. The cave is situated at the west end of a collapsed lava tube that has been extensively modified with terraced fill and facing walls. A deposit 0.2 m thick was found just inside the dripline of this relatively small cave. Artifacts recovered here include 39 volcanic glass flakes and three bone picks. Charcoal, marine shell, and fish and pig remains were also recovered (Hammatt et al. 1987:39). Two enclosures, a large paved area, and a rock mound are immediately adjacent to the lava tube to the south. The area to the north has been grubbed. Hammatt et al. interpret the site as a habitation/ work area.

Site 13188 was tested during the current project. It consists of two linear lava tube chambers that are both accessed through a vertical skylight opening at the center. Two 1.0 by 1.0 m test units were excavated at the site, one unit per chamber. The deposit inside the cave was found to have a maximum thickness of 0.08 m. A small quantity of marine shell fragments, burned and unburned kukui nut (*Aleurites moluccana* L. [Willd.]) and charcoal were recovered, in addition to nine volcanic glass flakes. A charcoal sample comprised of scattered flecks collected from TU-2 was submitted to Beta Analytic for age determination. This sample was determined to be modern (BETA-34210).

All of the caves occur at elevations of 550 ft or greater. The most intensive use is indicated for Site 13183, located at 710 ft AMSL.

C-Shape - The only C-shape identified was present at Site 13243 in Keahuolu. It is in direct association with two recent hearths and is most likely of recent construction.

Enclosures - Among the 22 enclosures identified, 11 are in current use as agricultural features and are probably of relatively recent construction. These 11 enclosures are present at four sites—13175 (8), 13183 (1), 13217 (1), and 13237 (1). All but one of these sites (13237) are in Kealakehe.

One of the enclosures (Site 13251) may have been associated with ranching. This enclosure is at the eastern edge of the grazing land in Kealakehe and has been extensively disturbed by bulldozing; it is the largest enclosure recorded within the project area (c. 756.0 sq m interior). The walls of the enclosure are in very poor preservation; however, they appear to have been bifaced and core-filled.

The remaining 10 enclosures exhibit estimated interior areas that range from 12.7-396.6 sq m. Four of these features appear to have been used for agricultural purposes. They consist of loosely stacked, unfaced walls that are generally mounded rather than vertical. Three of these agricultural enclosures (at Sites 13186, 13252, and 13254) are the three smallest abandoned enclosures, and are very similar in size and form to enclosures that are in current use or have recently been abandoned. The enclosures are in the northeastern corner of the Kealakehe parcel, at elevations of 500 ft AMSL or higher. This is the same area that the enclosures in current use are concentrated within.

Five enclosures at five sites exhibit bifaced, core-filled walls, and may have functioned in a ceremonial or habitation capacity instead of, or in addition to, an agricultural capacity. They are all rectangular to trapezoidal in plan. The largest of these bifaced enclosures (369.60 sq m) is at Site 13228, located at 600 ft AMSL in Keahuolu. This enclosure exhibits a paved interior and has a prominent natural knoll in the center. A second enclosure, with a possible ceremonial function, is at Site 13213, located at 510 ft AMSL in Kealakehe. This 155.0 sq m enclosure is situated immediately adjacent to an associated platform.

Three bifaced, core-filled enclosures with possible habitation as well as agricultural functions are present at Sites 13183, 13213, and 13214. These sites are in Kealakehe, at 450-700 ft AMSL. Interior area of these features ranges from 93.1 (13183) to 172.0 sq m (13213). The enclosures at Sites 13213 and 13214 have interior features such as platforms, paved areas, and pahoehoe excavations. The Site 13183 enclosure has been disturbed by bulldozers and the interior features are indeterminate. The site is associated with a habitation cave as well as an agricultural enclosure that is in current use (for a mango tree).

Hearths - The two hearths identified are of recent construction and use. They are both at Site 13243 in Keahuolu. A C-shape and windbreak wall are also present at this site.

Kerbstone Trails - Five kerbstone trail sections were identified, three in Kealakehe and two in Keahuolu. The longest section is a portion of Mamalahoa Trail (Site 00002); this portion is oriented NW-SE, parallel to Queen Kaahumanu Highway at about 50 ft AMSL. The trail continues in both directions beyond the project area.

Two east-west (mauka-makai) trail sections were located in upper Kealakehe, at 550-700 ft AMSL. The longest of these is Site 13219, identifiable for 250.0 m. This intact section is cut at its east end by rip-rap and at its west end by the Site 13184 wall. Additional isolated sections were located west of the grazing land wall, indicating that the trail continues makai for an unknown distance (probably to Mamalahoa Trail or to Honokohau). This trail apparently continued eastward to a junction with a kerbstone trail that followed the approximate alignment of Palani Road. From this junction, it continued to the upper Government Road, which followed the alignment of the current Mamalahoa Highway (Emerson Survey Map 1882).

Site 13212 is a 62.0 m long kerbstone trail section located near the southern boundary of Kealakehe. The east and west ends of the section are currently defined by surface disturbance and are extremely vague. This trail may have continued east to intersect with the trail that followed the Palani Road alignment; however, cartographic evidence for this continuation is presently not available.

The two kerbstone trail sections identified in Keahuolu (13234 and 13244) are 244.0 and 350.0 m long, respectively. It is likely that these sections, which are along the eastern boundary of the survey area, represent the same trail. This trail is probably the first historic period alignment of the existing Palani Road (Emerson Survey Map 1882).

Midden Scatter - A single surface midden scatter was identified at Site 13209 in Kealakehe. This scatter occurs in association with 55 other features, including platforms, terraces, cairns, a steppingstone trail, and 40 pahoehoe excavations. The midden deposit is in a natural pahoehoe depression and covers a 44.8 sq m. It consists of marine shell fragments mixed with organic soil c. 0.08 m thick.

Modified Outcrops - Modified outcrops were identified at eight sites, two of which are in Keahuolu (13241 and 13246 [26 features]). Sites with modified outcrops range in elevation from 300 ft AMSL (one site) to 750 ft AMSL. Moderately concentrated outcrops occur at Sites 13185 (12) and 13241 (25). Twenty-eight additional features are present at Site 13185, and 24 additional agricultural features are present at Site 13241.

Modified outcrops consist of natural pahoehoe depressions, slopes, or flats that have been cleared of large loose rocks and filled with gravels and small cobbles. The larger stones are generally arranged around or near the perimeter of the cleared area in loose piles or alignments. In some cases, the resulting feature is somewhat terrace-like in appearance. Modified outcrops are distinguished from pahoehoe excavations in that the lava mantle is not penetrated. They may otherwise have similar morphological characteristics.

The majority of the modified outcrops were not individually measured or recorded during the inventory survey. It is likely that there are considerably more of these features within the project area. They are currently assumed to represent agricultural activities.

Pahoehoe Excavations - Pahoehoe excavations were observed at 25 sites. Most of the excavations (173 of 258, 67%) are at 14 sites in Keahuolu, between elevations of 550 and 750 ft AMSL. Counts of 20 or more pahoehoe excavations were obtained at four sites, 13209 in Kealakehe (40), and 13221 (25), 13227 (48), and 13239 (20) in Keahuolu.

Characteristic pahoehoe excavations consist of small lava blisters that have the surface broken away, creating a hole where the gas pocket existed. Depth of the hole usually ranges from 0.40 to 0.90 m. The blocks and pieces of pahoehoe debris broken away are usually arranged around the perimeter of the hole in a circular alignment, or are in loose piles to the outside. In some cases, the large blocks are inside the hole, aligned against the walls. The hole is often partially filled with pieces of pahoehoe that are size-sorted (smaller pieces on the bottom, larger pieces on top). The gravels that occur in lower layers of these holes are often very angular and unweathered, and appear to be artificially produced by crushing larger rocks. Soil is often mixed with the gravels; the soil is not visible unless the upper layer of larger rocks is removed.

Comparison of surface area values for recorded pahoehoe excavations suggests that there may be at least two distinct size groups. Half of the measured excavations have surface areas between 3.0 and 10.0 sq m. Only one excavation exhibits an area that is between 10.0 and 40.0 sq m (17.3 sq m), yet 35% exhibit areas greater than 40.0 sq m (43.20-

77.19 sq m). This pattern may, however, be a result of sampling error, since the majority of the observed excavations were not individually measured.

Pahoehoe excavations that occur within the project area are assumed to have functioned as agricultural features. These features are referred to as "planting pits" by Soehren (1975), who observed an unknown quantity in Honokohau, but states that "[n]o attempt was made to record such features" (1987:1). It is suspected that pahoehoe excavations and modified outcrops were disregarded in other prior studies of Kealakehe and Keahuolu. These features, together with rock mounds, are clearly the predominant agricultural features within the project area. Any attempt to measure the spatial patterning and relative intensity of agricultural activities must rely heavily upon these features. It is therefore important that a typological system, based on quantifiable variables, be developed for recording pahoehoe excavations.

Pavements - Five paved areas were recorded at three Kealakehe sites within the project area—13183 (1), 13203 (1), and 13252 (3). These features consist of a single layer of pebble-size pahoehoe or aa that is spread over a flat surface. The pavements at Sites 13183 and 13252 are associated with other habitation and agricultural features. At Site 13203, the pavement is associated with a terrace that is interpreted as an agricultural feature. It is difficult to assign a feature-specific function to the pavements; they may reflect general yard area landscaping.

Platforms - Sixteen platforms were identified at nine sites, eight of which are in Kealakehe. Concentrations of platforms occur at Sites 13181 (4) and 13253 (3). Both of these sites are along the northern boundary of Kealakehe, in relatively low elevations (300 ft and 50 ft AMSL, respectively). Platforms at both sites are tentatively interpreted as burial monuments. The platforms at Site 13181 are rectangular in plan and have surface areas of 9.00 to 31.90 sq m. Platform heights range from 0.75 to 1.25 m. At Site 13253, the platforms are oval to five-sided, with surface areas of 6.25 to 23.00 sq m. Maximum height of these platforms is 0.73 m. In addition to the size, shape, and height differential between platforms at these sites, the construction techniques and materials is different. Likewise, the site settings contrast markedly. Site 13181 is on a very prominent ridgetop, whereas Site 13253 is in a ravine at the base of a high aa flow.

Three additional platforms have been interpreted as possible burial features. These are at Sites 13178, 13209, and 13223. The platforms all have relatively small surface areas (1.30 to 13.30 sq m) and are less than 1.00 m high.

Platforms interpreted as habitation features are present, one each, at Sites 13209, 13210, and 13214. These sites are all in southern Kealakehe, between 450 and 650 ft AMSL. The platforms exhibit a very uniform surface area (42.7 to 49.4 sq m) and range in height from 0.75 to 1.20 m.

Roadbed - A historic machine-made roadbed was identified in Keahuolu (Site 13246). This feature represents an old Palani Road alignment; other portions of the same alignment are present southwest of the current project area, along the present Palani Road.

Rock Mounds - During enumeration and recording of the 350+ rock mounds observed within the project area, a distinction was made between faced mounds, linear mounds, and circular to oval mounds.

Faced mounds exhibit at least one side that is stacked vertically and faced. Most of the faced mounds are faced on all sides. They are distinguishable from platforms in that their surfaces are rough, mounded, and are not paved. Thirteen faced mounds were identified at four sites; three in Kealakehe (13193 [1], 13252 [3], and 13254 [6]), and one in Keahuolu (13240 [3]). Nine of the faced mounds are at two adjacent sites that are probably part of the same agricultural complex. These mounds are generally rectangular to circular in plan and have surface areas that range from 5.7 to 16.5 sq m. Heights range from 0.6 to 1.5 m.

A number of faced rock mounds were identified by Hammatt et al. (1987) in their project area, which is just east of the eastern edge of Site 13254. Hammatt et al. tested eight mounds in order to determine if human skeletal remains were present beneath them (Hammatt et al. 1987:8,63,64). No skeletal remains, midden, or artifacts were recovered, and it was concluded that the faced mounds were relatively formalized "clearance mounds."

Linear rock mounds are low, unfaced mounds that are at least twice as long as they are wide. Ninety-seven linear mounds were observed at 14 sites within the project area. Ninety-three of these mounds (nine sites) are in Keahuolu. The most concentrated occurrence is at Site 13221, where 55 were enumerated.

In general, the linear mounds are too short to be considered kuaiwi walls. As defined by Kirch (1985:228), kuaiwi walls are long, parallel field boundaries that generally follow the slope of the land. The longest linear mound recorded in the project area is 25.00 m long. Average length among 14 mounds from all 14 sites is 11.20 m (range 4.2-25.0 m). Width ranges from 1.00-4.00 m (average 2.10 m), and height ranges from 0.60 to 1.25 m.

A total of 240 circular to oval rock mounds were observed at 23 sites. A clear majority (209, 87%) of the mounds are in Keahuolu, at 15 different complexes. Within a sample group of 12 mounds from 10 sites, the average surface area at the base is 5.8 sq m (range 2.6-12.8 sq m), and the average height is 0.64 m (range 0.30-1.25 m). An unusually large mound was observed at Site 13211, which has a surface area at the base of c. 106.9 sq m. This mound has a central depression/cleared area, making it appear somewhat doughnut-shaped in plan view. A second unusual mound was observed at Site 13249. This feature is teardrop in plan, and also exhibits a depression in the center of the widest portion. It covers a surface area of c. 16.3 sq m.

Steppingstone Trails - Eleven steppingstone trail sections were located, all on aa lava flows. Ten of the sections are in Kealakehe, at ten different sites. Together, the ten sections cover 571.0 linear m. It is suspected that six of the sections are parts of two trails. Sections were observed at Sites 13186, 13204, 13206, and 13207, which may well represent the same north-south trail across Kealakehe. These sites are aligned at or just above the 400 ft elevation contour, from the northern boundary to within c. 250.00 m of the southern boundary. Trail sections at Sites 13194 and 13197 are very likely the same mauka-makai trail that crosses Mamalahoa Trail and continues to Aimakapa Pond on the coast. It is also likely that the section at Site 13253 once joined with this trail makai of Queen Kaahumanu Highway in Honokohau.

The single steppingstone trail section in Keahuolu is at Site 13242; the section is 70.0 m long and is oriented NE-SW.

Terraces - Seventy-three terraces were identified at 20 sites within the project area. Only six (8%) of the terraces are in Keahuolu (five sites). Metric dimensions are available for 47 terraces from 16 sites. Within this group, overall surface area ranges from 2.2 to 117.3 sq m. Average surface area is 28.2 sq m. Four terraces exhibit surface areas greater than 50.00 sq m. These features are at Sites 13176, 13207, 13249, and 13254, all in Kealakehe. Sixteen terraces have surface areas between 25.0 and 49.9 sq m; 17 have surface areas between 10.0 and 24.9 sq m, and 10 are less than 10.0 sq m in surface area.

Fifty-seven of the 73 identified terraces appear to have agricultural functions; two may have been used for habitation, one is possibly ceremonial, and 13 are possible burials. The possible burials all occur at two sites (13184 and 13253). The possible ceremonial terrace is at Site 13176; it is a large, stepped terrace situated on a prominent ridge, and is associated with a second large (117.30 sq m) terrace that may be a habitation or ceremonial feature.

Trails - Two trail sections were identified at Sites 13201 and 13202 in Kealakehe. These sections consist of cleared and packed corridors through aa; they are located c. 152.0 m apart and are probably sections of the same north-south footpath.

Walls - Eighteen walls were identified, two of which are in Keahuolu. Seven of the walls appear to be associated with ranching activities and are probably historic. One is an ahupua'a boundary (Site 5011), one is associated with recent camping activities (Site 13243 in Keahuolu), and nine are associated with agricultural activities. The nine agricultural walls occur at five sites, one of which is in Keahuolu.

Five of the agricultural walls (at Sites 13190, 13239, and 13252) are relatively short and are either curved or L-shaped. They range in length from 5.2 to 29.0 m, and appear to serve as windbreaks or soil retention features around the perimeters of planting areas.

Four agricultural walls can be considered kuaiwi walls. These are all in the northeast corner of the project area, in Kealakehe, at Sites 13216 (1) and 13254 (3). The walls are oriented with the slope of the land and are essentially parallel. They range in length from 44.0 to 103.00 m and are generally unfaced, with some faced sections.

In summarizing the general patterning of formal feature categories, it might be noted that although the overall density of features is greater in the Keahuolu parcel of the project area, there are distinct differences in the patterning of specific formal types. The Keahuolu parcel clearly contains the bulk of the relatively informal agricultural features, such as 96% of the linear rock mounds (93 of 97), 87% of the circular rock mounds (209 of 240), and 67% of the pahoehoe excavations. In comparison, 94% of the recorded platforms (15 of 16) are in Kealakehe, as well as 92% of the terraces (67 of 73), 91% of the enclosures (20 of 22), 89% of the walls (16 of 18), 77% of the faced mounds (10 of 13), and 100% of the pavements (5 of 5). This difference can only be partially explained by differences in the proportion of higher vs. lower elevations between the two parcels. A much clearer picture of this pattern will emerge upon completion of the analysis of survey data from lower elevations in Keahuolu (report on PHRI Project 89-596, pending).

Functional Categories

Within and among the seventeen formal groups described above, eight general functional categories are represented (Table 4).

Table 4.

FREQUENCY OF FORMAL FEATURE TYPES BY FUNCTIONAL CATEGORIES

Feature Type	Count	% of Category	% of Total
Agricultural Features			
Enclosures	15	2.0	-
Faced mounds	9	1.2	-
Linear rock mounds	97	13.2	-
Modified outcrops	46	6.3	-
Pahoehoe excavations	258	35.1	-
Pavements	3	0.4	-
Rock mounds	242	32.9	-
Terraces	57	7.7	-
Walls	9	1.2	-
Subtotal:	**736**	**100.0**	**87.6**
Habitation Features			
Caves	3	25.0	-
C-shapes	1	8.3	-
Hearths	2	16.7	-
Midden scatter	1	8.3	-
Pavements	1	8.3	-
Platforms	3	25.0	-
Wall	1	8.3	-
Subtotal:	**12**	**99.9**	**1.4**
Transportation Features			
Steppingstone trails	11	57.9	-
Kerbstone trails	5	26.3	-
Footpaths	2	10.5	-
Roadbeds	1	5.3	-
Subtotal	**19**	**100.0**	**2.3**
Possible Ceremonial Features			
Enclosures	2	40.0	-
Platform	2	40.0	-
Stepped Terrace	1	20.0	-
Subtotal:	**5**	**100.0**	**0.5**

Table 4. (cont.)

Feature Type	Count	% of Category	% of Total
Habitation or Agriculture Features			
Enclosures	3	50.0	-
Pavements	1	16.7	-
Terraces	2	33.3	-
Subtotal:	**6**	**100.0**	**0.7**
Indeterminate Markers			
Cairns	26	3.1	-
Land Division/Ranching Features			
Walls	8	88.9	-
Enclosure	1	11.1	-
Subtotal:	**9**	**100.0**	**1.1**
Possible Burial Features			
Faced Mounds	4	14.8	-
Platforms	10	37.0	-
Terraces	13	48.2	-
Subtotal:	**27**	**100.0**	**3.2**
Total:	**840**	**100.0**	**99.9**

category clearly indicates a predominance of agricultural features (87.6% of 840 features). Habitation features and possible habitation/agricultural features combined (2.1%) are proportionately less frequent than transportation features (2.3%) or possible burials (3.2%).

Agriculture - Agricultural features occur as single-component sites in only three instances (Sites 13217, 13237, and 13250). In two of these three cases, the isolated feature is in an enclosure that is in current use. The third single component agricultural site (13250) is a terraced rock mound. This feature is in an area of very high grass, and the absence of nearby features has not been substantially demonstrated at this time.

Among the agricultural features, 99.6% occur in complexes with one or up to 119 additional features. Complexes with agricultural features account for 43 of the 53 recorded complexes. Thirty-seven of the 43 complexes with agriculture features have either one or no features that fit another functional category. The most frequently occurring non-agricultural features in agricultural complexes are cairns and trails.

Feature counts and reliable overall site area data are available for 35 of the 37 complexes that are comprised solely or predominantly of agricultural features (Table 5). Among these 35 complexes, the total count for agricultural features ranges from two to 120, with a mean of 21 and

Table 5.

FEATURE COUNTS, SITE AREA, AND ELEVATIONS FOR AGRICULTURAL COMPLEXES

Kealakehe Sites				Keahuolu Sites			
No.	Fea. Cnt.	Area*	Elev.#	No.	Fea. Cnt.	Area*	Elev.#
13175	8	7,200	720	13220	3	120	540
13178	3	64	350	13221	80	2,100	530
13183	5	1,000	710	13222	19	600	550
13185	40	5,600	565	13224	28	1,600	540
13186	3	1,500	400	13225	7	340	580
13188	3	105	350	13226	13	924	590
13189	3	150	340	13227	120	3,500	600
13190	30	410	290	13229	10	600	640
13200	2	30	300	13231	8	600	630
13203	2	49	260	13233	6	750	610
13207	4	780	390	13235	33	4,250	620
13209	56	4,050	460	13236	6	750	650
13210	3	375	600	13238	20	180	650
13211	2	576	560	13239	33	1,200	640
13212	8	2,666	560	13240	33	1,500	660
13249	7	510	560	13241	49	4,140	630
13252	17	2,500	630	13247	4	3,750	590
13254	74	14,000	625				

* Sq m
\# Ft AMSL

median of eight. Twenty of the 35 complexes include one or more pahoehoe excavations. Counts of this formal type range from one to 48 per complex, with a mean of 12 excavations per complex. Twenty-five complexes contain one or more rock mounds. Counts of rock mounds range from one to 72 per complex, with a mean of 14. Sixteen complexes consist solely of pahoehoe excavations, rock mounds, or a combination of both. The remaining 21 sites have terraces, walls or modified outcrops.

A series of descriptive statistics were generated using the 35 agricultural complexes in order to determine if (a) feature density and formal types present were related to elevation, and (b) if the composition of the complexes varied between ahupua'a. Seventeen of the 35 complexes compared here are in Keahuolu and 18 are in Kealakehe.

Three elevational groupings were delineated; greater than or equal to 600 ft, 300-599 ft, and less than 400 ft. Fifteen complexes are at elevations of 600 ft or greater. These contain a total of 423 features (mean 28, range 3-120). Overall complex area of this group averages 2,836.33 sq m, and the average area per feature is 152.05 sq m.

Eighteen complexes are at elevations between 300 and 599 ft AMSL. These contain a total of 278 features (mean 15, range 2-80). Overall complex area of this group averages 1,414.72 sq m, and the average area per feature is 165.7 sq m.

Seven agricultural complexes are at elevations less than 400 ft. These contain a total of 46 features (mean 7, range 2-30). Overall complex area averages 1,588 sq m and average area per feature is 50.64 sq m. Three of these seven complexes include pahoehoe excavations (total of 21 excavations) and two include rock mounds (total of 12 mounds). It is only in these lower elevations that pahoehoe excavations outnumber rock mounds.

Among the upper elevation complexes (600 ft AMSL or greater), seven have pahoehoe excavations and 13 have rock mounds (seven have both). Total number of pahoehoe excavations in this group is 114 (44% of all pahoehoe excavations); average per complex is 16 (range 1-48). The average area per feature on this complexes is 71.3 sq m. Upper elevation complexes with rock mounds contain a total of 228 mounds (65% of all rock mounds). Average count per complex is 18, and the average area per feature is 96.60 sq m.

Upper elevation complexes contain twice as many rock mounds as pahoehoe excavations and a significantly higher proportion of all rock mounds in comparison to all pahoehoe excavations. The 300-599 ft elevation group includes 11 complexes with pahoehoe excavations and 12 complexes with rock mounds. A total of 108 excavations and 110 mounds are present, and mean counts per complex are very similar (nine excavations per site and ten mounds per site). The overall count for pahoehoe excavations here is not significantly different than the upper elevation count, and more complexes have excavations. For rock mounds, there is a decrease of over 50% in the overall count, and a slight decrease in the number of sites. Overall area per rock mound increases from 96.6 to 157.1 sq m.

The general trend indicated by these data is that rock mounds show a higher degree of correlation with elevational change than pahoehoe excavations. They may therefore reflect a more specialized use or a more limited range of associated cultigens than pahoehoe excavations.

Agricultural terraces exhibit a tendency to be more common and more dispersed between 300 and 600 ft AMSL. At 600 ft or above, 22 terraces occur at four sites, whereas between 300-600 ft, 38 terraces occur at 11 sites. Nine terraces occur at four sites with elevations less than 400 ft. As indicated above, most of the terraces are in Kealakehe; only six are in Keahuolu. If terrace frequency is related to elevational change, as suggested here, then the lower terrace count for Keahuolu is at least partially accounted for by this factor.

Comparisons between agricultural complexes in the two ahupua'a indicate differences in several characteristics. For the 18 Kealakehe complexes, overall site area ranges from 30.00 to 14,000.00 sq m, with a mean area of 2,309.17 sq m. In Keahuolu, area ranges from 120 to 4,250 sq m, with an average area of 1,582.5 sq m. As mentioned above, there is a significant difference in the frequency of rock mounds at the two ahupua'a. In Kealakehe, 70 rock mounds are present at 18 complexes. Maximum number of mounds per complex is 36. At Keahuolu, 278 mounds are present at 17 complexes; maximum number at a complex is 72. The average total agricultural features per complex varies considerably. For Kealakehe, an average of 14.55 features occurs per complex; in Keahuolu, the average count is 27.7, nearly double.

Habitation - The twelve features assigned a habitation function occur at nine sites, including one recent occupation (Site 13243). This latter site has four features and is one of two habitation sites in the Keahuolu parcel.

The three habitation caves (13183, 13188, and 13230) appear to represent temporary use. The most substantial occupation deposit is at Site 13183, which may represent a repeatedly used field shelter/work area. Permanent habitation is suggested, but not yet demonstrated, at three sites with platforms (13209, 13210, and 13214). A surface midden scatter is also present at Site 13209. These sites are all in the southeastern corner of Kealakehe, between 400 and 500 ft AMSL.

All other habitation sites are tentatively interpreted as temporary use areas. These include the recent hearths, wall and C-shape at Site 13243, and a pavement at Site 13252.

Habitation is considered a possible function at six features that occur at six complexes. Three of these complexes (13183, 13210, and 13214) have other features that have been assigned a possible habitation function. An enclosure and a paved area at Site 13252 may also have been associated with habitation, in addition to the modified lava tube and cave. At Site 13210, a terrace may have been used for habitation, in addition to the platform. At Site 13214, an enclosure surrounds the platform that appears to be associated with habitation. A possible habitation terrace occurs at Site 13176, and a second enclosure that may have surrounded a house yard occur at Sites 13213, located just east of Site 13214. With the exception of the recent features, all habitation sites appear to date to the Pre-Contact Period.

Transportation - Among the 19 transportation sites, five are kerbstone trail sections that can be assigned to the nineteenth century. One of the sites (13246) is a twentieth century roadbed, and the 13 steppingstone trails and footpaths are most likely pre-contact to early historic. As discussed above, most of the trails are in Kealakehe.

A minimum of four trails are represented by the 11 steppingstone trail sections, and one trail is probably represented by the two footpath sections. In general, the steppingstone trail sections and footpaths were only discernible

across aa. A minimum of two north-south routes and two mauka-makai routes are represented by these 13 trail sections.

The five kerbstone trail sections represent a minimum of four trails. Two are oriented mauka-makai and are situated in the north and south portions of Kealakehe, respectively. One (Mamalahoa Trail) is oriented north-south, and one appears to follow the Palani Road alignment, which is generally north-south and mauka-makai. The latter trail, represented by two sections, is in Keahuolu.

Possible Burials - Features that may contain human interments occur at seven sites and include faced mounds, platforms, and terraces. The most concentrated occurrence of these features is at Site 13253, where seven terraces and three platforms are present. This site was described by Soehren (1975) as a burial area. For the most part, the features exhibit formal characteristics of burial monuments. A second concentration of probable graves is at Site 13181, where four platforms occur. This site and Site 13253 are located along the northern boundary of Kealakehe. A third concentration of possible burials is at Site 13185, where six faced terraces occur. Additional agricultural features are present at this site and the probability of burials being present here is felt to be not as great as at the preceding two sites.

Four faced mounds, three at Site 13254 and one at 13193, are included in the list of possible burials. On the basis of findings during excavation of eight faced mounds in Kealakehe by Hammatt et al. (1987), the likelihood of locating skeletal remains in these features is not extremely high, but the possibility nevertheless exists.

Possible Ceremonial - Five features at four sites have attributes that suggest their use as ceremonial structures. These include a large stepped terrace (Site 13176) located along the northern boundary of Kealakehe, a terrace and platform complex (Site 13205) in Kealakehe, a large platform at the major agricultural complex in northeastern Kealakehe (Site 13254), and an enclosure in Keahuolu (Site 13228).

Subsurface Findings

Subsurface materials were collected from two test units at Site 13188. Both test units were 1.00 by 1.00 m sq, and were excavated to the bedrock floor of the cave. The deposit in Test Unit 1 (TU-1) was only 0.03 m thick. The deposit in TU-2 was 0.08 m thick. Both deposits consisted of a single stratigraphic layer (Layer I) consisting of dark reddish-brown loam with numerous rootlets.

A total of 6.31 g of marine shell and shell fragments was recovered from the two test units (Table 6). Despite the greater volume of soil removed from TU-2, both units produced similar total weights of marine material (3.01 g for TU-1 and 3.12 g for TU-2).

All shellfish remains recovered are 1/4" size grade; no shellfish remains were present in the 1/8" size grade material, which was examined in the laboratory. As indicated (Table 6), only small amounts of four shellfish species were present in the cave deposit. The overall volume of the remains, and the similarity of represented species in both test units suggests that a single incidence of occupation may be represented. Among the 15 enumerated shell pieces, eight are complete Isognomonidea valves, one is a complete Thaididae shell, and two are complete *N. picea*.

Table 6.

SUMMARY OF MIDDEN REMAINS, SITE 13188

Midden	TU 1		TU 2		Total Wt.
	Weight (g)	Count	Weight (g)	Count	
Cypraeidae	0.38	4	0.65	1	1.21
Isognomonidae	1.68	5	0.65	3	2.33
Nerita picea	0.56	4	-	-	0.56
Thaididae	0.39	1	1.82	1	2.21
Total Shellfish:	**3.01**	**14**	**3.12**	**5**	**6.31**
Kukui nut shell	2.11	4	-	-	2.11

All kukui nut shell remains were recovered from TU-1. The kukui nut shell is fragmented and is partially charred. Pieces of charred woody plant remains were present in TU-2; all of these pieces were collected, and were used collectively as a dating sample (discussed below).

In addition to the midden remains, nine volcanic glass pieces were recovered from TU-1. All volcanic glass pieces are minute flakes with no modifications.

Age Determinations

A single radiometric dating sample was collected from Site 13188 during subsurface testing. This sample was comprised of numerous small woody plant flecks that were scattered throughout Layer I of TU-2. The sample was determined to have a count rate statistically indistinguishable from the modern count rate at the 1/2 sigma level (BETA 34210).

Although the radiometric sample was determined to be indistinguishable from modern, the presence of volcanic glass flakes in association with the sample indicates a likely occupation sometime before the twentieth century. The carbonized materials scattered in the deposit may have been derived from a brush fire, rather than from a fire inside the cave. The entrance to the cave is oriented in such a manner that wind-born materials can easily accumulate inside.

A date extending into the modern period was also obtained from a hearth at Site 11, located in an area immediately east of this survey area (Hammatt et al. 1987). A calendric range of AD 1645-1950 was determined for this sample (Hammatt et al. 1987:60). Site 11 was located along the western boundary of Hammatt's project area and is very likely part of the Site 13183 complex, which includes a cave (Feature A) that was also tested by Hammatt et al. as Site 12.

CONCLUSION

DISCUSSION

The observations presented in the preceding section, concerning agricultural feature patterning, relative density of features within agricultural complexes, and the relationship between certain formal agricultural feature types and elevation, provide some indication of the research potential of sites within the project area. Subsequent work could explore this potential more fully by simply altering data collection procedures: the conclusions in the preceding section are limited primarily by the collection procedures employed during the project. For example, the determination of site boundaries (hence overall site area) is a relatively subjective procedure that becomes severely affected by surface visibility. Procedures to assure more accurate boundary delineation would enhance the accuracy, and thus utility and range, of research results.

In order to obtain reliable data for continued analysis of the agricultural complexes, it is recommended that a systematic sampling approach be adopted, whereby sample blocks or transects are cleared of vegetation, and all features within the designated area are plotted and recorded. These sample transects or blocks should be located independently of the existing sites, in order to control for those features not located between survey sweeps in areas of dense vegetation.

The use of sampling blocks will provide a reliable basis for feature density and relative frequency of types, and provide a more realistic framework for comparing elevational variation. A sampling scheme will also help determine the best means for identifying site boundaries (or the absence of such) in areas where this is problematic. For example, it is suspected that several of the complexes in Keahuolu are currently delineated on the basis of no visibility, rather than the absence of features. Total clearing of the entire 150-acre parcel is not feasible; however, boundary delineation would be nearly accomplished if every complex were cleared in order to determine site boundaries. The area incorporated by agricultural complexes recommended for further data collection is 55,650 sq m. A systematic sampling approach should provide sufficient data for the mitigation of adverse effects on a large proportion of the agricultural complexes recommended for further data collection.

In conjunction with a sampling approach, a more exact and replicable feature typology should be developed. With a proper typology, the spatial patterning of various feature types can be rapidly recorded, without the time-consuming process of drawing each feature to scale. Given the expanse of the project area and extensive amount of clearing that will have to be completed for detailed scaled mapping, this procedure will of necessity be limited to a relatively small proportion of the area recommended for further work. Plotting features by type will provide a much larger data base for examining spatial patterns.

GENERAL SIGNIFICANCE ASSESSMENTS AND RECOMMENDED GENERAL TREATMENTS

A summary of tentative general significance assessments is given (Table 7) in order to facilitate DLNR-HSS/SHPO review and cultural resource management planning. Significance categories are based on the National Register criteria for evaluation, as outlined in the Code of Federal Regulations (36CFR Par 60). Sites determined to be potentially significant for information content (Category A, Table 7) are assessed under Criterion D, which defines significant resources as ones which "...have yielded, or may be likely to yield, information important in prehistory or history." Sites potentially significant as excellent examples of a unique site or site type (Category B) are evaluated under Criterion C, which defines significant resources as those which "...embody the distinctive characteristics of a type, period, or method of construction...or that represent a significant and distinguishable entity whose components may lack individual distinction."

Sites with potential cultural significance (Category C) are evaluated under guidelines prepared by the Advisory Council on Historic Preservation entitled "Guidelines for Consideration of Traditional Cultural Values in Historic Preservation Review" (Draft Report, August 1985). The guidelines define cultural value as "...the contribution made by an historic property to an ongoing society or cultural system. A traditional cultural value is a cultural value that has historic depth." The guidelines further specify that "[a] property need not have been in consistent use since antiquity by a cultural system in order to have a traditional cultural value."

In order to facilitate future client management decisions regarding site treatments, sites were further evaluated in terms of PHRI Cultural Resource Management (CRM) value modes which are derived from the previously mentioned evaluation criteria. The archaeological sites are evaluated in terms of potential scientific research, interpretive, and/or

cultural values. **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** refers to the potential of archaeological resources to preserve and promote cultural and ethnic identity and values. See Table 2 (at end) for CRM value mode assessments for individual sites.

Based on the above federal and state criteria, of the 82 sites identified within the project area, 63 are assessed as significant solely for information content (National Register Criterion D). Ten sites are assessed as significant for information content and as being excellent examples of a site type (National Register Criterion C). Among these ten sites, three also have high cultural value and seven have a provisional assessment of high cultural value, pending the findings of subsurface investigations. Four sites are assessed as having information value and as provisionally having high cultural value, pending the findings of subsurface testing. Finally five sites with information value have provisional assessments of high interpretive and cultural values, pending the results of further data collection.

No Further Work - Of the 63 sites identified as having significant information content, 21 are assessed as having information content at the level of local analysis, and have been subjected to an adequate level of data recovery for the mitigation of the information loss (Significance Category X, Recommended Treatment Category NFW). These include six cairn sites (13177, 13191, 13192, 13195, 13196, and 13199), three recent agricultural enclosures (13175, 13217, and 13237), a recent campsite (13243), two historic walls (13215 and 13216), four small complexes consisting of one cairn and a single agricultural feature (13182, 12198, 13208, and 13245), a bulldozed enclosure (13251), an isolated rock mound (13250), two small agricultural complexes (13200 and 13249) and a cave that was tested during this project and was determined to have little additional new information (13188). These sites have been mapped, described, and photographed, and their locations have been plotted; no further work is recommended.

Further Data Collection - Forty-two sites are tentatively assessed as having information value at the local or regional level of analysis, and are recommended for further data collection (Significance Category A, Recommended Treatment FDC). They potentially contain information pivotal to understanding prehistoric and early historic settlement and agricultural land use patterns in leeward Hawaii, in addition to providing locally significant information. The majority of these sites are agricultural complexes, some of which include habitation or possible habitation features (31 sites, 76% of category). They include Sites 13186, 13187, 13189, 13190, 13203, 13207, 13210-14, 13220-22, 13224-27, 13228, 13231-33, 13235, 13236, 13238-41, 13246, 13247, and 13252.

Six sites are walls that require additional data collection in order to determine period of construction and intended function; they include Sites 5011, 13179, 13180, 13184, 13218, and 13248. Two sites recommended for further data collection have habitation (13183) or possible habitation (13230) cave features, and three of the sites are trail sections that could not be satisfactorily located and followed during this survey (Sites 13201, 13202, and 13244). Additional data collection is recommended as a mitigatory step if these sites or portions of these sites are affected by development.

Further Data Collection with Interpretive Development - Ten sites are recommended for interpretive development, following further data recovery. Three of these sites are trails which have both interpretive and cultural value, *in addition to information content* (Significance Categories A,B,C; Recommended Treatment Categories FDC, PID). They include the Site 13194 steppingstone trail, the Site 13219 kerbstone trail, and Mamalahoa Trail (Site 2).

Seven sites have high interpretive value as excellent examples of a site type and also have provisional cultural value as containing either possible burial features or ceremonial features (Significance Categories A,B, provisional C; Recommended Treatment categories FDC, PID). Site 13176 has the best-preserved, largest, and most formalized stepped terrace in the project area; it is interpreted as a possible ceremonial feature, pending further data collection. Sites 13181 and 13253 are unique complexes believed to consist solely of burial features. Site 13185 is a unique complex comprised of very distinctive, formalized faced terraces, some of which are believed to contain burials. Site 13209 is a habitation/agricultural complex which exhibits a wide range of formal feature types, including a possible burial platform. Finally, Site 13254 is a major agricultural complex which contains the only well-preserved examples of kuaiwi walls and a very wide range of formal feature types. It is thought to include habitation platforms, possible burial features (faced mounds), and a possible ceremonial platform.

Further Data Collection with Provisional Preservation As Is - Four sites include or consist of features that may contain human interments, and are recommended for

Table 7.

SUMMARY OF GENERAL SIGNIFICANCE ASSESSMENTS AND RECOMMENDED GENERAL TREATMENTS

Site Number	Significance Category				Recommended Treatment			
	A	X	B	C	FDC	NFW	PID	PAI
13175	-	+	-	-	-	+	-	-
13177	-	+	-	-	-	+	-	-
13182	-	+	-	-	-	+	-	-
13188	-	+	-	-	-	+	-	-
13191	-	+	-	-	-	+	-	-
13192	-	+	-	-	-	+	-	-
13195	-	+	-	-	-	+	-	-
13196	-	+	-	-	-	+	-	-
13198	-	+	-	-	-	+	-	-
13199	-	+	-	-	-	+	-	-
13200	-	+	-	-	-	+	-	-
13208	-	+	-	-	-	+	-	-
13215	-	+	-	-	-	+	-	-
13216	-	+	-	-	-	+	-	-
13217	-	+	-	-	-	+	-	-
13237	-	+	-	-	-	+	-	-
13243	-	+	-	-	-	+	-	-
13245	-	+	-	-	-	+	-	-
13249	-	+	-	-	-	+	-	-
13250	-	+	-	-	-	+	-	-
13251	-	+	-	-	-	+	-	-
Subtotal:	**0**	**21**	**0**	**0**	**0**	**21**	**0**	**0**

General Significance Categories:

A = Important for information content, further data collection necessary (PHRI=research value);
X = Important for information content, no further data collection necessary (PHRI=research value, SHPO=not significant)
B = Excellent example of site type at local, region, island, State, or National level (PHRI=interpretive value); and
C = Culturally significant (PHRI=cultural value).

Recommended General Treatments:

FDC = Further data collection necessary (intensive survey and testing, 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 minimal further data collection necessary

Table 7. (cont.)

Site Number	Significance Category				Recommended Treatment			
	A	X	B	C	FDC	NFW	PID	PAI
05011	+	-	-	-	+	-	-	-
13179	+	-	-	-	+	-	-	-
13180	+	-	-	-	+	-	-	-
13183	+	-	-	-	+	-	-	-
13184	+	-	-	-	+	-	-	-
13186	+	-	-	-	+	-	-	-
13187	+	-	-	-	+	-	-	-
13189	+	-	-	-	+	-	-	-
13190	+	-	-	-	+	-	-	-
13201	+	-	-	-	+	-	-	-
13202	+	-	-	-	+	-	-	-
13203	+	-	-	-	+	-	-	-
13207	+	-	-	-	+	-	-	-
13210	+	-	-	-	+	-	-	-
13211	+	-	-	-	+	-	-	-
13212	+	-	-	-	+	-	-	-
13213	+	-	-	-	+	-	-	-
13214	+	-	-	-	+	-	-	-
13218	+	-	-	-	+	-	-	-
13220	+	-	-	-	+	-	-	-
13221	+	-	-	-	+	-	-	-
13222	+	-	-	-	+	-	-	-
13224	+	-	-	-	+	-	-	-
13225	+	-	-	-	+	-	-	-
13226	+	-	-	-	+	-	-	-
13227	+	-	-	-	+	-	-	-
13229	+	-	-	-	+	-	-	-
13230	+	-	-	-	+	-	-	-
13231	+	-	-	-	+	-	-	-
13232	+	-	-	-	+	-	-	-
13233	+	-	-	-	+	-	-	-
13235	+	-	-	-	+	-	-	-
13236	+	-	-	-	+	-	-	-
13238	+	-	-	-	+	-	-	-
13239	+	-	-	-	+	-	-	-
13240	+	-	-	-	+	-	-	-
13241	+	-	-	-	+	-	-	-
13244	+	-	-	-	+	-	-	-
13246	+	-	-	-	+	-	-	-
13247	+	-	-	-	+	-	-	-
13248	+	-	-	-	+	-	-	-
13252	+	-	-	-	+	-	-	-
Subtotal:	**42**	**0**	**0**	**0**	**42**	**0**	**0**	**0**

Table 7. (cont.)

Site Number	Significance Category				Recommended Treatment			
	A	X	B	C	FDC	NFW	PID	PAI
00002	+	-	+	+	+	-	+	-
13194	+	-	+	+	+	-	+	-
13219	+	-	+	+	+	-	+	-
Subtotal:	**3**	**0**	**3**	**3**	**3**	**0**	**3**	**0**
13178	+	-	-	*	+	-	-	*
13193	+	-	-	*	+	-	-	*
13205	+	-	-	*	+	-	-	*
13223	+	-	-	*	+	-	-	*
Subtotal:	**4**	**0**	**0**	**4**	**4**	**0**	**0**	**4**
13176	+	-	+	*	+	-	+	*
13181	+	-	+	*	+	-	+	*
13185	+	-	+	*	+	-	+	*
13209	+	-	+	*	+	-	+	*
13228	+	-	+	*	+	-	+	*
13253	+	-	+	*	+	-	+	*
13254	+	-	+	*	+	-	+	*
Subtotal:	**7**	**0**	**7**	**7**	**7**	**0**	**7**	**7**
13197	+	-	*	*	+	-	*	-
13204	+	-	*	*	+	-	*	-
13206	+	-	*	*	+	-	*	-
13234	+	-	*	*	+	-	*	-
13242	+	-	*	*	+	-	*	-
Subtotal:	**5**	**0**	**5**	**5**	**5**	**0**	**5**	**0**
Total:	**61**	**21**	**15**	**19**	**61**	**21**	**15**	**11**

*Provisional assessment; definite assessment pending further data collection (i.e., testing features for presence/absence of skeletal remains)

preservation in the event that human remains or evidence of mortuary use is identified during further data collection (Significance Category A, provisional C; Recommended Treatment Category FDC, provisional PAI). The potential burial features include a platform at Site 13178, an isolated faced mound (Site 13193), a platform at Site 13205, and two platforms at Site 13223.

Further Data Collection with Provisional Interpretive Development - Five sites that are currently significant for information content may be found to exhibit both interpretive and cultural values, pending the results of further data collection (Significance Categories A, provisional B and C; Recommended Treatment Category FDC, provisional PID). These include five trail sections, three of which may be found to connect with each other, resulting in the identification of major mauka-makai or north-south routes. These include Sites 13197, which may well connect with Site 13194, currently assessed as having high interpretive and cultural value; and Sites 13204 and 13206, which may connect to form a north-south route across the ahupua'a. Provisional interpretive and cultural value is also assigned to the Site 13242 trail section and the Site 13234 kerbstone trail, which may represent the original alignment of Palani Road. For these sites, an assessment of interpretive and cultural values is contingent upon identifying additional connective sections, or continuations of the existing sections.

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Table 2.

SUMMARY OF IDENTIFIED SITES AND FEATURES

SIHP Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	*CRM Value Mode Assess. R	I	C	#Field Work Tasks DR	SC	EX
00002	Kerbstone trail (Mamalahoa Trail)	Transportation	M/H	H	M	+	-	-
05011	Wall	Land division	M	M	M/H	-	-	-
13175	Complex (8)	Agriculture	L	L	L	-	-	-
	A-H Enclosure							
13176	Complex (4)	Agric.-transp.-poss. ceremonial	M	M	M/H	+	-	+
	A Stepped terrace B Terrace C Modified outcrop D Steppingstone trail							
13177	Cairn	Indet. markers	L	L	L	-	-	-
13178	Complex (3)	Agriculture-poss. burial	M/H	L	L/H	+	-	+
	A Platform B Phh. excavation (2)							

*Cultural Resource Management Value Mode Assessment:

Nature: R = scientific research
I = interpretive
C = cultural
Degree: H = high
M = medium
L = low

#Recommended Further Data Collection Field Work Tasks:

DR = detailed recording (scaled drawings, photographs, and written descriptions)
SC = surface collections
EX = test excavations

Table 2. (cont.)

SIHP Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13179	Wall	Land division/ ranching	M	L	L/M	+	-	-
13180	Wall	Land division/ ranching	M	L	L/M	+	-	-
13181	Complex (4) A Platform (2) B Platform C Platform	Possible burial	M/H	M	M/H	+	-	+
13182	Complex (2) A Cairn B Phh. excavation	Agric.-marker	L	L	L	-	-	-
13183	Complex (5) A Lava tube cave B Pavement C Enclosure D Rock mound E Enclosure	Habitation-agriculture-poss. burial	H	M	L/H	+	+	+
13184	Complex (2) A Wall B Wall remnant	Land division	M	M/L	M	+	-	-
13185	Complex (40) 13 Terraces 12 Modified outcrops 12 Rock mounds 2+ Phh. excavations 1 Cairn	Agric.-poss. burial/ poss. habitation	H	M/H	M/H	+	-	+
13186	Complex (2) A Steppingstone trail B Enclosure	Transportation-agriculture	M	M	M	+	+	+

Table 2. (cont.)

SIHP Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13187	Complex (3) A Phh. excav. B Phh. excav. C Phh excav.	Agriculture	M	L	L	+	-	-
13188	Complex (3) A Cave B Terrace C Terrace	Habitation	M	L	L	+	+	+
13189	Complex (2) A Terrace B Terrace	Agriculture	M	L	L	+	-	+
13190	Complex (30+) A Wall B Phh. excavation (2) C Modified outcrop D Phh. excavation (6) Plus ten rock mounds and ten phh. excav.	Agriculture	M/H	L	L	+	-	+
13191	Cairn	Indet. marker	L	L	L	-	-	-
13192	Cairn	Indet. marker	L	L	L	-	-	-
13193	Mound	Poss. burial/ agriculture	L/M	L	L/H	+	-	+
13194	Steppingstone trail	Transportation	M/H	M	M/H	+	-	-
13195	Complex (2) A Cairn B Cairn	Historic marker	L	L	L	-	-	-
13196	Complex (2) A Cairn B Cairn	Indet. marker	L	L	L	-	-	-

Table 2. (cont.)

SIHP Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13197	Steppingstone trail	Transportation	M/H	L	M/H	+	-	-
13198	Complex (2)	Indet. marker-quarry/agriculture	L	L	L	-	-	-
	A Cairn B Phh. excavation							
13199	Cairn	Recent marker	L	L	L	-	-	-
13200	Complex (2)	Agriculture	M	L	L	-	-	-
	A Rock mound B Rock mound							
13201	Trail	Transportation	M	L	M	+	-	-
13202	Complex (3)	Transportation-marker	M	L	M	+	-	-
	A Cairn (2) B Trail							
13203	Complex (2)	Agriculture/ poss. habitation	M/H	L	L	+	-	+
	A Terrace B Pavement							
13204	Steppingstone trail	Transportation	M	M	M	+	-	-
13205	Complex (2)	Habitation/ poss. ceremonial	H	M	M/H	+	-	+
	A Platform B Enclosure							
13206	Steppingstone trail	Transportation	M	M	M/H	+	-	-
13207	Complex (5)	Transportation-agriculture/ poss. habitation	M/H	M	M	+	+	+
	A Steppingstone trail B Terrace (3) C Terrace							

Table 2. (cont.)

SIHP Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13208	Complex (4)	Agriculture-marker	L	L	L	-	-	-
	A Modified outcrop B Cairn C Cairn D Cairn							
13209	Complex (56+)	Habit.-marker-agric.-transp.-poss. burial	H	M	M/H	+	+	+
	A Steppingstone trail B Cairn C Stepped terrace D1 Terrace D2 Platform D3 Rock mound E Platform F Stepped terrace G Modified outcrop I Cairn J Cairn K Modified outcrop (3) L Cairn (collapsed) M Midden deposit Plus 40+ Phh. excavations							
13210	Complex (3)	Habitation/agriculture	H	L	L	+	-	+
	A Platform B Terrace C Terrace							
13211	Complex (2)	Agriculture	M	L	L	+	-	-
	A Rock mound B Terrace w/wall							
13212	Complex (8)	Agriculture-transportation	M	L	M	+	-	-
	A Phh./aa excavation B Terrace (6) C Kerbstone trail							

Table 2. (cont.)

SIHP Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13213	Enclosure	Agriculture/ poss. habitation	M	L	L	+	-	+
13214	Complex (2)	Agriculture/ poss. habitation	M	L	L	+	-	+
	A Enclosure B Platform							
13215	Wall	Ranching	L	L	L	-	-	-
13216	Wall	Land division/ agriculture	M	L	L/M	-	-	-
13217	Enclosure	Agriculture (recent)	L	L	L	-	-	-
13218	Wall	Land division-ranching	M/L	M/L	M/L	+	-	-
13219	Kerbstone trail	Transportation	M/H	M	M/H	+	-	-
13220	Complex (3)	Agriculture	M	L	L	+	-	-
	A Linear rock mound B Phh. excavation C Circular rock mound							
13221	Complex (80)	Agriculture	M/H	L	M	+	-	+
	55 Linear rock mounds 25 Phh. excavations							
13222	Complex (19)	Agriculture	M/H	L	M	+	-	+
	A Phh. excavation B Linear rock mound Plus 14 circular rock mounds and 3 phh. excav.							

Table 2. (cont.)

SIHP Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13223	Complex (4)	Agriculture/ habitation/ poss. burial	H	M	L/H	+	-	+
	A Enclosure B Platform C Terrace w/six cleared depressions D Platform							
13224	Complex (28+)	Agriculture	M	L	L	+	-	-
	A Terrace Plus 19 phh. excav. and 8 rock mounds							
13225	Complex (7)	Agriculture	M	L	L	+	-	-
	A Phh. excav. (3) B Linear rock mound Plus 3 circular rock mounds							
13226	Complex (13)	Agriculture	M	L	L	+	-	-
	A L-shaped rock mound/wall Plus 7 phh. excav., 4 rock mounds, and 1 terrace							
13227	Complex (120)	Agriculture	H	M	M	+	-	+
	59 Circular rock mounds 48 Pahoehoe excavations 13 Linear rock mounds							
13228	Enclosure	Indet./possible ceremonial	M/H	M	M/H	+	-	+
13229	Complex (10+)	Agriculture	M	L	L	+	-	-
	A1 Cairn w/3 enclosed phh. excavations A2 Modified pahoehoe excav. A3 Modified pahoehoe excav. A4 Modified pahoehoe excav. B Modified pahoehoe excav. Plus 5+ rock mounds							
13230	Walled cave	Habitation	H	L	L	+	+	+

Table 2. (cont.)

SIHP Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13231	Complex (8+)	Agriculture	M	L	L	+	-	-
	1 Linear rock mound 7 Rock mounds							
13232	Complex (10)	Agriculture	M	L	L	+	-	-
	10 Phh. excavations							
13233	Complex (6+)	Agriculture	M	L	L	+	-	-
	3+ Linear rock mounds 3+ Rock mounds							
13234	Kerbstone trail	*Transportation*	*M/H*	*M*	*M/H*	+	-	-
13235	Complex (33+)	Agriculture	M/H	L	L	+	-	-
	13+ Linear rock mounds 10+ Circular rock mounds 10+ Phh. excavations							
13236	Complex (6)	Agriculture	M	L	L	+	-	-
	1 Linear rock mound 5 Rock mounds							
13237	Enclosure	Agriculture (recent)	L	L	L	-	-	-
13238	Complex (20)	Agriculture	M	L	L	+	-	-
	10 Phh. excavations 10 Rock mounds							
13239	Complex (33)	Agriculture	M/H	M	L	+	-	-
	A Wall B Cairn C Terrace Plus 20 phh. excav. and ten rock mounds							

Table 2. (cont.)

SIHP Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13240	Complex (33+)	Agriculture	M	L	L	+	-	-
	20+ Rock mounds 10+ Phh. excavations							
13241	Complex (49)	Agriculture-poss. habit.	M	M	L	+	-	+
	A Terrace B Modified outcrop C L-shaped rock mound D Terrace Plus 24 modified outcrops and 21 rock mounds							
13242	Steppingstone trail	Transportation	M	M	M/H	+	-	-
13243	Complex (4) (recent)	Habitation	L	L	L	-	-	-
	A C-shape B Hearth C Hearth D Wall							
13244	Kerbstone trail	Transportation	M	M/L	M	+	-	-
13245	Complex (3)	Marker-agriculture	L	L	L	-	-	-
	A Cairn (2) B Rock mound							
13246	Complex (6+)	Agriculture-transportation	M	L	L	+	-	-
	A Roadbed B Linear mound C Linear mound D Depression w/2 alignments E Phh. excavation w/alignment F Linear mound Plus additional phh. excavations							

Table 2. (cont.)

SIHP Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13247	Complex (4)	Agriculture	M	L	L	+	-	-
	A Linear mound (2) B Cleared depression C Stepped terrace							
13248	Wall	Land division	M/H	M	M/H	+	-	-
13249	Complex (7)	Agriculture	M	L	L	-	-	-
	A Terrace B1 Terrace B2 Linear mound C Terrace D Terrace E Rock mound F Rock mound							
13250	Terraced rock mound	Agriculture	M	L	L	-	-	-
13251	Enclosure	Agriculture/ ranching	M	L	L	-	-	-
13252	Complex (17)	Agriculture- possible habitation	H	M	L/M	+	-	+
	A Faced mound B Faced mound C Enclosure D Faced mound E1 Walled pavement w/2 cairns and a rock mound E2 Cairn E3 Cairn E4 Phh excavation E5 Rock mound E6 Wall E7 Wall F Terrace w/central depression G Terrace H L-shaped wall I Pavement J Pavement K Rock mound							

Table 2. (cont.)

SIHP Site Number	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13253	Complex (11)	Burial-transp.	H	H	H	+	-	+
	A Platform							
	B Platform							
	C Terrace							
	D Terrace							
	E Terrace							
	F Terrace							
	G Terrace							
	H Terrace							
	I Terrace							
	J Platform							
	K Steppingstone trail							
13254	Complex (74+)	Habit.-agric.-transp.- poss. burial	H	M	M/H	+	-	+
	A Terrace							
	B Terrace							
	C Terrace							
	D Faced mound							
	E Faced mound							
	F Terrace							
	G1 Terrace							
	G2 Terrace							
	H Terrace							
	I Wall							
	J Faced mound							
	K Terrace (3)							
	L Terrace							
	M Terrace							
	N Terrace wall							
	O Terrace							
	P Wall							
	Q Terrace							
	R Steppingstone trail							
	S Wall/terrace							
	T Faced mound							
	U Faced mound							
	V Platform							
	W Terrace							
	X Enclosure							
	Y Faced mound							

APPENDIX A

SITE DESCRIPTIONS

SITE NO.: State: 00002
SITE TYPE: Mamalahoa Trail
TOPOGRAPHY: Relatively flat aa, general area affected by bulldozing
VEGETATION: Trail surface covered with fountain grass; surrounding area devoid of vegetation
CONDITION: Fair to poor
INTEGRITY: Affected by vehicular traffic
PROBABLE AGE: Historic
FUNCTIONAL INTERPRETATION: Transportation
DIMENSIONS: 1,220.20 m by 4.20 m by 0.20 m (approx.)
DESCRIPTION: Mamalahoa Trail is generally a graded kerbstone horse trail/road that was constructed under government direction during the nineteenth century. Portions of the trail follow a prehistoric transportation route. The portion of Mamalahoa Trail that is within the project area is constructed from cobble and pebble size aa pieces, and is raised slightly above the surrounding aa surface. The trail surface has been affected by vehicular use and presently has two parallel tire tracks and a raised, humped center. The sides of the trail slope downward to the surrounding surface, and there is little to no evidence remaining of the kerbstone alignments that are present along well-preserved sections of the trail.

SITE NO.: State: 13175 PHRI: T-1
SITE TYPE: Complex (8 Features)
TOPOGRAPHY: Located on a western-sloping mixed pahoehoe/aa flow
VEGETATION: Mango trees, koa-haole, lantana, grass, Christmas-berry, liliko'i, noni and kukui nut tree.
CONDITION: Poor-good
INTEGRITY: Unaltered
PROBABLE AGE: Historic (recent)
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall site area measures c. 90 m N-S by 80 m E-W. The complex consists of eight bifaced enclosures, each situated around a single mango tree. A single piece of unmodified coral was observed outside of one of the enclosures (Feature F). No cultural deposit was observed; however, medium brown loam is present inside all features. The site is within a cattle pasture and the enclosures were probably built to protect the mango trees from livestock damage.

FEATURE A: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 5.30 m by 5.10 m by 1.10 m maximum wall height
DESCRIPTION: Feature A is a circular enclosure with a mature mango tree located in the center. It consists of large to small aa cobbles; larger cobbles are at the base of the walls and the smaller cobbles toward the top. The walls are bifaced and slightly wider at the base. The eastern segment of the wall is collapsed in three places. The remainder of the wall is in excellent condition. Average wall thickness is 0.6 m. Diameter of the mango tree is 0.7 m.

FEATURE B: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 5.00 m by 4.60 m by 0.60 m maximum wall height
DESCRIPTION: This circular enclosure is located 44 m from Feature A at 245 degrees Az. It is situated around a mango tree (0.35 m in diameter). The walls are bifaced and consist of aa cobbles stacked three to four courses high. Larger rocks are at the base of the walls, which is slightly wider than the top. Wall thickness is 0.6 m at the top.

FEATURE C: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 6.30 m by 6.30 m by 0.90 m maximum wall height
DESCRIPTION: Feature C is located 27 m from Feature B at 198 degrees Az. It is a circular enclosure built around a mature mango tree (0.60 m in diameter). Construction is similar to Features A and B; aa cobbles are stacked three to four courses high, with larger rocks at the base of the bifaced walls. The western side of the enclosure is the longest segment of the wall still standing, measuring 3.6 m. The wall thickness is 0.80 m at the top.

FEATURE D: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 4.90 m by 4.90 m by 0.65 m maximum wall height
DESCRIPTION: This circular enclosure is located 22.5 m from Feature C at 259 degrees Az. The walls are bifaced, and constructed from aa cobbles stacked one to three courses high. Only the base of the wall remains intact. Cobbles have fallen both inside and outside of the wall. The wall thickness is 0.70 m. A mango tree 0.70 m in diameter is present in the center of the enclosure.

FEATURE E: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 6.40 m by 5.50 m by 1.05 m maximum wall height

DESCRIPTION: Feature E is 24.5 m from Feature D at 138 degrees Az. It is a circular, bifaced enclosure with a mature mango tree located in the center. It consists of stacked aa cobbles with a core filling of smaller aa cobbles. Twenty-five percent of the wall has collapsed; the remainder has only partial collapse. Cobbles have fallen both inside and outside of the wall. The wall thickness is 0.80 m.

FEATURE F: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 5.00 m by 5.20 m by 1.10 m maximum wall height
DESCRIPTION: This circular enclosure is located 24.5 m from Feature F at 159 degrees Az. The walls are bifaced and consist of stacked aa boulders and cobbles with a core filling of smaller cobble. A mango tree 0.60 m in diameter is inside the enclosure. One piece of unaltered coral was located one meter outside of the northern wall.

FEATURE G: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 5.30 m by 5.20 m by 1.00 m maximum wall height
DESCRIPTION: Feature G is 30.70 m from Feature F at 341 degrees Az. It is a circular, bifaced enclosure with a mature mango tree located in the center. The enclosure consists of aa boulders and cobbles stacked four to six courses high, with a core filling of small to medium aa cobbles. Average wall thickness 0.80 m.

FEATURE H: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 4.80 m by 4.70 m by 1.10 m maximum wall height
DESCRIPTION: This ia a circular, bifaced enclosure, located 15.80 m from Feature G and 202 degrees Az. It consists of aa boulders and cobbles stacked three to four courses high, with a core filling of medium aa cobbles. Average wall thickness is 0.60 m.

SITE NO.: State: 13176 PHRI: T-2
SITE TYPE: Complex (4 Features)
TOPOGRAPHY: Along the western edge and slope of a prominent pahoehoe/aa ridge. The aa runs along the naturally stepped slope with pahoehoe on top of the ridge.
VEGETATION: Thick immature koa-haole, klu, airplant
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture-possible ceremonial-transportation
DESCRIPTION: The complex consists of a stepped terrace (Feature A), a terrace (Feature B), a modified outcrop (Feature C) and a short steppingstone trail (Feature D). Overall site dimensions are 33.4 m E-W by 8.4 m N-S. A complete Cellana sp. shell was observed on Feature B; no other portable remains were identified.

This site is located very close to the northern boundary of Kealakehe Ahupuaa, on a prominent ridge that affords a view of the entire lower portion of the land division and an extensive section of coastline.

FEATURE A: Stepped terrace
FUNCTION: Possible ceremonial
DIMENSIONS: 8.40 m by 13.4 m by 1.8 m maximum height
DESCRIPTION: This feature consists of two levels; the upper terrace measures 6.1 m NE-SW by 4.3 m, and ranges in height from 1.0 to 0.7 m. The lower level extends 9.1 m northwest and 2.8 m southwest from the base of the upper level, and has an average height of 0.80 m. The feature incorporates a naturally bi-leveled aa flow escarpment. The upper level is roughly rectangular in shape, with three faced sides, and the lower level is semicircular, with faced sections of fill along the natural scarp. The lower level is present along the three sides of the upper level, and is absent on the northeast side. Soil was noted at the northeastern edge of the terrace, where the fill gradually thins to meet a pahoehoe surface.

The upper terrace consists of weathered aa boulders, cobbles and pebbles. The surface is level, and paved with small cobbles and pebbles. The structure is faced on the west, north, and south sides; walls are vertical and nicely faced. The west face of the upper terrace is 0.7 to 1.0 m high and the north face is 0.7 m high. The east side is a natural pahoehoe outcrop. The lower level on the northwest side is not as regularly paved, and the fill stones are larger and looser. A possible filled hole or excavation is present on the northwest side of the lower level.

At the western point of the upper level is a rectangular opening built into the fill. This opening measures 0.60 m by 0.45 m by 0.70 m deep and is cleared except for some cobbles that have fallen in. This hole may have been made when the terrace was filled. The sides of the hole are vertical and faced; the base is a natural surface of gravel-sized rocks. The west edge of the hole is 0.68 m from the edge of the terrace.

FEATURE B: Terrace
FUNCTION: Agriculture
DIMENSIONS: 15.24 m by 7.70 m by 1.03 m maximum height
DESCRIPTION: This terrace is semicircular and faced

along the west, south and southeast sides. The faced sides were apparently vertical, but have since collapsed. Intact wall sections exist at the southwest corner and along the southeast side. Up to seven courses of stone are present along the intact side wall sections. The terrace is consists of aa boulders and cobbles and is paved on the surface with aa cobbles and pebbles. Pavement and fill thin at the northwest and northern sides, where the terrace surface meets a pahoehoe surface. A complete Cellana sp. shell, with edges gone, is visible within the fill along the west face of Feature B.

FEATURE C: Modified outcrop
FUNCTION: Indeterminate
DIMENSIONS: 2.60 m by 2.50 m by 0.45 m maximum height
DESCRIPTION: This feature is located adjacent to the southeastern side of Feature A, along an exposed pahoehoe shelf. It consists of a depression in the pahoehoe that has been cleared, and an associated rock pile. The pahoehoe depression is 1.0 m E-W by 0.50 m N-S. The rock pile is adjacent to the east side of the cleared depression; it is 1.9 m N-S by 1.36 m E-W, and has a maximum height of 0.45 m. A small circular hole (0.18 m by 0.20 m) is located in the center of the rock pile.

FEATURE D: Steppingstone trail
FUNCTION: Transportation
DIMENSIONS: 1.70 m by 0.56 m by 0.05 m
DESCRIPTION: A short stepping stone path extends eastward from the southeastern corner of the upper terrace level of Feature A. This path follows along the edge of the aa scarp and passes along the south side of Feature C. It ends 3.0 m west from Feature B. The path consists of four similarly-sized pahoehoe slabs set closely aligned on the aa surface.

SITE NO.: State: 13177 PHRI: T-3
SITE TYPE: Cairn
TOPOGRAPHY: In a depression on an aa flow which slopes gently to the southwest.
VEGETATION: Koa-haole, airplant and grasses.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Indeterminate
FUNCTIONAL INTERPRETATION: Marker
DIMENSIONS: 1.00 m by 1.10 m by 0.85 m
DESCRIPTION: The cairn consists of small aa boulders and large cobbles stacked in a pyramid, roughly circular at the base. It is stacked six courses high. No trail or other features are in the vicinity of the cairn.

SITE NO.: State: 13178 PHRI: T-4
SITE TYPE: Complex (3 Features)
TOPOGRAPHY: On a gently sloping pahoehoe flow; in area of exposed outcrops.
VEGETATION: Kiawe, fountain grass, lantana and succulents.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture-possible burial
DESCRIPTION: The overall site dimensions are c. 8.0 m by 8.0 m. The complex consists of a platform (Feature A) and two pahoehoe excavations (Feature B). No portable remains were noted.

FEATURE A: Platform
FUNCTION: Possible burial
DIMENSIONS: 2.05 m by 2.00 m by 0.40 m maximum height
DESCRIPTION: The platform consists of a ring-like perimeter of pahoehoe slabs and boulders that is filled with pahoehoe cobbles and aa clinkers. The perimeter is a single course high, and the surface of the platform is relatively level.

FEATURE B: Pahoehoe excavations (2)
FUNCTION: Agriculture
DIMENSIONS: 7.00 m by 4.00 m by 0.85 m maximum height
DESCRIPTION: Two cleared pahoehoe excavations spaced 2.5 m apart on a north-south axis comprise this feature. The northernmost excavation is 2.5 m west of Feature A. It is 2.75 m N-S and 2.0 m E-W, and consists of a cleared area along the west face of an excavated outcrop. Maximum depth of the excavation is 0.43 m. The southern excavation is a circular blister with an opening 1.75 m E-W by 2.0 m N-S and a maximum depth of 0.85 m. The southern perimeter of the excavation is open, and the cleared area inside is heavily vegetated.

SITE NO.: State: 13179 PHRI: T-5
SITE TYPE: Wall
TOPOGRAPHY: Located on a SW - facing, gradual slope; immediate surface topography is irregular and both pahoehoe and aa lava flows are present.
VEGETATION: Kiawe, koa-haole, fountain grass, air plants, impatiens.
CONDITION: Excellent
INTEGRITY: Possibly altered with modern modifications
PROBABLE AGE: Indeterminate
FUNCTIONAL INTERPRETATION: Land division/ ranching
DIMENSIONS: 244.00 m by 0.72 m by 1.56 m (approx.)

DESCRIPTION: This bifaced core-filled wall consists of pahoehoe cobbles and small boulders with a core fill of cobbles and pebbles. The wall is oriented north-south and continues beyond the project area to the north. The overall length given here includes only that portion within the project area. At the northern boundary, this wall intersects with the Site 13180 wall. An aluminum cattle gate is mortared into the wall at this intersection.

SITE NO.: State: 13180 PHRI: T-6,18
SITE TYPE: Wall
TOPOGRAPHY: Located on a SW-facing gentle slope with irregular surface topography of both pahoehoe and aa lava flows.
VEGETATION: Kiawe, koa-haole, fountain grass, lantana, air plants, noni, ferns, and Christmas-berry
CONDITION: Excellent
INTEGRITY: Possibly altered
PROBABLE AGE: Indeterminate
FUNCTIONAL INTERPRETATION: Land division/ ranching
DIMENSIONS: 518.00 m by 0.58 m by 1.12 m (approx.)
DESCRIPTION: The wall is oriented on a NE-SW axis. The NE end of the wall is bifaced and made of small pahoehoe boulders to large cobbles, with a core fill of pahoehoe pebbles. The wall incorporates a natural pahoehoe barrier along the northeastern portion.

The SW portion of the wall runs along an aa flow, and consists of aa. It is built with aa cobbles and pebbles, with no size sorting between facing and fill stones.

No mortar was used to actually hold the wall together, only except where modern additions were found. It could not be determined if this was an old wall with modern alterations or if this is a later wall with these features built in.

The NE portion of the wall has a salt lick trough and a water trough built into the wall. The salt lick trough is inset into the pahoehoe blocks with dimensions of 0.92 m by 0.48 m by 0.14 m deep. A canopy is created over the lick using 2" X 5 1/2" posts inset into the mortar (the wood is hand carved to make it fit into the post hole). The two braces and a cross board support the metal sheeting used for the roof. Braces are made with 2" X 3" pieces of lumber. The tin roofing is 1.3 wide by 2.46 m long. The water trough is made of concrete and is 2.60 m by 1.22 m by 0.58 m. Two metal bars stretch across the opening in the wall, over the water trough.

A gate is located at the intersection between the northeastern end of this wall and the Site 13179 wall. This is a modern aluminum cattle gate. Concrete is used to make the frame for the closing side of the gate.

SITE NO.: State: 13181 PHRI: T-7 ***(Figure A-1)***
SITE TYPE: Complex (4 Features)
TOPOGRAPHY: On the crest and upper west-facing slopes of a prominent pahoehoe ridge, along the northern boundary of Kealakehe.
VEGETATION: Kiawe, koa-haole, and fountain grass
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Possible burial
DESCRIPTION: The overall dimensions of this site are c. 40.0 m N-S by 15.0 m E-W. The site consists of four platforms. Two marine shell fragments were observed on Feature A.

FEATURE A: Platform (2)
FUNCTION: Possible burial
DIMENSIONS: 14.00 m by 7.00 m by 2.50 m maximum height
DESCRIPTION: Feature A consists of two adjacent platforms built of small boulders and medium to large cobbles of basalt. The platforms are located on top of a linear outcrop oriented north/south.

The north platform is roughly rectangular with a fairly flat and level surface, and faced on the NE, NW, and SE sides. The faces are three to six courses high (.40 to 1.25 m). The south and southwest sides are built against the central portion of the outcrop. The dimensions are 3.5 m N-S by 3.5 m E-W.

The south platform is also roughly rectangular and about 0.50 m lower on the outcrop than the north platform. The surface is also paved and leveled with large pahoehoe cobble fill. The structure is faced on the SW, NW and east sides with small boulders from two to four courses high (0.50 m to 0.75 m high). The south platform dimensions are 3.0 m N-S by 3.0 m E-W. Two pieces of marine shell were found on this feature.

FEATURE B: Platform
FUNCTION: Possible burial
DIMENSIONS: 6.80 m by 4.00 m by 1.50 m maximum height
DESCRIPTION: This D-shaped platform is located approximately 30 m from Feature A at 351 degrees Az. It consists of pahoehoe boulders and cobbles. The south and west sides of the platform are faced, and range in height from 1.5 m at the west end to 0.50 m at the south end. The north side of the platform abuts a relatively vertical bedrock face and has an average height of 0.90 m.

FEATURE C: Platform
FUNCTION: Possible burial

Figure A-1. SITE 13181, FEATURE A. VIEW TO SOUTHEAST (PHRI Neg. 1301-4)

DIMENSIONS: 5.80 m by 5.50 m by 1.50 m maximum height
DECRIPTION: Feature C is a D-shaped platform located 12 m from Feature C at 225 degrees Az. It consists of pahoehoe boulders to cobbles. The north, south and east sides of the platform are faced and the western, straight side abuts a nearly vertical bedrock face. The faced sides range in height from 1.5 to 0.70 m, and the west side averages 0.50 m high. A small rectangular depression 0.60 by 0.45 m is located at the eastern end of the platform.

SITE NO.: State: 13182 PHRI: T-8
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: On an exposed pahoehoe outcrop along a gentle, southwest-facing slope.
VEGETATION: 'Ilima, koa-haole, uhaloa, and fountain grass.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Indeterminate
FUNCTIONAL INTERPRETATION: Marker-agriculture
DESCRIPTION: The overall dimensions of this site measure c. 12.0 m N-S by 12.0 m E-W. The site consists of a cairn and a pahoehoe excavation. No portable or cultural remains were observed.

FEATURE A: Cairn
FUNCTION: Marker
DIMENSIONS: 0.50 m by 0.50 m by 0.70 m
DESCRIPTION: The cairn consists of a loosely piled formation five courses high and made of pahoehoe cobbles. The cairn is situated on top of a pahoehoe outcrop and the area around it is paved with pebbles.

FEATURE B: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 4.50 m by 3.70 m by 0.25 m
DESCRIPTION: Feature B is located 8 m from Feature A at 352 degrees Az. The excavation is generally cleared of rocks, but the area around the excavation may have been paved.

SITE NO.: State: 13183 PHRI: T-9 ***(Figure A-2)***
SITE TYPE: Complex (5 Features)
TOPOGRAPHY: In a narrow, collapsed lava tube and on a relatively flat aa flow
VEGETATION: Lantana, koa-haole, fountain grass, mango, kukui nut, vines, succulents, Christmas-berry, and air plant.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation-agriculture-possible burial
DESCRIPTION: The overall dimensions of this site measure c. 50.0 m N-S by 20.0 m E-W. The site consists of a modified lava tube, pavement, two enclosures and a rock mound.

FEATURE A: Modified lava tube
FUNCTION: Habitation-possible burial
DIMENSIONS: 32.00 m by 5.10 m by 2.00 m
DESCRIPTION: This feature was previously recorded as Site 12 by Hammatt, Schidler and Borthwick (1987) during a survey of an adjacent project area to the east. It consists of a collapsed lava tube with a overhang and cave at the southwest end. The tube has been modified with pavement, rock fill, terracing and stacked walls. The entrance to the cave at the southwest end of the tube is currently blocked off by a wall-like pile of aa rubble. To either side of the cave mouth is a cleared, paved area that is protected by a pahoehoe overhang.

A one meter square test unit was excavated by Hammatt et al. near the center of the overhang floor, just inside the drip line. Two soil layers were identified; the uppermost consisted of the pavement fill with loose dark brown silt. This layer was 0.05 m thick and contained 10 volcanic glass flakes, marine shell, charcoal and echinoid (Hammatt et al. 1987:39). The second layer averaged 0.15 m thick and consisted of dark grayish-brown silt loam with marine shell midden, 29 volcanic glass flakes and one core, three bone picks, and fish and pig remains. The feature was interpreted as a probable habitation and work area (Hammatt et al. 1987:39).

FEATURE B: Pavement
FUNCTION: Agriculture/habitation
DIMENSIONS: 8.50 m by 8.00 m by 1.00 m
DESCRIPTION: Feature B is located immediately to the south of the collapsed lava tube, on the aa flat. The south end of the feature has been scraped away by a bulldozer, and this side may have been terraced prior to disturbance. The east edge is bounded by a smooth pahoehoe flow and the west side is bounded by a bulldozed pile of large boulders. The south portion of the pavement is densely packed pahoehoe cobbles. Other portions are sparsely paved with pahoehoe cobbles and gravel.

FEATURE C: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 2.60 m by 2.20 m by 0.45 m maximum height
DESCRIPTION: This enclosure is located 38 m from Feature A at 8 degrees Az. It stands on and incorporates a natural aa rise, and is currently in very poor condition. Three mango trees are growing in the center of the enclosure. A 1.2 m section along the southern end is still intact and

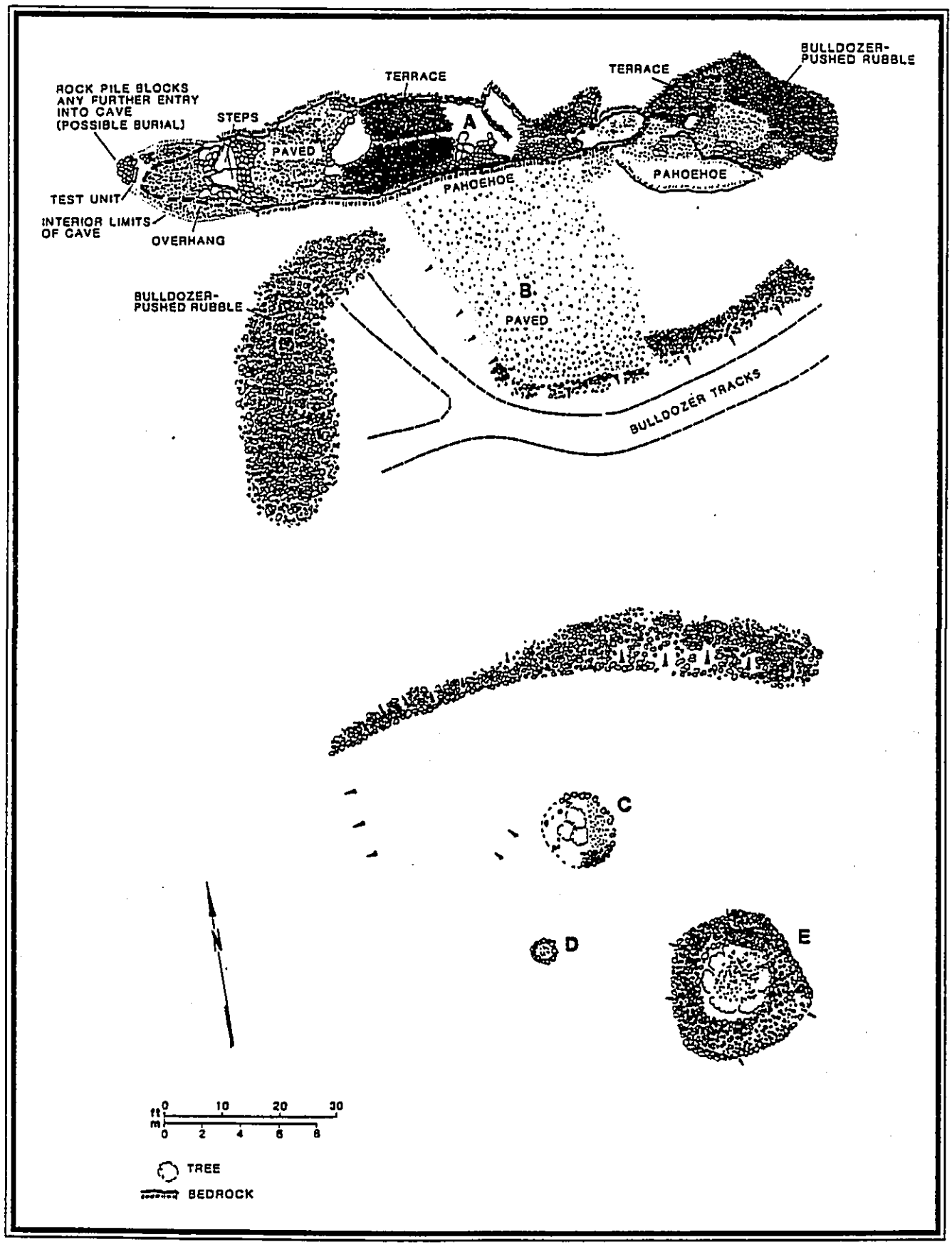

Figure A-2. SITE 13183

consists of two to three courses of aa cobbles. The remainder of the enclosure consists of a single course of aa cobbles which do not form an entire ring. Rubble created from the collapse of the wall extends c. 1.0 m along the interior side of the enclosure wall.

FEATURE D: Rock mound
FUNCTION: Agriculture
DIMENSIONS: 2.60 m by 1.80 m by 0.50 m maximum height
DESCRIPTION: This small mound is located 4 m from Feature C at 20 degrees Az. The perimeter consists of pahoehoe and aa boulders, and the fill consists of pahoehoe cobbles and aa clinkers. The mound is circular and has a flat, paved surface. The perimeter stones are stacked one to two courses high, and height varies from 0.2 to 0.5 m.

FEATURE E: Enclosure
FUNCTION: Agriculture/habitation
DIMENSIONS: 9.80 m by 9.50 m by 1.10 m maximum height
DESCRIPTION: This disturbed enclosure is located 7.10 m from Feature C at 135 degrees Az. Only a portion of the wall along the northeast side of the enclosure is intact; all other sections are collapsed. The intact portion of the wall is faced on the exterior side and consists of aa cobbles, stacked 4-5 courses high. This section is 5.00 m long, 2.00 m wide and 1.10 m high. Overall shape of the feature is indeterminate; however, estimated interior dimensions are 5.30 m N-S by 4.47 m E-W.

SITE NO.: State: 13184 PHRI: T-10
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: Uneven aa and pahoehoe flows; some alteration from bulldozing in immediate area.
VEGETATION: Koa-haole, kukui nut, Christmas-berry, air plant, fountain grass, and kiawe.
CONDITION: Good to poor
INTEGRITY: Feature A unaltered, Feature B dismantled
PROBABLE AGE: Historic
FUNCTIONAL INTERPRETATION: Land division
DESCRIPTION: The site consists of a standing rock wall (Feature A) and the remnants of a dismantled rock wall (Feature B), which runs parallel to Feature A, along its west side.

FEATURE A: Wall
FUNCTION: Land division
DIMENSIONS: 1311.00 m N-S; 427.00 m E-W by 0.70 m by 1.15 m max. ht.
DESCRIPTION: The N-S section of this wall spans the entire width of the Kealakehe Ahupuaa, at or just above the 183.0 m (600 ft) elevation contour. The southern end of the wall connects with the boundary wall between Kealakehe and Keahuolu. At the northern end, the wall turns toward the east and continues 427.0 m to the existing housing subdivision. The eastern end of the wall is broken, and it is likely the wall continued mauka beyond its current location. The wall is double-faced with core filling, and is slightly wider at the base. The basal width averages 0.70 m, whereas the top width averages 0.55 m. It consists of pahoehoe and aa boulders and large cobbles, stacked five to nine courses high; smaller cobbles and pebbles were used for core fill. The wall is in generally very good condition; only one or two areas of collapse were noted along the N-S section.

FEATURE B: Wall remnant
FUNCTION: Land division
DIMENSIONS: 1311.00 m by 1.20 m by 0.60 m maximum height
DESCRIPTION: This is the basal remnant of a wider wall, located 2 to 3 m west of and parallel with the N-S section of Feature A. It currently consists of a base and associated rubble, which varies in height from 0.20 to 0.60 m. Portions of the wall remnant have been breached by bulldozers, but sections were observed across the entire width of the ahupua'a. It is possible that many of the stones in this feature were borrowed for construction of the more recent wall.

SITE NO.: State: 13185 PHRI: T-11
SITE TYPE: Complex (40 Features)
TOPOGRAPHY: In and along the sides of a distinct ravine which has vertical to steep sloping sides of pahoehoe and pockets of aa.
VEGETATION: Koa-haole, air plant, and lantana.
CONDITION: Good
INTEGRITY: Unaltered except by bulldozer
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture-poss. burial/poss. habitation
DESCRIPTION: The overall site dimensions are c. 140 m E-W by 40 m N-S. The site consists of 13 faced terraces, 12 modified outcrops, 12 rock mounds, two+ pahoehoe excavations, and one cairn. The terraces and modified outcrops are generally located along the sides of the ravine, whereas the rock mounds are along the center. There were no portable remains or cultural deposits observed, however, soil is present at most features.

FEATURE - : Faced terraces (13)
FUNCTION: Agriculture/poss. burial/poss. habitation
DESCRIPTION: The terraces consist of aa and pahoehoe cobbles and pebbles, and range in height from 1.04 to 1.97 m. These features are built on natural shelves along the sides of the ravine and are generally elliptical. The faced sides exhibit very formalized, vertical stacking, and the

surfaces are leveled and paved. Length varies from 5.00 to 12.00 m along an east-west axis, and width varies from 1.0 to 3.0 m. The terraces are most concentrated near the center of the site, where the ravine is narrowest (9.00 to 14.00 m wide). There are slightly more terraces on the south side of the ravine.

FEATURE - : Modified outcrops (12)
FUNCTION: Agriculture/poss. habitation
DESCRIPTION: Many modifications are present on both pahoehoe and aa outcrops within the site. These include cleared and filled depressions, alignments along the edges of outcrops, and leveled aa deposits.

FEATURE - : Rock mounds (12)
FUNCTION: Agriculture/poss. habitation
DESCRIPTION: The rock mounds exist primarily in the center of the ravine, and most exhibit at least one or two faced sides. Shape of the mounds varies considerably; some exhibit nearly squared corners, whereas others are oval to round. Height of the mounds ranges from 0.85 to 1.24 m. Length ranges from 2.4 to 5.0 m, and width ranges from 1.6 to 4.6 m. The surfaces of the mounds are irregular, and most consist of aa cobbles, with no distinguishable core fill.

FEATURE - : Pahoehoe excavations (2+)
FUNCTION: Agriculture
DESCRIPTION: These two pahoehoe excavations are located out of the ravine, immediately to the south. They consist of excavated blisters that exhibit no formalized modification. Excavated blocks are scattered about the perimeters of the cleared holes. It is likely additional excavations exist in the area.

FEATURE - : Caim
FUNCTION: Agriculture/marker
DESCRIPTION: The caim is located in the western portion of the site, near the center of the ravine. It consists of pahoehoe slabs and aa cobbles. It is 0.56 m high and 0.90 m wide at the base.

SITE NO.: State: 13186 PHRI: T-12
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: Exposed aa flow with lower vegetated aa flows on the north, east and south sides; gentle slope on the southwest side.
VEGETATION: Koa-haole, air plant, alahe'e, vines, lantana.
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture-transportation
DESCRIPTION: The overall site dimensions are c. 75.0 m N-S by 20.0 m E-W. The site consists of a steppingstone trail (Feature A) and an enclosure (Feature B). Marine shell midden was observed at Feature B.

FEATURE A: Steppingstone trail
FUNCTION: Transportation
DIMENSIONS: 18.50 m by 0.40 m by 0.15 m
DESCRIPTION: The identifiable portion of this trail crosses an aa flow, and is distinguishable as a cleared path with larger aa slabs imbedded as stepping stones. The trail has some curves but generally runs NW-SE (340 degrees Az.). A few scattered pieces of *Conus* shell were observed along the trail.

FEATURE B: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 3.75 m by 3.40 m by 1.00 m maximum height
DESCRIPTION: This roughly square enclosure is located c. 50.0 m from Feature A at 130 degrees Az. It consists of aa boulders and cobbles, stacked three courses high, and one to two stones wide. Wall height ranges from 0.55 to 1.00 m, with maximum height at the northern corner. The surface inside the enclosure consists of aa rubble fill. A 1.30 m long section in the center of the northwestern wall is down, and it is uncertain whether there was a formal entranceway here at one time.

Two meters to the northeast is a stone alignment of aa boulders and cobbles. The alignment is roughly stacked and not faced; it is oriented N-S, and curves to the east at the southern end. The alignment is 6.00 m long, averages 0.75 m wide, and varies in height from 0.60 to 0.40 m.

SITE NO.: State: 13187 PHRI: T-13
SITE TYPE: Complex (3 Features)
TOPOGRAPHY: Irregular pahoehoe flow with slight slope to the southwest.
VEGETATION: Koa-haole, alahe'e and grasses.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall site dimensions are c. 75.0 m N-S by 20.0 m E-W. The site consists of three pahoehoe excavations. No portable remains or cultural deposits were observed.

FEATURE A: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 8.90 m by 6.80 m by 0.95 m maximum depth

The excavated area of this feature is roughly oval. Excavated pahoehoe blocks are loosely stacked and arranged primarily on the southeast and north sides of the excavation.

FEATURE B: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 3.25 m by 2.70 m by 0.70 m maximum depth
DESCRIPTION: This excavation is 15.5 m from Feature A at 100 degrees Az. It is roughly oval and the excavated blocks are stacked mainly on the west and east sides of the excavation.

FEATURE C: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 8.70 m by 5.50 m by 0.90 m maximum depth
DESCRIPTION: This excavation is immediately to the south of Feature B. It is also roughly oval with excavated blocks stacked mainly on the south and east sides.

SITE NO.: State: 13188 PHRI: T-14 ***(Figures A-3/A-4)***
SITE TYPE: Complex (3 Features)
TOPOGRAPHY: In a partially collapsed lava tube and shallow ravine in pahoehoe; general topography gently slopes to the southwest.
VEGETATION: Koa-haole, fountain grass, Christmas-berry, air plant, vines and kiawe.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation/ agriculture
DESCRIPTION: The overall site dimensions are c. 21.0 m E-W by 5.0 m N-S. The site consists of a cave (Feature A) and two terraces (Features B and C). Subsurface testing was conducted at Feature A, where midden, artifacts and soil deposits were found.

FEATURE A: Cave
FUNCTION: Habitation
DIMENSIONS: 17.00 m by 4.50 m by 1.00 m maximum ceiling height
DESCRIPTION: The cave consists of two interconnecting tube sections separated by a low ceiling and stacked rocks. The west tube is 9.7 m long by 2.0-3.0 m wide, and the east tube is 13.0 m long by 2.0-3.0 m wide. Both tubes have ceiling heights ranging from 0.40 to 1.0 m. Access to both sections of the cave is through a centrally located vertical opening in the tube ceiling. The entrance is 1.80 E-W by .70 N-S. Ceiling height at the entrance is 1.0 m. A series of pahoehoe slabs is stacked below the opening in order to aid access to the cave. Portable remains including shell fragments, coral and soil deposits containing charcoal were observed on the cave floor prior to testing.

Two 1 by 1 m. test units were excavated in the cave, one in each of the chambers. The units were located on either side of the entrance, where soil and midden accumulation appeared to be thickest. Test Unit 1 was excavated in the eastern chamber. The deposit here was found to be 0.03 m thick and consisted of very loose, dark reddish-brown loam with lots of rootlets. Material recovered from screened soil includes nine volcanic glass flakes, burned and unburned kukui nut shell fragments, and a small amount of fragmented marine shell.

Test Unit 2 was excavated in the western chamber, 1.20 m away from Test Unit 1. The deposit here was found to be 0.08 m thick and was more compacted than the fill in Test Unit 1. A charcoal sample for dating was collected from Test Unit 2. This sample was submitted to Beta Analytic and was determined to be of modern age (BETA-34210).

FEATURE B: Terrace
FUNCTION: Agriculture
DIMENSIONS: 3.50 m by 2.90 m by 0.60 m maximum height
DESCRIPTION: This rectangular terrace is located 20.0 m from the opening of Feature A at 50 degrees Az. It is situated in a pahoehoe depression along the lower slopes of a shallow ravine. The terrace consists of small to medium pahoehoe boulders and cobbles, with perimeter stones slightly larger than surface fill stones. The perimeter is raised on the east, south and west sides, and has faced walls on the west and south sides. Maximum height (0.60 m) is at the southwest corner; the east and west sides are 0.35 to 0.40 m high.

FEATURE C: Terrace
FUNCTION: Agriculture
DIMENSIONS: 3.00 m by 3.00 m by 0.56 m maximum height
DESCRIPTION: This L-shaped terrace is located 5.0 m west of Feature B, in the same ravine setting. It consists of small to medium pahoehoe boulders, with slightly larger perimeter stones. The perimeter is raised on the east, south and west sides, but none of the sides is formally faced. Height varies from 0.20 to 0.56 m. A soil deposit which averages 0.05 m deep is present along the east side of the terrace.

SITE NO.: State: 13189 PHRI: T-15
SITE TYPE: Complex (2 Features)

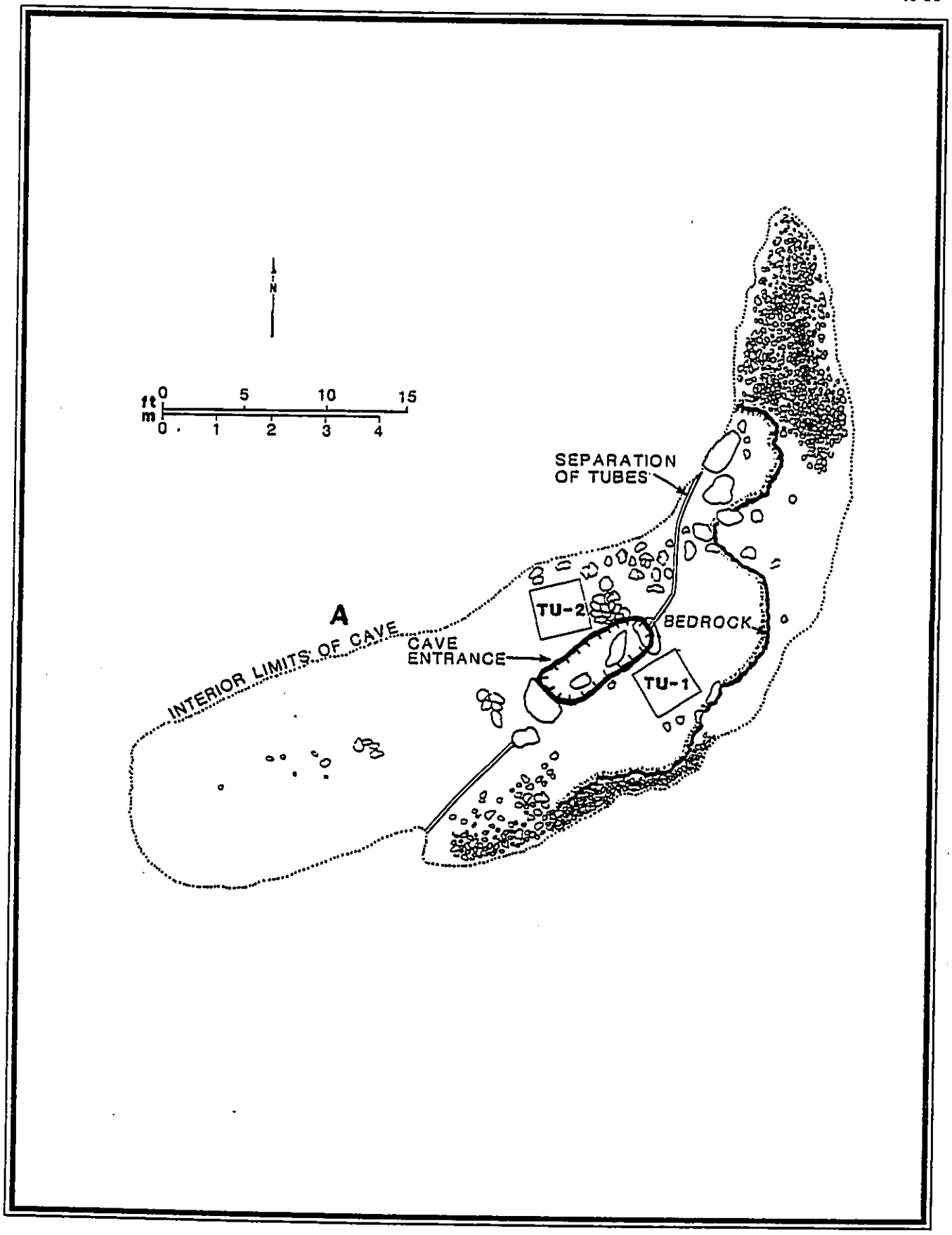

Figure A-3. SITE 13188, FEATURE A

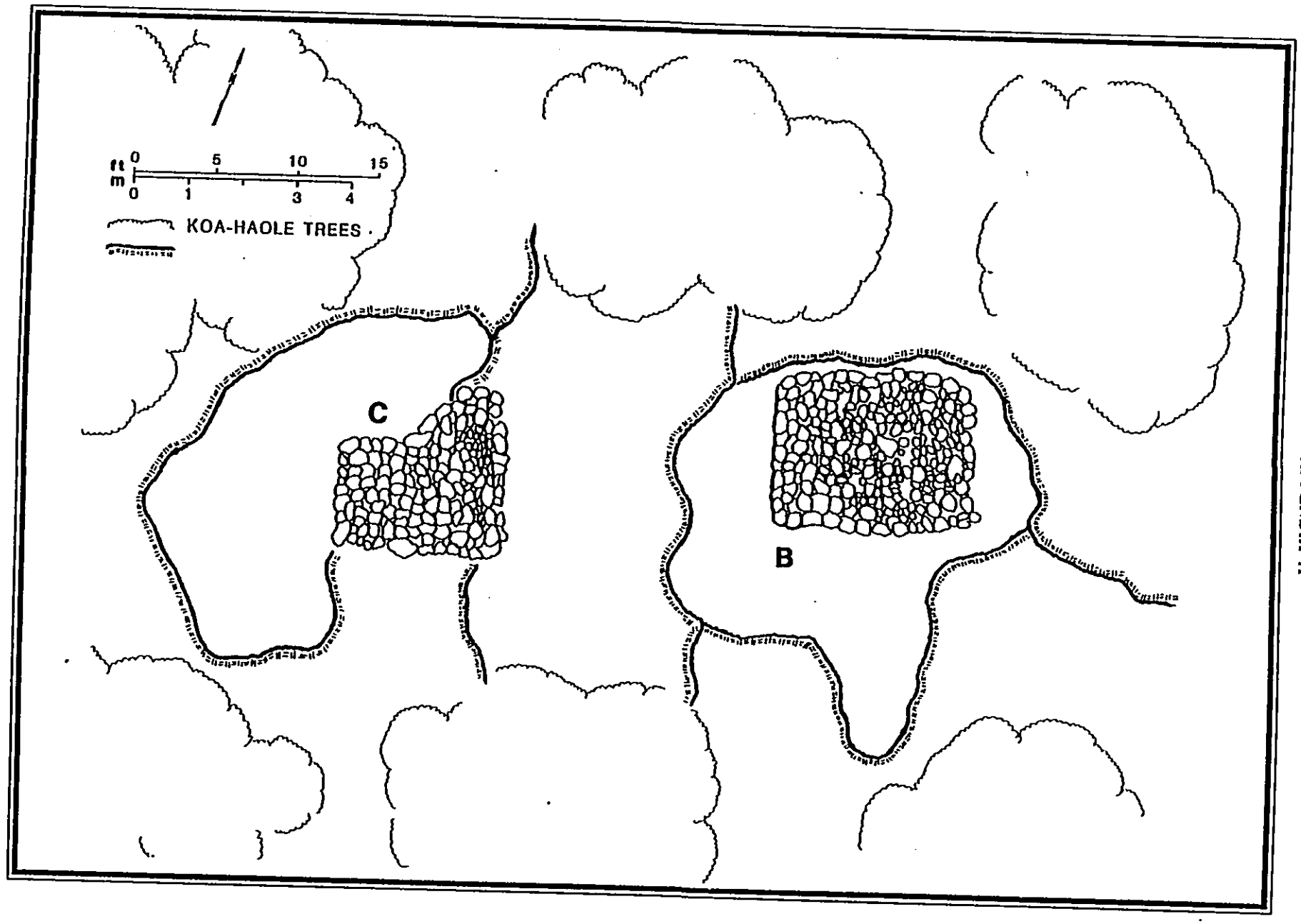

Figure A-4. SITE 13188, FEATURES B AND C

TOPOGRAPHY: On a gentle southwest facing pahoehoe slope.
VEGETATION: Koa-haole, fountain grass, air plant and alahe'e
CONDITION: Poor
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall site dimensions are c. 15.0 m NW-SE by 10.0 m SW-NE. The site consists of two terraces and a pahoehoe excavation. No portable remains or cultural deposits were observed.

FEATURE A: Terrace
FUNCTION: Agriculture
DIMENSIONS: 7.20 m by 2.90 m by 0.45 m maximum height
DESCRIPTION: The terrace is adjacent to a pahoehoe excavation, which was apparently the source of building material. Pahoehoe boulders and cobbles were used in the perimeter, and the surface is paved with smaller pahoehoe pieces. Additional boulders are located to the southwest side of the terrace; these are currently scattered in no particular pattern.

FEATURE B: Terrace
FUNCTION: Agriculture
DESCRIPTION: This terrace is located 2.5 m from Feature A. Measurements could not be obtained due to the presence of a large wasp nest on the feature. The perimeter consists of pahoehoe boulders and cobbles and the surface is paved with pahoehoe cobbles and pebbles. The sides of this feature are formally aligned; however, no heights were obtained.

SITE NO.: State: 13190 PHRI: T-16
SITE TYPE: Complex (30 Features)
TOPOGRAPHY: On a southwest-facing, gentle slope with aa and pahoehoe.
VEGETATION: Koa-haole, fountain grass, alahe'e and kiawe.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall site dimensions are c. 41.30 m NE-SW by 10.0 m SE-NW. The site consists of a wall (Feature A), two pahoehoe excavations (Feature B), a modified outcrop (Feature C), a cluster of six pahoehoe excavations (Feature D), plus ten additional pahoehoe excavations and ten rock mounds. No portable remains or cultural deposits were observed; however, soil deposits were observed.

FEATURE A: Wall
FUNCTION: Agriculture
DIMENSIONS: 5.20 m by 1.00 m by 0.90 m maximum height
DESCRIPTION: This wall is at the highest point of the site, and overlooks the other features on the site. It is slightly curved and stands on an aa flow which appears to be leveled and paved with clinker to gravel rocks. The wall consists of stacked aa rocks and is oriented generally north-south. The west side is faced and the east side slopes outward from the top to the base; the top is irregular. There is no indication of core filling. The south end of the wall tapers down to the aa flow surface and the north end stops abruptly.

FEATURE B: Pahoehoe excavations (2)
FUNCTION: Agriculture
DIMENSIONS: 6.80 m by 3.60 m by 1.00 m maximum depth
DESCRIPTION: Feature B consists of two modified pahoehoe excavations situated side by side. They are located 39.30 m from Feature A at 40 degrees Az. Both excavations are roughly oblong and open to the west, roughly toward the downslope side. Both excavations are modified by stacking the excavated pahoehoe rock along the edges (inside and outside) and along the inside edges of a pahoehoe finger that divides the two features. The stacked pahoehoe cobbles vary in size from small to large. A soil deposit at least 0.15 m thick is present in the southern excavation, and there may be a layer of gravel in both excavations.

FEATURE C: Modified outcrop
FUNCTION: Agriculture
DIMENSIONS: 3.60 m by 3.60 m by 0.80 m maximum height
DESCRIPTION: This feature is located 11.0 m from Feature A at 115 degrees Az. It consists of an elliptical pahoehoe outcrop with pahoehoe boulders, slabs, and cobbles stacked below and on top of the edges to make a fairly level surface. The resulting configuration is terrace-like, and has a soil deposit c. 0.08 m thick on top. Immediately to the west side is a 3.2 by 2.8 m area of soil with an average thickness of 0.16 m. A few cobbles may have been placed along the west and northwest sides of this soil deposit.

FEATURE D: Pahoehoe excavation (6)
FUNCTION: Agriculture
DIMENSIONS: 15.40 m by 10.50 m by 2.00 m maximum depth
DESCRIPTION: Six pahoehoe excavations are clustered in this area, which is located 29.50 m from Feature A at 40 degrees Az. The excavations are present on a single outcrop and range in size from 0.88 m by 0.64 m to 5.80 m by

1.40 m. These excavations are located on the top, west, north and south sides of the pahoehoe outcrop. Adjacent to the excavations are large pahoehoe cobbles and small boulders, stacked up to three courses high. Soil deposits at least 0.08 to 0.12 m deep are present in the excavations.

FEATURE - : Rock mounds (10)
FUNCTION: Agriculture

FEATURE - : Pahoehoe excavations (10)
FUNCTION: Agriculture

SITE NO.: State: 13191 PHRI: T-17
SITE TYPE: Cairn
TOPOGRAPHY: On an aa ledge in a gently sloping aa field.
VEGETATION: Fountain grass, kiawe and Christmas-berry.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Indeterminate
FUNCTIONAL INTERPRETATION: Marker
DIMENSIONS: 1.07 m by 0.83 m by 1.55 m maximum height
DESCRIPTION: The cairn consists of loosely stacked aa cobbles arranged in a conical shape. As a result of the configuration of the ledge on which it is located, the northwest side of the cairn is taller than the southeast side, which is 1.02 m high.

SITE NO.: State: 13192 PHRI: T-19
SITE TYPE: Cairn
TOPOGRAPHY: Top of a slight pahoehoe knoll; general area slopes to the southwest.
VEGETATION: Fountain grass, koa-haole and 'ilima.
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Indeterminate
FUNCTIONAL INTERPRETATION: Marker
DIMENSIONS: 2.20 m by 1.60 m by 1.20 m
DESCRIPTION: The cairn is pyramid-shaped and circular at the base. Fresh marks on the stones indicate possible historic construction.

SITE NO.: State: 13193 PHRI: T-20 ***(Figure A-5)***
SITE TYPE: Faced rock mound
TOPOGRAPHY: Undulating pahoehoe flow sloping to the southwest; a steep slope directly to the southwest.
VEGETATION: Fountain grass, koa-haole and 'ilima.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Indeterminate
FUNCTIONAL INTERPRETATION: Agriculture/ possible burial
DIMENSIONS: 4.40 m by 4.30 m by 0.95 m maximum height
DESCRIPTION: This mound consists of loosely piled basalt cobbles and a few small boulders. It is generally circular and is rounded on the top. The east and south sides are faced with boulders, stacked 0.50 to 0.55 m high.

Two small cairns which appear very recent are located c. 15.0 m to the east and c. 20.0 m to the northeast.

SITE NO.: State: 13194 PHRI: T-21
SITE TYPE: Steppingstone trail
TOPOGRAPHY: The trail runs along the edge and across a major aa flow; in an area of pahoehoe outcrops and bulldozer disturbance.
VEGETATION: Fountain grass, koa-haole, 'ilima and morning glory vines.
CONDITION: Poor-fair
INTEGRITY: Unaltered except by bulldozer paths which cut across the trail.
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Transportation
DIMENSIONS: 374.00 m by 0.25-0.50 m(approx.)
DESCRIPTION: The trail consists of a cleared and packed path through the aa with spaced pahoehoe slabs that are inset into the aa. Most of the slabs are a minimum of 0.20 m and a maximum of 0.35 m in size. The rest of the slabs are small cobbles.

The western end of the trail is cut off by the Queen Kaahumanu Highway. Efforts to relocate it on the west side of the highway were unsuccessful. To the east of the highway, the Mamalahoa Trail appears to have crossed over this trail. To the east of the Mamalohoa Trail, it is broken by two different bulldozer paths over the aa. At the eastern end of the aa, the trail appears to make a sharp turn to the north. This turn may be an intersection between two trails; efforts to locate a continuation over the pahoehoe to the north and east were unsuccessful.

SITE NO.: State: 13195 PHRI: T-22
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: Sllightly undulating pahoehoe flow; an aa flow c. 40.0 m to the north.
VEGETATION: Fountain grass, koa-haole and 'ilima
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Historic
FUNCTIONAL INTERPRETATION: Historic marker
DESCRIPTION: These cairns are located c. 9.0 m apart in a N-S line. They are possible survey markers.

Figure A-5. SITE 13193. VIEW TO WEST
(PHRI Neg. 1301-8)

FEATURE A: Cairn
FUNCTION: Historic marker
DIMENSIONS: 1.00 m by 0.80 m by 0.80 m
DESCRIPTION: This cairn is the northernmost of the two and consists of large aa cobbles, stacked with no apparent core fill. The cairn is pyramid shaped and circular at the base.

FEATURE B: Cairn
FUNCTION: Historic marker
DIMENSIONS: 1.10 m by 0.90 m by 0.70 m (approx.)
DESCRIPTION: This is the southernmost cairn; it consists of large aa cobbles and is pyramid shaped, with a circular base. The cairn is partially collapsed. This cairn appears to be located on the Mamalahoa Trail.

SITE NO.: State: 13196 PHRI: T-23
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: Undulating pahoehoe terrain.
VEGETATION: Scattered Christmas-berry, alahe'e, koa-haole and small shrubs.
CONDITION: Poor-fair
INTEGRITY: Unaltered
PROBABLE AGE: Indeterminate
FUNCTIONAL INTERPRETATION: Marker
DESCRIPTION: Two cairns were identified at this site. They are located c. 3.00 m apart in an E-W line. They were possibly, constructed as survey markers or construction markers based on their close proximity to an east-west bulldozer path.

FEATURE A: Cairn
FUNCTION: Marker
DIMENSIONS: 1.45 m by 1.05 m by 0.60 m
DESCRIPTION: The eastern cairn consists of aa cobbles and small boulders, stacked with no indication of core fill.

FEATURE B: Cairn
FUNCTION: Marker
DIMENSIONS: 0.70 m by 0.70 m by 0.60 m
DESCRIPTION: The western cairn consists of aa cobbles and small boulders, stacked with no indication of core fill.

SITE NO.: State: 13197 PHRI: T-24
SITE TYPE: Steppingstone trail
TOPOGRAPHY: The terrain consists of an aa flow surrounding a 10.0 m wide pahoehoe flow. The flows are sloping seaward to the southwest.
VEGETATION: Scant scrub koa-haole with vines and grasses.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Transportation
DIMENSIONS: 40.00 m by 0.50 m by 0.10 m (approx.)
DESCRIPTION: The trail consists of a partially cleared and packed path across aa with randomly spaced pahoehoe slabs placed on the surface of the aa (not inset). The steppingstone slabs are small and average about 0.15 m by 0.15 m in size with an average thickness of 0.10 m. The steppingstones are irregularly spaced from 0.25 m to 1.0 m apart along the trail section. Many of the larger aa boulders and cobbles were left in place along the trail route.

The trail is oriented 180 degrees Az. and could be identified only where it crosses aa. Both ends as currently defined are at the north and south edges of the aa flow.

SITE NO.: State: 13198 PHRI: T-25
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: Area of very irregular pahoehoe with scattered aa.
VEGETATION: Dense growth of koa-haole
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Marker-quarry
DESCRIPTION: A cairn (Feature A) and a pahoehoe excavation (Feature B) were identified at this site.

FEATURE A: Cairn
FUNCTION: Marker
DIMENSIONS: 1.77 m by 1.22 m by 1.38 m maximum height
DESCRIPTION: This feature consists of a naturally upthrusted pahoehoe slab on which are stacked two pahoehoe slabs. The dimensions include the natural feature. The height of the cairn varies from 0.70 m to 1.38 m.

FEATURE B: Pahoehoe excavation
FUNCTION: Quarry/agriculture
DESCRIPTION: The pahoehoe excavation is located 5.80 m from Feature A at 108 degrees Az.

SITE NO.: State: 13199 PHRI: T-26
SITE TYPE: Cairn
TOPOGRAPHY: On a southwest-facing aa flow.
VEGETATION: Sparse vegetation: Christmas-berry and fountain grass.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Recent historic
FUNCTIONAL INTERPRETATION: Recent marker

DIMENSIONS: 1.25 m by 1.20 m by 1.00 m
DESCRIPTION: The cairn consists of loosely piled aa cobbles and boulders, and has no core fill. A piece of lumber protrudes from the top, at the center of the cairn. The cairn is located adjacent to a bulldozer path and is probably associated with this feature.

SITE NO.: State: 13200 PHRI: T-27
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: In a valley formed by two aa ridges/ flows; scattered aa fingers overlying pahoehoe.
VEGETATION: Koa-haole, various grasses, prickly pear cactus, Christmas-berry and alahe'e
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: Two rock mounds were identified at this site, within an area c. 9.80 m E-W by 3.0 m N-S.

FEATURE A: Rock mound
FUNCTION: Agriculture
DIMENSIONS: 2.65 m by 2.20 m by 0.60 m maximum height
DESCRIPTION: This oval-shaped mound consists of small, loosely piled aa pebbles and cobbles.

FEATURE B: Rock mound
FUNCTION: Agriculture
DIMENSIONS: 2.50 m by 1.99 m by 0.50 m maximum height
DESCRIPTION: Feature B is also oval-shaped and consists of aa pebbles and cobbles.

SITE NO.: State: 13201 PHRI: T-28
SITE TYPE: Trail
TOPOGRAPHY: Aa flow on a southwest-facing slope.
VEGETATION: Grass, koa-haole, 'ilima and morning glory vines.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Transportation
DIMENSIONS: Length indeterminate; average 0.25 m wide
DESCRIPTION: This small footpath through aa is cleared and paved with packed aa clinkers. Tall grasses are growing in the trail at this particular point, whcih makes it easy to distinguish the trail from the flow.

Heavy vegetation and/or possible bulldozer destruction makes it difficult to determine the length of the trail. Possibly, this trail connects with the Site 13202 trail, located c. 152.00 m to the northeast. There has been a great deal of bulldozer activity within this immediate area.

SITE NO.: State: 13202 PHRI: T-29
SITE TYPE: Complex (3 Features)
TOPOGRAPHY: On an aa flow, southwest exposure.
VEGETATION: Uhaloa, koa-haole, grass, vines, alahe'e, a'ali'i and Christmas-berry.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Transportation-markers
DESCRIPTION: Two cairns (Feature A) and a trail (Feature B) were identified at this site. Considerable bulldozer disturbance has occurred in the immediate area of the site. Overall site area is c. 13.00 by 12.00 m.

FEATURE A: Cairns (2)
FUNCTION: Marker
DIMENSIONS: N cairn: 1.00 m by 1.00 m by 0.75 m.
S cairn: 0.80 m by 0.60 m by 0.70 m.
DESCRIPTION: Both cairns consist of the same materials: loosely stacked aa cobbles and small boulders. The boulders range in size from 0.20 m minimum to 0.30 maximum. The cairns are c. 10.50 m apart, and both are located adjacent to the southwest side of the trail. The northern cairn is 0.10 m from the trail. The southern cairn is 0.20 m from the trail.

FEATURE B: Trail
FUNCTION: Transportation
DIMENSIONS: Indeterminate length, width averages 0.25 m
DESCRIPTION: The trail consists of a cleared path, paved with packed aa clinkers and pebbles. This feature may connect with trail Site 13202, located c. 152.0 m to the southwest.

SITE NO.: State: 13203 PHRI: T-30 ***(Figure A-6)***
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: Along the northern face of a pahoehoe outcrop located in an aa flow; general exposure to the southwest.
VEGETATION: Koa-haole, a'ali'i, vines, lantana, 'ilima, uhaloa, and fountain grass.
CONDITION: Good to poor
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture/ possible habitation
DESCRIPTION: Overall complex area is c. 12.3 m N-S by 4.0 m E-W. Two features were identified: a terrace (Feature A) and a paved area (Feature B). No portable remains or soil deposits were observed.

FEATURE A: Terrace
FUNCTION: Agriculture/possible habitation

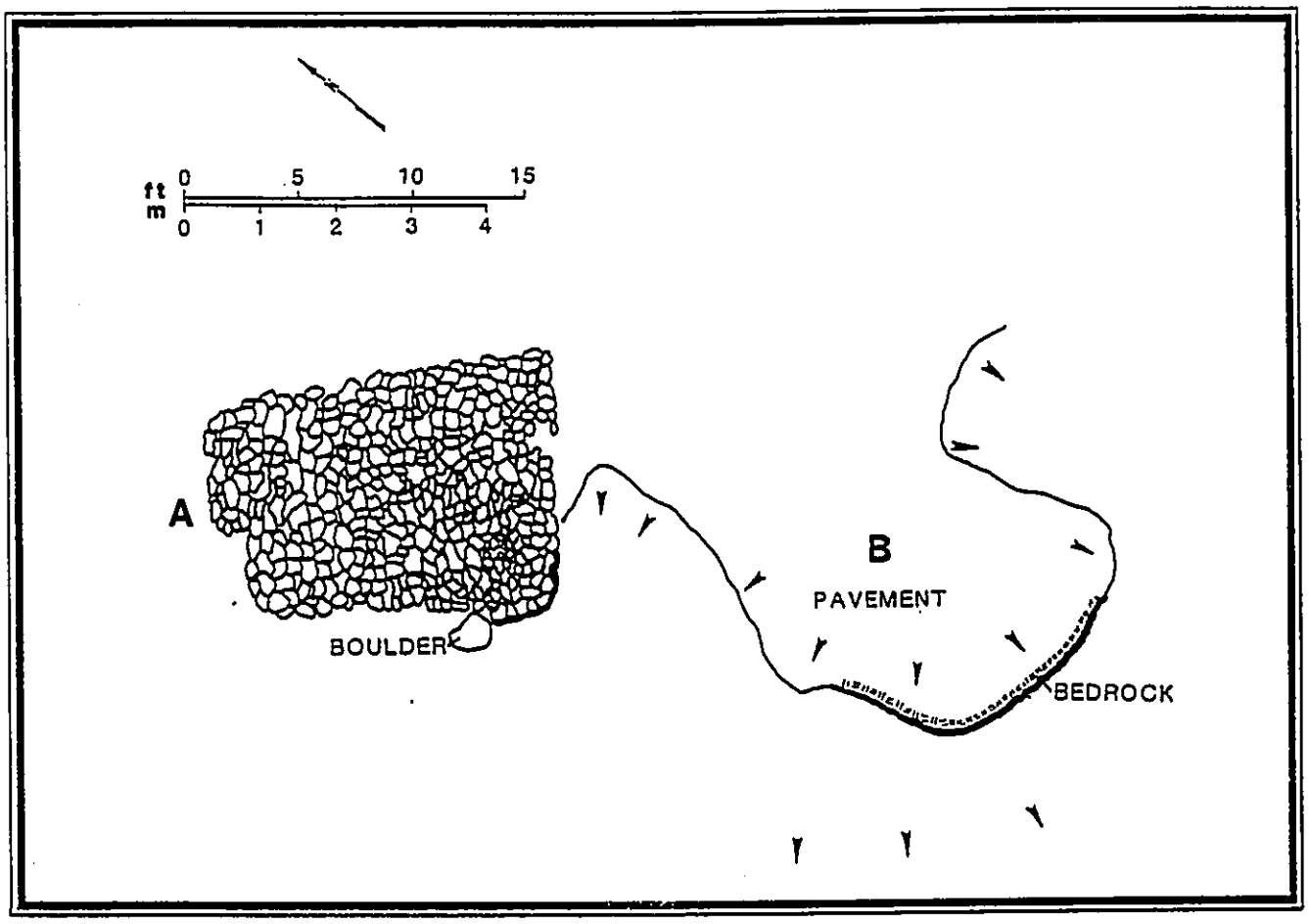

Figure A-6. SITE 13203

DIMENSIONS: 4.90 m by 4.00 m by 0.30 m maximum height
DESCRIPTION: Feature A is roughly rectangular, and consists of loosely stacked aa, large cobbles to small boulders. The terrace is faced on the northeast, southeast and southwest sides up to three courses high, although the facing is badly deteriorated. Maximum height is at the southern corner; minimum height (0.25 m) is at the west corner. The surface of the terrace is very uneven and has no indication of pavement.

FEATURE B: Pavement
FUNCTION: Agriculture/possible habitation
DIMENSIONS: 6.60 m by 6.40 m by 0.75 m maximum height
DESCRIPTION: This pavement is located 3.0 m south of Feature A, on a slightly raised pahoehoe outcrop. It consists of aa pebbles and small cobbles that are slightly mounded. No definite perimeter is present; however, this feature may be a deteriorated terrace. The height of this feature varies from 0.50 m to 0.75 m.

There is evidence of paving surrounding Feature B on the south, west, and north sides. The paving is more like a path than an agriculturally paved area.

SITE NO.: State: 13204 PHRI: T-31
SITE TYPE: Steppingstone trail
TOPOGRAPHY: Undulating aa.
VEGETATION: Akia, koa-haole, a'ali'i, Christmas-berry, lantana and fountain grass.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Transportation
DIMENSIONS: 15.40 m by 0.84 m
DESCRIPTION: The trail is oriented NW-SE (308/128 degrees Az.). It consists of a cleared and packed path across aa with randomly spaced aa slabs set in the center of the path. The slabs range in size from 0.13 m by 0.15 m to 0.33 m by 0.46 m. The identifiable portion of the trail ends at the edges of the aa. This site may connect with the Site 13206 steppingstone trail, located c. 220.00 m to the south.

SITE NO.: State: 13205 PHRI: T-32 ***(Figure A-7)***
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: Top of aa flow ridge on the southwest edge of a high flow.
VEGETATION: Koa-haole, alahe'e, Christmas-berry, airplant, noni, fountain grass, scrub brush and one unknown tree.
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation/possible ceremonial
DESCRIPTION: The site consists of a platform (Feature A) and an enclosure (Feature B). Overall site area is c. 30.0 m by 25.0 m. Portable remains observed include kukui nut shell adjacent to Feature A and a waterworn cobble, which is incorporated into the northwest wall of Feature B. A pahoehoe outcrop is incorporated into both features, and aa areas between the outcrop and the features are slightly cleared, with a few small boulders placed in gaps in the bedrock.

FEATURE A: Platform
FUNCTION: Habitation/possible ceremonial
DIMENSIONS: 6.00 m by 6.00 m by 1.05 m maximum height
DESCRIPTION: This is a roughly rectangular platform of aa boulders and cobbles. The southwest side is primarily natural aa outcrop with small boulders used as fill. The remaining three sides are faced. The southeast side is stacked three to seven courses to a maximum height of 1.05 m; this side is slightly collapsed. The northeast side is stacked three to four courses to a maximum height of 0.65 m. The northwest side is stacked one to three courses to a maximum height of 0.45 m.

The surface of the platform is generally flat and level. The northeastern portion is paved with aa cobbles. Kukui nut shells were found upslope against the side of the platform.

FEATURE B: Enclosure
FUNCTION: Habitation/possible ceremonial
DIMENSIONS: 15.50 m by 10.00 m by 1.10 m maximum wall height
DESCRIPTION: This enclosure is located 5.0 m from Feature A at 160 degrees Az. It is rectangular, and consists of aa boulders and cobbles. The intact portions of the walls are double-faced with aa cobble and small boulder core fill. Wall base boulders are up to 0.90 m in diameter.

The southeast wall is the best preserved portion of the enclosure. The wall facing was stacked three to six courses to a maximum height of 1.05 m and an average width of 1.10 m. The south corner is collapsed. The southwest wall has some remaining faced sections but is mostly collapsed. The average height is 0.50 m and the average width is 0.90-1.10.

There is a possible entrance in the southwest wall 5.0 meters from the west corner. It is a low cobble-filled area with a possible stepping stone. Some cobbles are located near the entrance.

A 2.0 m long section of the northwest wall is intact; the remainder is collapsed. The intact portion is stacked four courses to a maximum height of 0.95 m and a width of 0.65 m. The surface of the interior is irregular bedrock and loose rubble. Much of the loose rubble is probably from wall collapse.

SITE NO.: State: 13206 PHRI: T-33
SITE TYPE: Steppingstone trail
TOPOGRAPHY: Terrain consists of aa flow.
VEGETATION: Koa-haole, klu and Christmas-berry.
CONDITION: Excellent
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Transportation
DIMENSIONS: 29.00 m by 0.43 m by 0.40 m
DESCRIPTION: The trail is oriented in a SW-NE direction across an aa flow. It consists of thirty pahoehoe slabs placed on the aa surface. The slabs vary in size from 0.41 m by 0.32 m to 0.20 m by 0.18 m and the thickness ranges from 1.3 to 0.40 m. This trail may connect with the Site 13204 trail, located c. 220.00 m to the north.

SITE NO.: State: 13207 PHRI: T-35
SITE TYPE: Complex (5 Features)
TOPOGRAPHY: Gently sloping pahoehoe and aa flows with numerous pahoehoe blisters.
VEGETATION: Kiawe, koa-haole, lantana, fountain grass and ferns.
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Transportation-agriculture/poss. habitation
DESCRIPTION: The complex consists of a steppingstone trail (Feature A), a cluster of three terraces (Feature B) and a fourth terrace (Feature C). Overall site area is c. 30.0 m E-W by 26.0 m N-S. The terraces are arranged around the edges of an aa flow, and the steppingstone trail crosses over the aa and approaches the terraces from the north. Waterworn basalt pebbles and a marine shell fragment were observed at Feature B, and at least 3 cm of soil is present at this feature. Soil may be present on Feature C as well. There are many

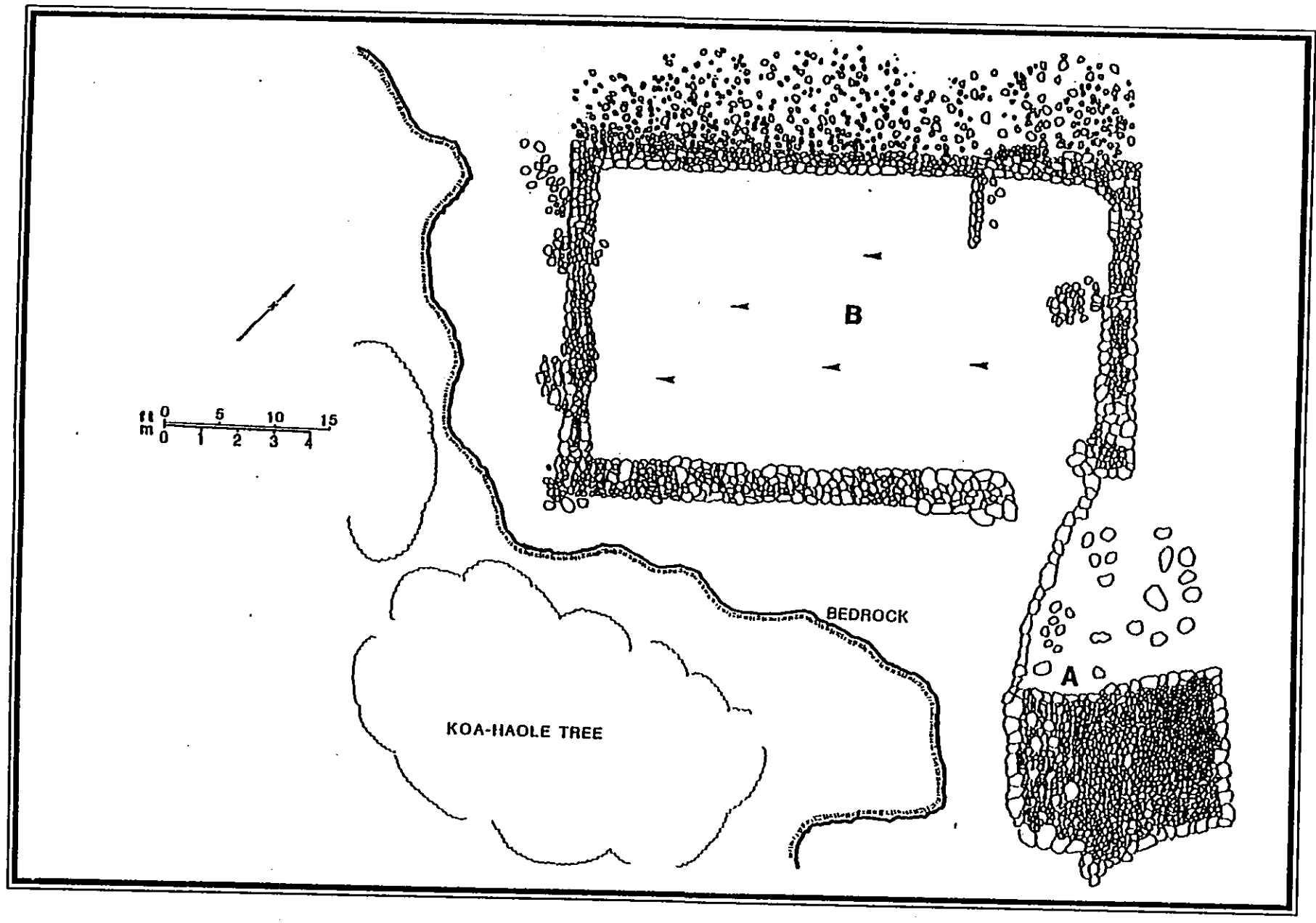

Figure A-7. SITE 13205

collapsed pahoehoe blisters in the area; these have been filled or capped with pahoehoe boulders and cobbles. Their function remains indeterminate at this time.

FEATURE A: Steppingstone trail
FUNCTION: Transportation
DIMENSIONS: 18.90 m by 0.66 m
DESCRIPTION: The trail consists of a linear pattern of pahoehoe slabs that have been inset level with the aa surface. The trail is oriented generally north-south and the southern end is on the Feature B upper level terrace, 3.0 m west of the terrace wall.

FEATURE B: Terraces (3)
FUNCTION: Agriculture/possible habitation
DIMENSIONS: Overall 17.00 m by 13.50 m by 1.68 m maximum height
DESCRIPTION: This feature consists of three interconnecting terraces arranged to form an arc around the side of an aa flow. The terraces are bordered by upright and stacked aa and pahoehoe ranging in size from large pebbles to small boulders.

The lower terrace is raised on the south and east sides to a maximum height of 0.74 m. The perimeters consist of stacked pahoehoe and aa boulders with several upright slabs incorporated into the sides. The surface is 3.80 m SW-NE by 3.60 m N-S. A soil deposit at least 0.03 m thick was observed on this terrace.

The upper terrace is divided into two parts by Feature A. It is mostly a natural aa shelf that has been leveled and outlined with aa and pahoehoe boulders, stacked one to two courses high. The stacked perimeters have a maximum height of 0.92 m. The surface area is 13.80 m E-W by 5.8 m N-S, one to two courses high. Two waterworn basalt pebbles and an unidentified marine shell fragment were observed on this terrace surface.

The smallest terrace measures c. 7.90 m (N-S) by 4.10 m (E-W) and is immediately adjacent to Feature A, which is to the west. The surfaces of the terraces are paved with small pebble to small cobble aa, some of which may be natural.

FEATURE C: Terrace
FUNCTION: Agriculture/possible habitation
DIMENSIONS: 3.70 m by 3.50 m by 0.85 m maximum height
DESCRIPTION: This terrace is located along the southwest side of an aa outcrop, 3.00 m west of Feature B. The terrace is raised on the south and west sides, and the perimeter consists of stacked and upright aa with a single pahoehoe upright. The material used ranges from large pebbles to large cobbles. The interior of the terrace is paved with small pebble to medium cobble aa. No soil was observed on the terrace surface; however, it may be present beneath the pavement.

SITE NO.: State: 13208 PHRI: T-36
SITE TYPE: Complex (4 Features)
TOPOGRAPHY: Situated on a high outcrop within a rough irregular pahoehoe flow.
VEGETATION: Koa-haole, grasses, scrub brush, noni and Christmas-berry.
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture-markers
DESCRIPTION: The site consists of a modified outcrop (Feature A) and three small rock piles that may be collapsed cairns. The overall site area is c. 18.0 m E-W by 6.0 m N-S. No soil or portable remains were observed on the site.

FEATURE A: Modified outcrop
FUNCTION: Agriculture
DIMENSIONS: 7.00 m by 5.00 m by 1.10 m maximum height
DESCRIPTION: The outcrop is a lava bubble which has a smooth and roughly level surface. Pahoehoe cobbles and boulders have been stacked along the west side of the outcrop, to a height level with the top of the blister (three courses). The stacked wall is 2.70 m long and has a maximum width of 1.30 m. Cobble and pebble fill is present to the east side of the wall, forming a terrace-like surface. Near the north edge of the outcrop there is an area of collapsed blister or possibly a pahoehoe excavation. The opening is 1.10 m (N-S) by 0.90 m (E-W). No modifications were noted in the blister, and only cow bones were observed.

FEATURE - : Cairns (3)
FUNCTION: Markers
DIMENSIONS: 1.00 m by 1.50 m by .40 m maximum height
DESCRIPTION: Three small rubble piles interpreted as possible collapsed cairns were located in the vicinity of Feature A. One of the piles is on the Feature A outcrop, 2.5 m southeast of the terrace fill. The largest pile is at the base of the Feature A outcrop, 3.0 m to the west. The third pile is located in a pahoehoe depression 18.0 m from Feature A at 140 degrees Az.

SITE NO.: State: 13209 PHRI: T-37,38
(Figures A-8 and A-9)
SITE TYPE: Complex (56+ Features)
TOPOGRAPHY: The terrain is a medium slope consisting of pahoehoe, aa flows and bedrock outcropping.
VEGETATION: Noni, kiawe, koa-haole, shower trees, fountain grass, lantana and air plants.
CONDITION: Good
INTEGRITY: Partially altered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation-agriculture-possible burial-marker-transportation
DESCRIPTION: Sixteen features were identified and measured within an area 135.00 m NE-SW by 30.00 m SE-NW at this site. An additional 40 pahoehoe excavations were observed, but not individually measured within the site area. Recorded features include a steppingstone trail (Feature A), four cairns (Features B, I, J, and L), three terraces (Features C, D1, and F), two platforms (Features D2 and E), four modified outcrops (Features G and K), a rock mound (Feature D3), and a surface midden deposit (Feature M). In addition to the midden observed at Feature M, thick soil deposits were observed at Feature K, and three waterworn basalt cobbles were observed on Feature D.

FEATURE A: Steppingstone trail
FUNCTION: Transportation
DIMENSIONS: 15.60 m by 4.00 m by 0.30 m
DESCRIPTION: The identified portion of this trail crosses aa. It consists of randomly spaced pahoehoe slabs that are slightly inset into the aa surface. The trail is oriented generally east-west and appears to head toward Feature J, a cairn. A possible branch trail was identified at the west end of Feature A. This possible trail is a cleared path through the aa (no steppingstones) 0.30 m to 0.60 m wide. It is oriented north-south.

FEATURE B: Cairn
FUNCTION: Marker
DIMENSIONS: 1.27 m by 1.17 m by 0.61 m
DESCRIPTION: This feature is located 24.0 m southwest of Feature A on an aa flow. It consists of loosely stacked aa and pahoehoe chunks, and is conical, with a circular base. There may be some cobble core fill inside the structure.

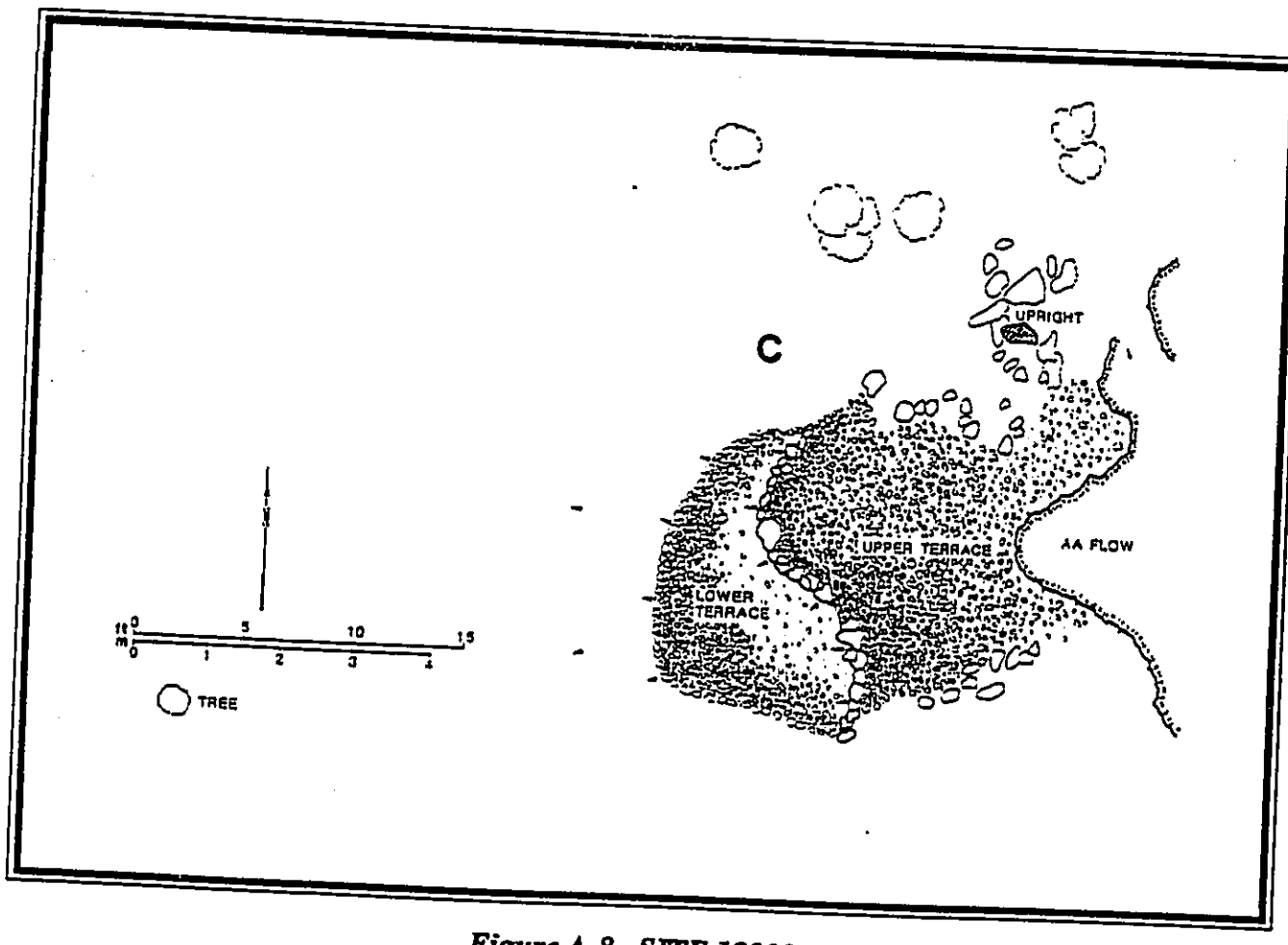

Figure A-8. SITE 13209

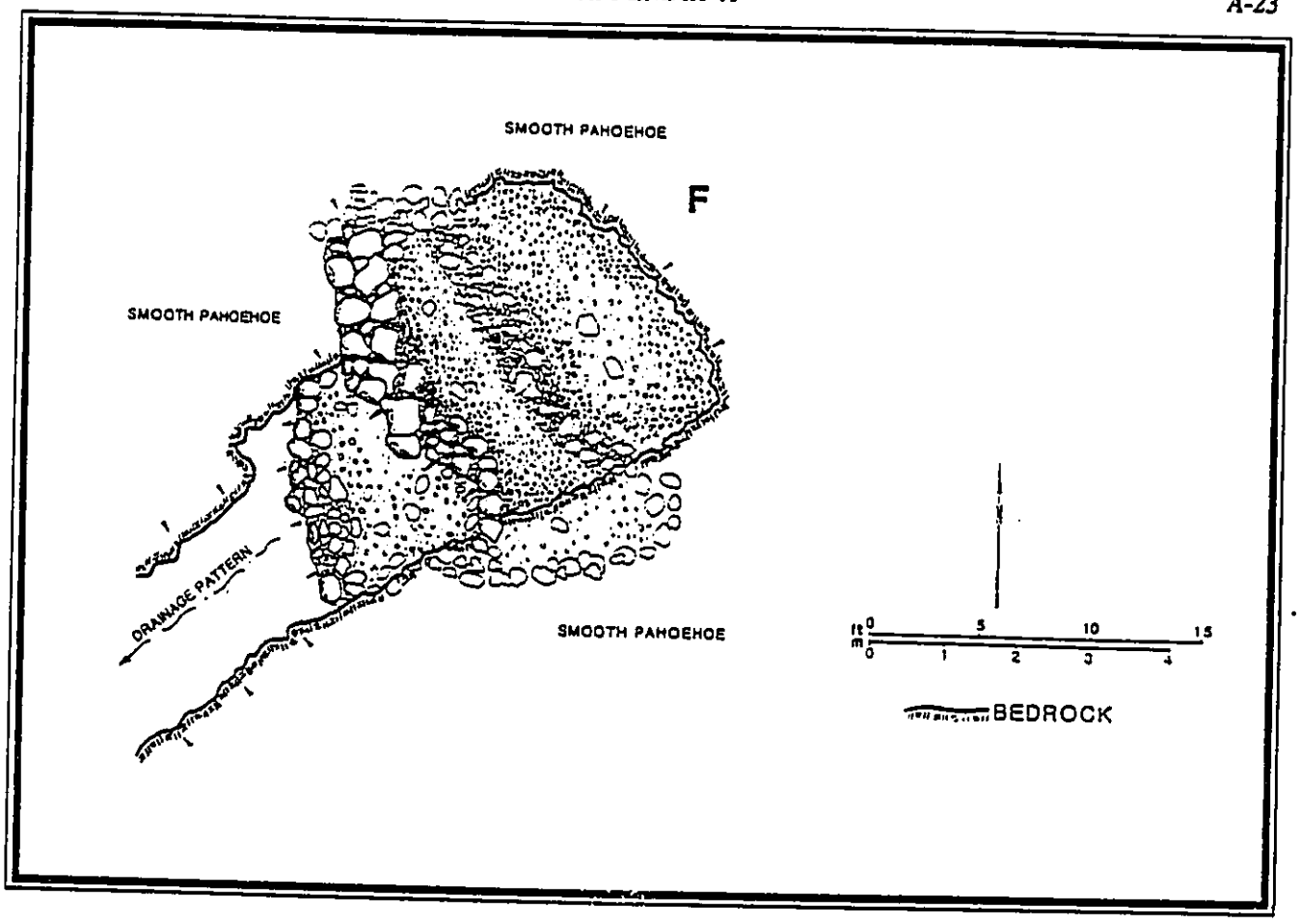

Figure A-9. SITE 13209

FEATURE C: Stepped terrace
FUNCTION: Agriculture
DIMENSIONS: 6.50 m by 5.50 m by 0.30 m maximum height
DESCRIPTION: Feature C is located 3.6 m from Feature B at 335 degrees Az. The terrace has two levels and is stepped with a single course alignment of pahoehoe and aa boulders. The lower level is semicircular and is situated along a sloping aa surface, which was leveled with aa clinkers and cobbles. The upper level is amorphous in shape, and follows the natural configuration of the aa outcrop. The surface is leveled with aa clinkers and cobbles. A pile of aa cobbles is present on the northern corner of the upper level. No soil was observed on the surface of this terrace.

FEATURE D1: Terrace
FUNCTION: Agriculture/habitation/possible burial
DIMENSIONS: 6.00 m by 8.80 m
DESCRIPTION: The Feature D structures are clustered in an area 5.8 m from Feature C at 192 degrees Az. The terrace is oval and consists of loosely piled pahoehoe and aa boulders and cobbles. The terrace is situated along the slope of an outcrop. The surface is leveled, but the sides are not faced. Three water worn basalt cobbles were found in the vicinity.

FEATURE D2: Platform
FUNCTION: Agriculture/habitation/possible burial
DIMENSIONS: 1.44 m by 0.91 m by 0.42 m maximum height
DESCRIPTION: This platform is located on top of the Feature D1 terrace. It is rectangular , and consists of aa and pahoehoe cobbles and boulders. The northeast side of the platform abuts a flow edge; the other three sides are raised one to two courses above the terrace surface.

FEATURE D3: Rock mound
FUNCTION: Agriculture
DIMENSIONS: 2.20 m by 1.20 m by 0.58 m
DESCRIPTION: The mound is rectangular and located on the west corner of the terrace.

FEATURE E: Platform
FUNCTION: Habitation
DIMENSIONS: 8.05 m by 6.10 m by 1.20 m maximum height

DESCRIPTION: Feature E is located 29.5 m east of Feature D and 27.5 m south of Feature A. This platform is roughly rectangular, with a C-shaped notch in the north side. The notch is 2.00 m wide and has a maximum depth of 2.00 m. The platform consists of piled pahoehoe blocks and slabs ranging from small boulders to small cobbles; there is no obvious facing or stacking. Pahoehoe outcrops are scattered in the immediate area, and one is incorporated into the SE corner of the structure. There is a possible cupboard in the SE area of the C-shaped notch. A deposit of sandy loam at least 0.12 m thick is present inside the notch area.

FEATURE F: Stepped terrace
FUNCTION: Agriculture
DIMENSIONS: 6.35 m by 4.95 m by 1.45 m maximum height
DESCRIPTION: Feature F is located c. 60.0 m northeast of Feature E and 42.5 m northeast of Feature A. It is situated in a narrow draw between pahoehoe outcrops, and consists of an upper D-shaped terrace with a smaller step along the southwest side. The terrace perimeter consists of pahoehoe blocks and slabs, and aa cobbles. The sides are stacked and faced, up to four courses high. The terraces are paved in the interior with small aa pebbles and cobbles.

The upper terrace is 4.45 m N-S by 4.15 m E-W, and has an average height of 0.50 m above the lower level terrace. A low linear mound is present across the major axis of the upper level, near the center. The mound is 0.70 m wide and 0.15 m high and consists of piled aa and pahoehoe rock. The lower terrace is 2.55 m N-S by 1.95 E-W, and has a maximum height of 0.80 m above the lowest point of the draw.

A soil deposit at least 0.06 m thick was observed in the draw immediately to the southwest of the lower terrace, and it is likely that soil is present beneath the pavement fill of the terraces.

FEATURE G: Modified outcrop
FUNCTION: Agriculture/habitation
DIMENSIONS: 1.90 m by 1.19 m
DESCRIPTION: Feature G is located 30.0 m from Feature M at 260 degrees Az. It is the westernmost feature at Site 13209, and is c. 50.0 m northeast of Site 13208. It consists of a natural depression in a pahoehoe outcrop that has been filled with pahoehoe cobbles.

FEATURE I: Cairn
FUNCTION: Marker
DIMENSIONS: 0.62 m by 0.56 m by 0.38 m
DESCRIPTION: This cairn is located on aa, 13.5 m from Feature A at 248 degrees Az. It consists of about four aa cobbles and some clinkers, stacked in a roughly circular formation. The largest stone is situated on top of the stack.

FEATURE J: Cairn
FUNCTION: Marker
DIMENSIONS: 0.76 m by 0.74 m by 0.44 m
DESCRIPTION: Feature J is located on aa, c. 7.00 m northeast of Feature I. It consists of about ten small aa boulders and cobbles which are loosely stacked in a conical formation.

FEATURE K: Modified outcrop (3)
FUNCTION: Agriculture/habitation
DIMENSIONS: 13.00 m by 12.50 m by 1.60 m maximum height
DESCRIPTION: A cluster of three modified pahoehoe outcrops is situated near the center of the site, c. 10.00 m southwest of Feature D. The bedrock forms a naturally enclosed and terraced area that was enhanced by modifications. Pahoehoe blocks ranging in size from small boulders to small cobbles were used to fill gaps and extend the size of the enclosed area.

The interior of the enclosed area is an oval-shaped, flat pahoehoe surface 3.50 m N-S by 3.00 m E-W with a soil deposit. It is surrounded on three sides by a high, natural outcrop filled in three places with pahoehoe cobbles. A 1.00 m wide natural entrance into the enclosed area is present at the southeast corner.

About 3.00 m to the east of the enclosed area is a natural flat that has been cleared and modified. This area is 4.00 m NW-SE by 3.50 m NE-SW, and is depressed an average of 0.20 m below the surrounding pahoehoe. A soil deposit is present.

Situated immediately north of the modified flat, a second area has been leveled by the filling of depressions with pahoehoe cobbles. A soil deposit is present on this feature as well.

FEATURE L: Rock pile (collapsed cairn)
FUNCTION: Marker
DIMENSIONS: 1.50 m by 1.35 m by 0.38 m
DESCRIPTION: This small rock pile, or possible disturbed cairn, is located 5.00 m from Feature K at 210 degrees Az. It consists of about 18 small pahoehoe boulders and cobbles loosely clustered on the unbroken surface of a pahoehoe flow.

FEATURE M: Midden deposit
FUNCTION: Habitation
DIMENSIONS: 8.00 m by 5.60 m by 0.03 m maximum depth
DESCRIPTION: This shallow surface midden deposit is located 13.0 m west of Feature L. The deposit is present in a semicircular pahoehoe depression, and consists of marine shell fragments mixed with loamy soil. Thickness of the deposit varies from 0.01 to 0.03 m.

FEATURE - : Pahoehoe excavations (40+)
FUNCTION: Agriculture
DESCRIPTION: There are at least 40 additional pahoehoe excavations with associated rock piles in the area of the recorded features.

SITE NO.: State: 13210 PHRI: T-39
SITE TYPE: Complex (3 Features)
TOPOGRAPHY: The immediate terrain consists of a southwest facing aa flow.
VEGETATION: Christmas-berry, koa-haole, air plants, alahe'e and vines.
CONDITION: Good to poor
INTEGRITY: Fair; Feature C altered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation/ agriculture
DESCRIPTION: The overall complex area is c. 25.0 m E-W by 15.0 m N-S. Three features were identified, a platform (Feature A) and two terraces (Features B and C). In addition, small pockets of pebble paving are present between the features. No soil or portable remains were observed.

FEATURE A: Platform
FUNCTION: Agriculture/habitation
DIMENSIONS: 7.00 m by 6.10 m by 1.10 m
DESCRIPTION: The platform is roughly rectangular and is situated on a naturally raised aa outcrop. The perimeters are faced, and consist of aa boulders and cobbles, stacked above the level of the platform surface. The surface is paved with aa pebbles and is built up in the east corner. The remainder of the surface is depressed.

An alignment of aa rocks 1.46 m long extends southeast from the southeast corner of the platform to a paved area 6.0 m long by 4.0 m wide. The area is built beside a natural aa outcrop and paved mostly with aa pebbles. To the southwest of the paved area (2.00 m) is a mounded pavement.

A second alignment of aa boulders extends 5.00 m northwest from the northwest corner of the platform and connects with Feature C.

FEATURE B: Terrace
FUNCTION: Agriculture/habitation
DIMENSIONS: 6.70 m by 5.20 m by 0.30 m maximum height
DESCRIPTION: The terrace is located 5.00 m southeast of Feature A. It is rectangular, with the southeast and northeast sides defined by an aa flow edge. The southwest side of the terrace is raised and faced with aa boulders and cobbles stacked two to three courses high. The terrace surface is paved with aa pebbles and cobbles. The northwest side of the terrace abuts the paved area described above.

FEATURE C: Terrace
FUNCTION: Agriculture/habitation
DIMENSIONS: 3.80 m by 2.00 m by 1.30 m maximum height
DESCRIPTION: Feature C is located c. 5.00 m north of Feature A, along the southwest side of an aa outcrop. The terrace consists of small aa boulders and cobbles, and is raised and faced on the southwest side. Four to seven courses of aa boulders and cobbles are stacked up to 1.30 m high along the southwest face. The surface is paved with small to large cobbles and is roughly flat and level. The terrace has been disturbed on the northeast and southeast sides from bulldozer activity; it was probably larger than current dimensions indicate.

SITE NO.: State: 13211 PHRI: T-40
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: Undulating pahoehoe flow with a southwest slope.
VEGETATION: Kiawe, koa-haole, kukui, fountain grass, air plant and Christmas-berry.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: A rock mound (Feature A) and a terrace (Feature B) were identified within an area 32.00 m N-S by 18.00 m E-W at this site. No portable remains were observed; however, deposits of dark brown loam up to 0.08 m thick are present in and around the features.

FEATURE A: Rock mound
FUNCTION: Agriculture
DIMENSIONS: 11.50 m by 9.25 m by 0.90 m maximum height
DESCRIPTION: This feature is a curved rock mound forming a roughly oval enclosure around a soil deposit. It consists of pahoehoe slabs and cobbles, and has two faced sections along the exterior southeast and southwest sides. Width of the mound ranges from 1.25 to 3.40 m. The area

inside the mound is 9.20 m N-S by 4.8 m E-W and has a soil deposit 0.02 to 0.08 m thick.

FEATURE B: Terrace with walls
FUNCTION: Agriculture
DIMENSIONS: 7.70 m by 6.30 m by 1.50 m
DESCRIPTION: Feature B is located 9.00 m north of Feature A, at the head of a natural pahoehoe channel. The terrace consists of large boulders to small cobbles of basalt. The western side of the terrace lies across the channel, which is c. 6.0 m wide at this point. The west face is stacked seven courses high and is partially collapsed. The top of the terrace is paved with small to medium cobbles.

To the west of the terrace, two walls are located along the sides of the channel. These walls are 3.00 m long and consist of pahoehoe boulders and cobbles stacked up to five courses high.

SITE NO.: State: 13212 PHRI: T-41
SITE TYPE: Complex (8 Features)
TOPOGRAPHY: The terrain is irregular pahoehoe and aa with a general southwestern exposure.
VEGETATION: Kukui, Christmas-berry, koa-haole, airplant, vines and alahe'e.
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric - historic
FUNCTIONAL INTERPRETATION: Agriculture-transportation
DESCRIPTION: This complex includes a pahoehoe excavation (Feature A), a cluster of six terraces (Feature B), and a kerbstone trail (Feature C). Overall site area is c. 62.0 m NE-SW by 43.20 m NW-SE. No portable remains were observed on the site; however, a horseshoe was noted c. 15.0 m north of the trail.

FEATURE A: Pahoehoe-aa excavation
FUNCTION: Agriculture
DIMENSIONS: 5.40 m by 3.20 m by 1.00 m maximum depth
DESCRIPTION: This excavation is located in a mixed pahoehoe/aa outcrop, where loose aa clinkers were cleared from the area and pahoehoe blocks were excavated from the face of a collapsed blister. The removed stones were piled in a ring around the edges of the excavation. The piles of stones range from 0.15 to 0.80 m in diameter.

FEATURE B: Terraces (6)
FUNCTION: Agriculture
DIMENSIONS: 18.10 m by 18.00 m by 1.60 m maximum height
DESCRIPTION: This cluster of terraces is located 3.0 m from Feature A, along the southwest slope of a pahoehoe outcrop. Within the cluster is a single faced terrace consisting of pahoehoe cobbles and boulders. This terrace is 3.70 m NW-SE by 2.65 m NE-SW and 1.60 m high along the faced side (SW). A natural hole is present in the southern corner of the terrace which has rocks piled up around it.

The remaining five terraces are located lower on the outcrop slope and consist of aa cobbles. These terraces follow natural outcrop configurations and were formed by filling gaps and depressions to create relatively level surfaces. These terraces are raised on the southwest sides, but are not faced. They are in various stages of deterioration.

FEATURE C: Kerbstone trail
FUNCTION: Transportation
DIMENSIONS: 62.00 m by 2.20 m by 0.95 m maximum kerbstone height
DESCRIPTION: This trail section runs upslope/downslope in a SW-NE orientation. The trail has been graded, and this has resulted in some sections consisting of fill and other sections consisting of bare pahoehoe. The perimeters are defined with aligned pahoehoe cobbles and boulders. Where fill occurs, the trail surface is paved with small to large pahoehoe cobbles. This feature is probably a historic horse or mule path.

SITE NO.: State: 13213 PHRI: T-42
SITE TYPE: Enclosure
TOPOGRAPHY: On irregular aa terrain; southwest-facing slope.
VEGETATION: Christmas-berry, fountain grass, air plants and koa-haole.
CONDITION: Poor
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture/ possible habitation
DIMENSIONS: 14.70 m by 11.70 m
DESCRIPTION: The enclosure is roughly trapezoidal, with the long axis oriented 145 degrees Az. The walls are bifaced and consist of aa boulders and cobbles with aa pebble and small cobble core fill. The northwest wall is 14.1 m long; the southeast wall is 12.5 m long; the northeast wall is 11.70 m long and the southwest wall is 9.60 m long (all measurements along exterior sides).

Inside the enclosure are pockets of soil and scattered aa cobbles and pebbles. A pile of aa pebbles which may represent a deteriorated cupboard is present in the northern corner.

To the northeast immediately outside the enclosure is an area of concentrated aa that may represent either wall fall from the enclosure or a deteriorated terrace.

SITE NO.: State: 13214 PHRI: T-43
SITE TYPE: Complex (2 Features)
TOPOGRAPHY: On irregular, mixed pahoehoe and aa terrain with a southwestern exposure.
VEGETATION: Koa-haole, low fern, fountain grass and airplant.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture/ possible habitation
DESCRIPTION: This site consists of an enclosure (Feature A) with a platform (Feature B) located inside. Overall site area is the same as Feature A dimensions. No portable remains or deposits were observed.

FEATURE A: Enclosure
FUNCTION: Agriculture/possible habitation
DIMENSIONS: 16.20 m by 10.30 m by 1.20 m maximum height
DESCRIPTION: This roughly rectangular enclosure has double-faced, core-filled walls ranging in width from 1.20 to 1.25 m. The wall perimeters consist of pahoehoe boulders, several of which are uprights. The core fill is pahoehoe cobbles and pebbles. The northeast wall is 16.20 m long; the southwest wall is 15.25 m long; the northwest wall is 8.60 m long and the southeast wall is 10.30 m long (exterior sides).

Within the enclosure and connected to the northeast, northwest and southeast walls is a platform (Feature B). To the south of the platform the interior surface is paved with rubble and raised an average height of 0.35 m above original ground surface. Near the center of the enclosure, against the southeast wall, is a pahoehoe excavation measuring c. 2.7 by 2.0 m.

FEATURE B: Platform
FUNCTION: Agriculture/possible habitation
DIMENSIONS: 8.60 m by 5.50 m by 0.75 m
DESCRIPTION: The platform is situated within and adjacent to the Feature A enclosure wall, in the northeastern corner. It consists of pahoehoe boulders, cobbles and pebbles. Two depressions exist in the surface of the platform, and it was not possible to determine whether pavement was once present on the surface. The feature is in a generally deteriorated condition.

SITE NO.: State: 13215 PHRI: T-44
SITE TYPE: Wall
TOPOGRAPHY: Smooth to rough undulating pahoehoe flow with scattered aa pockets.
VEGETATION: Air plant, koa-haole, kiawe, 'ilima, noni and fountain grass.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Historic
FUNCTIONAL INTERPRETATION: Ranching
DIMENSIONS: 18.00 m by 1.10 m by 1.00 m maximum height
DESCRIPTION: This relatively short wall section is double-faced and core-filled, and consists of pahoehoe cobbles and boulders, with some uprights incorporated into the faced sides. It is oriented NW-SE, and the southeastern end stops 9.00 m north of the Kealakehe/Keahuolu ahupuaa boundary wall (Site 13253). The sides of the wall are stacked and faced three to five courses high, at heights from 0.70 to 1.00 m. Portions of both sides of the wall have collapsed.

SITE NO.: State: 13216 PHRI: T-45
SITE TYPE: Wall
TOPOGRAPHY: Gently sloping pahoehoe and aa terrain that has been bulldozed.
VEGETATION: Mango, koa-haole and air plants.
CONDITION: Poor-fair
INTEGRITY: Possibly altered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Land division/ agriculture
DIMENSIONS: 49.14 m by 0.99 m by 1.24 m maximum height
DESCRIPTION: This double-faced, core-filled wall is oriented generally east-west. The east end of the wall is at the eastern boundary of the project area, where it terminates at a housing subdivision. The western end of the wall is within the boundaries of Site 13254, where it exhibits formal characteristics of a kuaiwi wall.

The wall consists of aa cobbles and is generally more curved and irregular than boundary walls of historic period construction. A portion of the wall near the western end widens from the average 0.85 m to a range of 2.10-3.90 m. This area consists of small boulders and cobbles of aa, stacked five courses high. The surface here is relatively level but not paved. The north side of the wall is faced, five courses high, 1.0 m high and in some areas collapsed. The south side of the wall has a sloping edge c. 0.50 m high. The

northeast corner of this widened area has a built up circular pile of small aa boulders with a depression in the center that may have supported a post at one time.

SITE NO.: State: 13217 PHRI: T-46
SITE TYPE: Enclosure
TOPOGRAPHY: Gently sloping pahoehoe, southwest exposure
VEGETATION: Mango, kiawe, fountain grass, lantana and elephant grass.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Recent historic
FUNCTIONAL INTERPRETATION: Agriculture (recent)
DIMENSIONS: 10.00 m by 4.00 m by 1.30 m maximum height
DESCRIPTION: This oval enclosure is built around a mature mango tree. It consists of pahoehoe boulders and cobbles stacked four to six courses on the exterior side, and an inner ring three courses high (c. 0.30-0.50 m). Overall width of the wall averages 0.80 m. There is no entranceway into the enclosure, which is partially collapsed.

SITE NO.: State: 13218 PHRI: T-47
SITE TYPE: Wall
TOPOGRAPHY: Gently sloping pahoehoe.
VEGETATION: Lantana, lilikoi, day flower, fountain grass and kiawe.
CONDITION: Poor
INTEGRITY: Unaltered
PROBABLE AGE: Historic
FUNCTIONAL INTERPRETATION: Land division/ ranching
DIMENSIONS: 80.00 m by 0.85 m by 1.50 m (approx.)
DESCRIPTION: This east-west wall extends from the Site 13184 wall eastward beyond the boundary of the project area. The length given here includes only that portion within the project area. Overall length is c. 640.00 m. The wall is bifaced and core-filled and has fencing wire, concrete slabs, and a salt lick incorporated into the construction.

SITE NO.: State: 13219 PHRI: T-48 ***(Figure A-10)***
SITE TYPE: Kerbstone trail
TOPOGRAPHY: Varies from sloping to level pahoehoe with some aa.
VEGETATION: Grass, koa-haole, Christmas-berry, klu, lantana, guava
CONDITION: Fair-good
INTEGRITY: Portions affected by bulldozing
PROBABLE AGE: Historic
FUNCTIONAL INTERPRETATION: Transportation
DIMENSIONS: 250.00 m by 1.70 m by 1.20 m maximum height
DESCRIPTION: This straight-line, graded kerbstone trail is oriented east-west and consists of both aa and pahoehoe boulders and cobbles, depending upon local terrain. The eastern end of the trail as currently defined is at a large riprap pile near the eastern boundary of the project area. The western end of the intact portion is at the Site 13184 wall. Two short sections were identified to the west of the wall, where extensive bulldozing and chain-dragging has occurred.

The trail perimeters are defined by aligned and/or stacked pahoehoe and aa boulders and cobbles, and the surface varies from a pebble pavement to cleared soil. Some sections of the trail have been filled up to 1.20 m high, and some sections are depressed into aa surfaces, in order to maintain a level grade. There are about four sections of upgrading c. 1.00 m high across low areas within the intact section of the trail. In two to three sections across aa the trail surface is below the surrounding grade.

The location of this trail section seems to correlate with a "3 ft road" plotted on Emerson's Survey Map (1882) of upper Kealakehe.

SITE NO.: State: 13220 PHRI: T-55
SITE TYPE: Complex (3 Features)
TOPOGRAPHY: Irregular pahoehoe, southwestern exposure.
VEGETATION: Dense akia, guava, fountain grass, Christmas-berry, lantana, 'ilima, vines, noni, air plant and koa-haole.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: A linear rock mound (Feature A), a pahoehoe excavation (Feature B), and a circular rock mound (Feature C) were identified within an area c. 12.20 m by 10.0 m at this site. No portable remains or deposits were noted.

FEATURE A: Linear rock mound
FUNCTION: Agriculture
DIMENSIONS: 5.00 m by 1.60 m by 0.80 m
DESCRIPTION: The mound consists of pahoehoe boulders and cobbles, and is oriented NE-SW.

FEATURE B: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 7.20 m by 6.00 m
DESCRIPTION: The pahoehoe excavation is located 2.50 m from Feature A at 70 degrees Az. The excavation is rectangular with pahoehoe boulders and cobbles loosely stacked around the outside edges.

Figure A-10. SITE 13219. TRAIL SEGMENT. VIEW TO EAST (PHRI Neg. 1304-11)

FEATURE C: Circular rock mound
FUNCTION: Agriculture
DIMENSIONS: 3.20 m by 1.92 m by 0.56 m
DESCRIPTION: This mound is 1.50 m from Feature A at 288 degrees Az. It consists of loosely piled pahoehoe boulders and cobbles.

SITE NO.: State: 13221 PHRI: T-56,57
SITE TYPE: Complex (80 Features)
TOPOGRAPHY: Undulating pahoehoe flow which slopes to the southwest.
VEGETATION: Christmas-berry, alahe'e, koa-haole, fountain grass and various other grasses, 'ilima, lantana and air plant.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: Over 55 linear stone mounds and 25 pahoehoe excavations were counted within an area 60.0 m N-S by 35.0 m E-W at this complex. The features could not be individually measured during this survey. It is likely additional features are present within the site boundaries, which were arbitrarily delineated for purposes of feature enumeration. The site appears to be contiguous with Site 13222, located to the northeast.

FEATURE - : Linear rock mounds (55)
FUNCTION: Agriculture
DESCRIPTION: The mounds range from 2.0 m to 6.0 m in length and 2.0 to 4.50 m in width and 0.80 to 1.50 m in height. They consist of piled to crudely stacked rocks on top of bedrock.

FEATURE - : Pahoehoe excavations (25)
FUNCTION: Agriculture
DESCRIPTION: The quarried materials are piled around the excavations in linear mounds. Soil deposits were observed in several of the excavations.

SITE NO.: State: 13222 PHRI: T-58
SITE TYPE: Complex (19 Features)
TOPOGRAPHY: Irregular pahoehoe, southwestern exposure.
VEGETATION: Dense vegetation of alahe'e, monkey pod, Christmas-berry, lauae, koa-haole, fountain grass and vines.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Agriculture-quarry
DESCRIPTION: Four pahoehoe excavations and 15 linear rock mounds were identified within an area 30.0 m E-W by 20.0 m N-S at this site. Measurements were recorded for one of the pahoehoe excavations (Feature A) and one of the linear rock mounds (Feature B).

FEATURE A: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 8.30 m by 9.30 m
DESCRIPTION: This is a filled excavation with a circular alignment around the edges. The pahoehoe flow has been excavated by pahoehoe extracting boulders and cobbles and then building up the edges of the excavation by stacking the rocks along the outer edges. The depression is filled with pahoehoe boulders down to pebbles, with the smaller pieces at the bottom and larger pieces on top. Large boulder size uprights are present along the southern edge of the excavation. Paving is to the east of this in an area which appears to be an opening in the circular pattern of the excavation. The south curve of the circle is paved outside the main circle about 1.00 to 1.50 m wide.

FEATURE B: Linear rock mound
FUNCTION: Agriculture
DIMENSIONS: 8.80 m by 2.50 m by 1.00 m maximum height
DESCRIPTION: The mound is oriented NE-SW, and consists of pahoehoe boulders to pebbles. The rocks are piled (not faced) on an unbroken pahoehoe surface.

SITE NO.: State: 13223 PHRI: T-59 ***(Figure A-11)***
SITE TYPE: Complex (10 Features)
TOPOGRAPHY: Irregular pahoehoe flows with many bedrock outcrops.
VEGETATION: Dense koa-haole, Christmas-berry, alahe'e, sparse grasses, air plants, 'iliima, guava, and lauae.
CONDITION: Good to poor
INTEGRITY: Unaltered; Feature A altered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Agriculture-habitation-possible burial
DESCRIPTION: An enclosure (Feature A), two platforms (Features B and D) and a terrace with six associated cleared depressions (Feature C) were identified at this complex. Overall site area is c. 27.00 m N-S by 25.00 m E-W. Portable remains observed include a waterworn basalt cobble, incorporated into the wall of Feature A, and waterworn basalt cobble fragments, located at Feature C. Pockets of loamy soil are scattered across the site. In addition, an unknown number of rock mounds are present within the site area.

FEATURE A: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 16.00 m by 14.50 m by 0.80 m maximum wall height

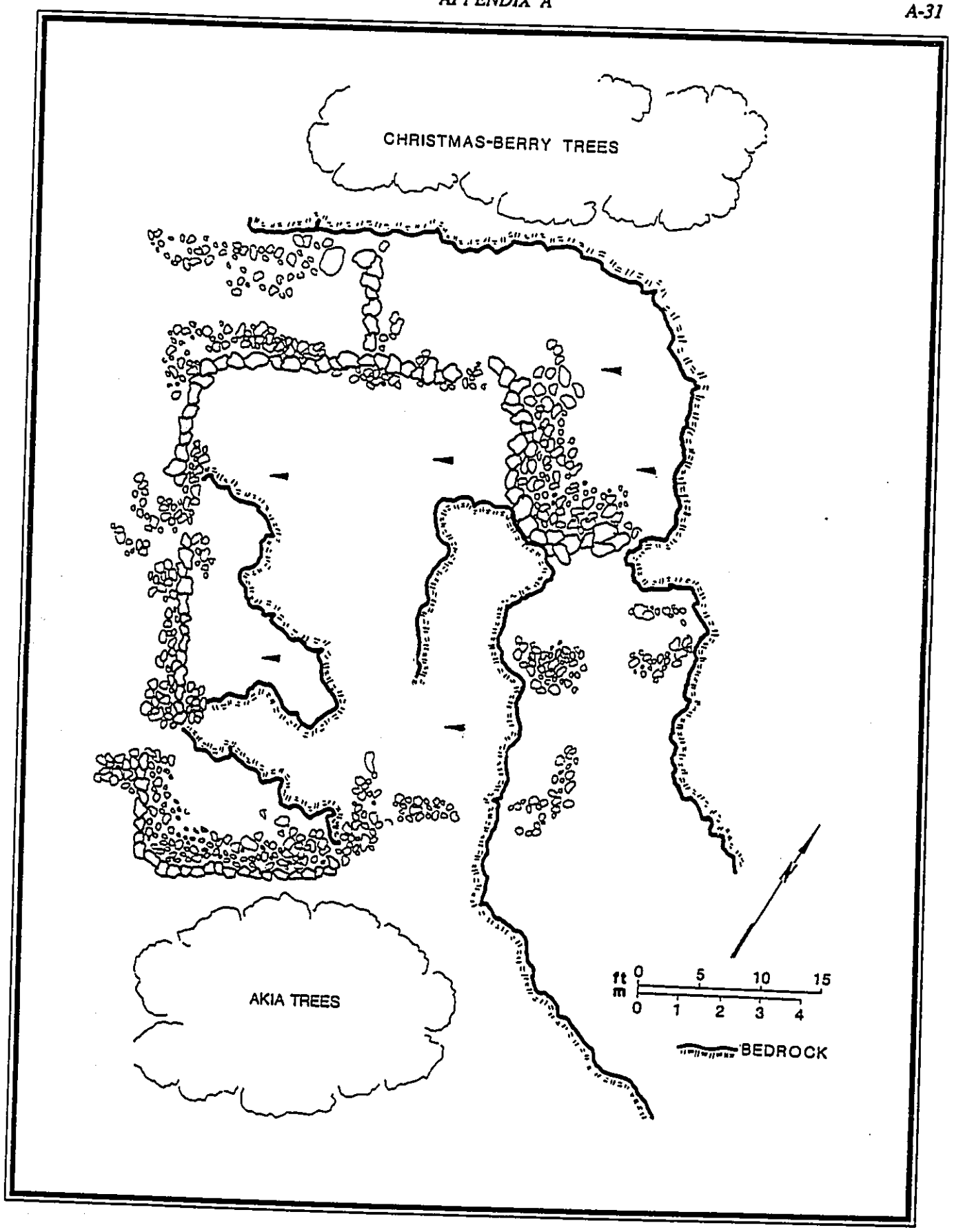

Figure A-11. SITE 13223

The enclosure walls consist of pahoehoe boulders and cobbles, stacked from one to three courses high (0.35 to 0.80 m), and one to two stones wide. No core fill is present in the walls. One waterworn rock was noted at the north end of the enclosure. The southeastern section of the enclosure wall is in very poor preservation; it consists of boulders scattered atop bedrock. Approximately two thirds of the interior area contains a 0.05-0.08 m thick deposit of dark brown loam.

FEATURE B: Platform
FUNCTION: Habitation/possible burial
DIMENSIONS: 3.70 m by 3.60 m by 0.70 m maximum height
DESCRIPTION: This nearly square platform is located 19.0 m from Feature A at 38 degrees Az. It consists of aa boulders and pahoehoe boulders, cobbles and pebbles. The platform base stands up to three courses high and is made mostly of small aa boulders. All four sides are faced, although sections are currently collapsed. The top of the platform is made mostly of pahoehoe cobbles and pebbles, and is slightly mounded. Height of the platform varies from 0.45 m to 0.70 m.

FEATURE C: Terrace with six cleared depressions
FUNCTION: Agriculture
DIMENSIONS: 5.00 m by 4.60 m by 0.80 m maximum height
DESCRIPTION: This cluster of features is located 11.40 m from Feature A. The terrace is situated along the southwest edge of a pahoehoe outcrop, and has a single faced side along the southwest. This side is stacked pahoehoe cobbles, one to two courses high. The top of the terrace is paved with pahoehoe cobbles and pebbles, with some exposed outcrop surfaces protruding. On the southeast corner of the terrace is a circular alignment of pahoehoe cobbles and boulders which forms the perimeter of a soil deposit. The alignment is 1.80 by 1.10 m across the inside.

The pahoehoe outcrop forms a natural edge between the terrace and six circular depressions which are lined with pahoehoe, small boulders and cobbles where the outcrop stops. These depressions are filled with soil and pahoehoe pebbles in the center.

FEATURE D: Platform
FUNCTION: Agriculture/habitation
DIMENSIONS: 2.50 m by 2.20 m by 0.60 m maximum height
DESCRIPTION: The platform is located immediately adjacent to the northeast of the Feature C terrace and modified outcrop area. It consists of pahoehoe boulders and cobbles, stacked and faced on all sides, one to three courses high (0.50 to 0.60 m). The top of the platform was apparently not paved, and near the center is a small depression. The platform is adjacent to a modified outcrop.

SITE NO.: State: 13224 PHRI: T-60
SITE TYPE: Complex (28+ Features)
TOPOGRAPHY: Irregular to hilly pahoehoe terrain; southwest facing slope.
VEGETATION: Heavy vegetation consisting of Christmas-berry, koa-haole, lantana, alah'ee, 'ilima, and grasses.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: A terrace (Feature A), 19+ pahoehoe excavations, and eight+ rock mounds were identified within an area 40.0 m N-S by 40.0 m E-W at this site. No portable remains were observed; however, soil pockets are present across the site.

FEATURE A: Terrace
FUNCTION: Agriculture
DIMENSIONS: 6.30 m by 5.70 m by 0.95 m maximum height
DESCRIPTION: The somewhat circular terrace consists of small pahoehoe boulders and cobbles. The south side is raised and faced with up to three courses of stacked boulders. The surface is not formally paved, and is leveled primarily by filling depressions in the natural outcrop. A pocket of soil at least 0.06 m thick was observed just outside the south wall. Adjacent to the northeast corner of the terrace is a rock mound.

FEATURE - : Pahoehoe excavations (19)
FUNCTION: Agriculture

FEATURE - : Rock mounds (8)
FUNCTION: Agriculture

SITE NO.: State: 13225 PHRI: T-61
SITE TYPE: Complex (7 Features)
TOPOGRAPHY: The site is situated on the S-SW facing slope. The terrain is irregular with pahoehoe outcrops.
VEGETATION: Dense vegetation; air plant, lantana, fountain grass, Christmas-berry, koa-haole, 'akia, monkey pod and grasses.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-historic
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: Three pahoehoe excavations (Feature A), a linear rock mound (Feature B) and three circular rock mounds were identified within an area c. 33.8 m N-S by

10.0 m E-W at this site. Dark brown loam was identified in pockets in and around the pahoehoe excavations.

FEATURE A: Pahoehoe excavations (3)
FUNCTION: Agriculture
DIMENSIONS: 9.00 m by 5.45 m
DESCRIPTION: Three sections along the edges of a pahoehoe blister have blocks knocked from the rock face, forming circular depressions. The depressions are built up along the outer edges with aligned pahoehoe blocks, and the interiors are filled with pahoehoe cobbles. Some flat slabs around the outer edges of the excavations are upright.

FEATURE B: Linear rock mound
FUNCTION: Agriculture
DIMENSIONS: 6.60 m by 1.60 m by 0.85 m maximum height
DESCRIPTION: The linear mound is located 19.0 m from Feature A at 292 degrees Az. It consists of pahoehoe boulders and cobbles, with no formalized stacking or facing. The mound is oriented SW-NE. To either side of the mound, the surface has been paved with small pahoehoe cobbles.

FEATURE - : Circular rock mound (3)
FUNCTION: Agriculture
DESCRIPTION: These were found in the immediate area of Features A and B.

SITE NO.: State: 13226 PHRI: T-63,64
SITE TYPE: Complex (13 Features)
TOPOGRAPHY: Undulating pahoehoe flow with a light slope to the southwest.
VEGETATION: Christmas-berry, alahe'e, koa-haole, sparse grass, air plant, ferns and monkey pod.
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: An L-shaped rock mound (Feature A), four circular rock mounds, seven pahoehoe excavations, and a terrace were identified within an area c. 33.0 m N-S by 28.0 m E-W at this site. This site is immediately adjacent to and north of Site 13223, and believed to be associated with this agricultural complex. It is also adjacent to and on the southwest edge of Site 13227.

FEATURE A: L-shaped rock mound
FUNCTION: Agriculture
DIMENSIONS: 23.50 m by 3.00 m maximum width by 0.95 m maximum height
DESCRIPTION: The mound is comprised of two linear sections; one 10.00 m long section is oriented NW-SE, and a 13.50 m long section is oriented NW-SW. The mound is composed of mostly small basalt boulders with some large to medium cobbles mixed in. These rocks are stacked roughly with some short areas of facing on the west and south sides. The NW-SE section has an average width of 2.10 m wide and ranges from 0.35 to 0.95 m in height. The NE-SW section widens to 3.0 m at the southwest end of the mound. Height of this section varies from 0.25 to 0.90 m.

FEATURE - : Rock mound (4)
FUNCTION: Agriculture
DESCRIPTION: In the vicinity of Feature A are at least four rock mounds; these are associated with pahoehoe excavations.

FEATURE - : Pahoehoe excavation (7)
FUNCTION: Agriculture
DESCRIPTION: There is a large pahoehoe excavation NW and directly adjacent to the NW corner of Feature A. At least six additional pahoehoe excavations with associated small stacked mounds of quarried material are present in the immediate vicinity of Feature A.

FEATURE - : Terrace
FUNCTION: Agriculture
DIMENSIONS: 2.25 m by 1.30 m
DESCRIPTION: Approximately 6.0 m south of the northern corner of Feature A is a small terrace. This feature is immediately northwest of a pahoehoe excavation and associated rock mound. The terrace consists of pahoehoe cobbles piled in a small quarried blister. The surface is flat and roughly level.

SITE NO.: State: 13227 PHRI: T-65
SITE TYPE: Complex (120 Features)
TOPOGRAPHY: Irregular pahoehoe and aa flows, southwest exposure.
VEGETATION: Dense upper story of Christmas-berry and alahe'e with moderately dense grasses, air plant, lauae, lantana, noni, and monkey pod.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: Features enumerated at this site include 59 circular rock mounds, 48 pahoehoe excavations, and 13 linear rock mounds. The area as defined for purposes of enumeration is 70.0 m NE-SW by 55.0 m NW-SE. Dark brown loam was observed in pockets across the site. Site No. 13226 is c. 45.0 m from this site at 185 degrees AZ, and Site 13235 is adjacent to the northeast.

FEATURE - : Circular rock mounds (59)
FUNCTION: Agriculture

DESCRIPTION: The circular mounds identified at this site are generally adjacent to pahoehoe excavations and may be constructed with quarried pahoehoe blocks and cobbles. These mounds have an average size of 2.0 by 2.0 m, and an average height of 0.75 m.

FEATURE - : Pahoehoe excavation (48)
FUNCTION: Agriculture
DESCRIPTION: The excavations present at the site are most commonly collapsed pahoehoe blisters with blocks knocked from the edges. The centers of the excavations are partially filled with pahoehoe pebbles underlying a layer of cobbles.

FEATURE - : Linear rock mound (13)
FUNCTION: Agriculture
DESCRIPTION: The linear rock mounds have an average size of 4.0 m by 2.0 m, and an average maximum height of 1.25 m.

SITE NO.: State: 13228 PHRI: T-66 ***(Figure A-12)***
SITE TYPE: Enclosure
TOPOGRAPHY: Situated on a knoll that consists of a central pahoehoe outcrop surrounded by aa.
VEGETATION: Christmas-berry, alahe'e, 'ilima, lantana and fountain grass.
CONDITION: Poor
INTEGRITY: Partially disturbed by bulldozer
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Indeterminate/ possible ceremonial
DIMENSIONS: 22.40 m by 16.50 m by 1.50 m maximum wall height
DESCRIPTION: This roughly rectangular enclosure consists of aa and pahoehoe boulders and cobbles. The walls are bifaced and stacked up to eight courses high; wall heights range from 0.40 along the interior at the southwest corner to 1.50 m along the exterior of the west wall. Intact wall sections vary in width from 0.80 to 1.20 m.

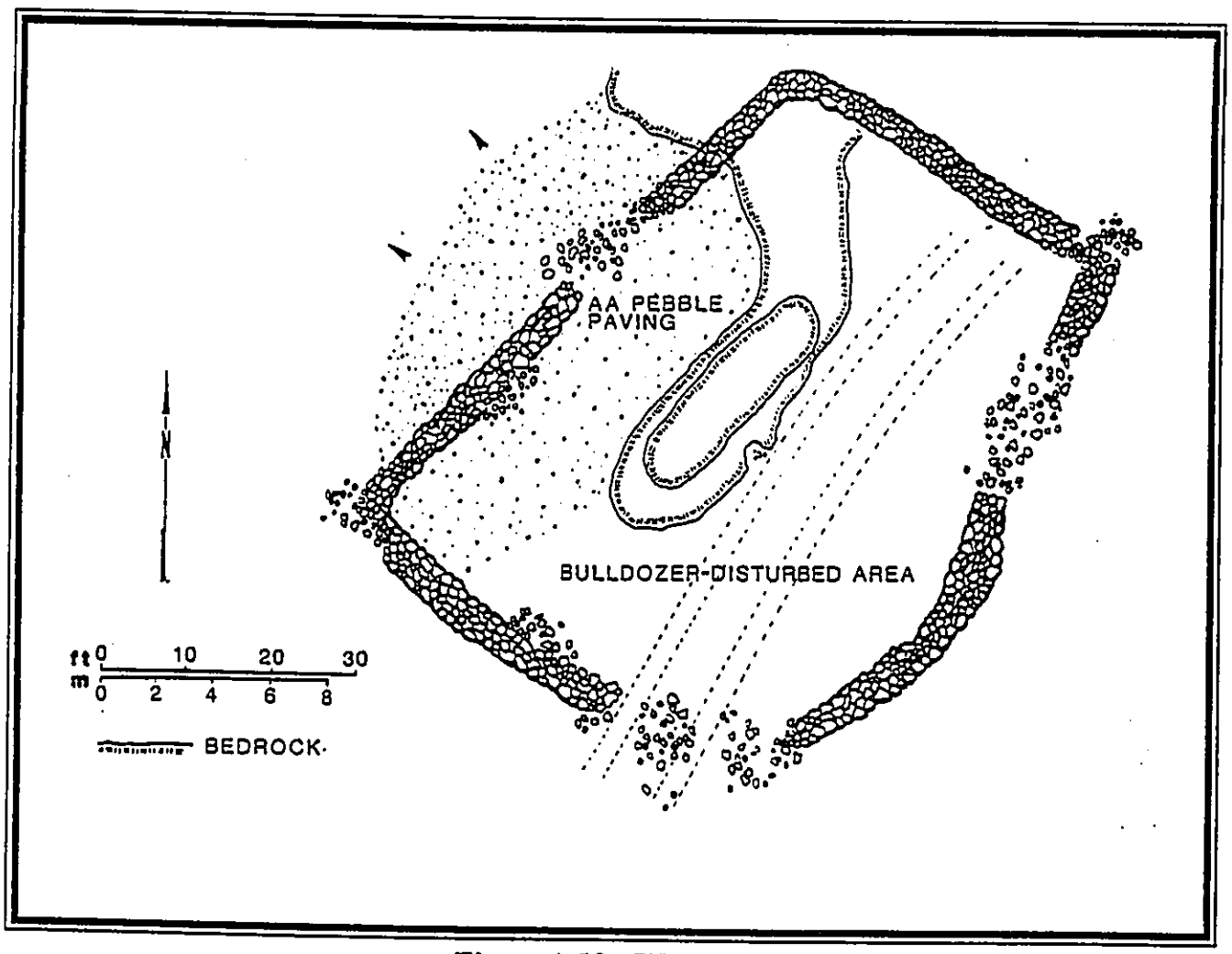

Figure A-12. SITE 13228

The south and eastern portions of the enclosure were affected by a bulldozer which drove through the south wall and into the structure, disturbing approximately half of the interior surface area. The undisturbed portion of the interior consists of a linear pahoehoe rise that may have been excavated along the east face, and a level pavement-like deposit of aa gravel. This pavement continues to the exterior, west side of the enclosure, where it is 15.0 m long and 4.00 m wide. On the north and NE sides of the enclosure, the wall is collapsed.

SITE NO.: State: 13229 PHRI: T-67
SITE TYPE: Complex (10+ Features)
TOPOGRAPHY: On a southwest-facing slope, surrounded by pahoehoe and aa lava flows.
VEGETATION: Dense vegetation of Christmas-berry, koa-haole, fountain grass, lantana, 'ilima, alahe'e, impatiens and vines.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: Features identified within this site include four modified pahoehoe excavations, a cairn, and at least five rock mounds. Overall complex area is c. 30.0 m N-S by 20.0 m E-W. Soil deposits are present inside the modified pahoehoe excavations.

Feature A is within a pahoehoe flow naturally suited and culturally adapted for agriculture. The top terracing has Features A1 and A2, a cairn and a circular alignment. The area surrounding it is paved. Dropping down the hill is another circular alignment carved out of a pahoehoe excavation area filled in with soil in the center. At the bottom of this natural terracing is the third circular alignment.

FEATURE A1: Cairn
FUNCTION: Agriculture
DIMENSIONS: 1.50 m by 1.00 m by 0.60 m maximum height
DESCRIPTION: The cairn is located on the upper tier of a naturally terraced pahoehoe outcrop which contains three modified pahoehoe excavations (Features A2-A4). The cairn is immediately adjacent to the northwest end of the Feature A2 alignment, and it consists of small pahoehoe cobbles.

FEATURE A2: Modified pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 2.00 m by 1.50 m by 0.20 m maximum height
DESCRIPTION: This feature consists of a pahoehoe excavation and an encircling alignment/wall. The alignment/wall is made with pahoehoe cobbles excavated from a collapsed area of a pahoehoe outcrop and stacked 1-2 courses high around the outer edges of the excavation. A deposit of dark brown loam is present in the center of the feature.

FEATURE A3: Modified pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 2.50 m by 2.00 m by 0.50 m maximum height
DESCRIPTION: This excavation is located downslope of Features A1 and A2, along the same pahoehoe outcrop. It is identical in construction with Feature A2, and slightly larger. Soil is also present in the center of this feature.

FEATURE A4: Modified pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 3.00 m by 2.50 m by 0.65 m maximum height
DESCRIPTION: Feature A4 is located downslope from Feature A3, on the same pahoehoe outcrop. The circular wall around the excavation at this locale is stacked up to three courses high, and is faced on the northeast side. Soil is present in the center of this feature.

FEATURE B: Modified pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 9.00 m by 5.00 m by 1.00 m maximum depth
DESCRIPTION: Feature B is located to the northeast of Feature A. It consists of a cleared pahoehoe excavation built up around the interior sides with pahoehoe cobbles. At the time of survey, the interior of the feature was damp and contained a lush growth of succulent plants.

FEATURE -: Rock mounds (5)
FUNCTION: Agriculture
DESCRIPTION: Five additional rock mounds are present in the area.

SITE NO.: State: 13230 PHRI: T-68 ***(Figure A-13)***
SITE TYPE: Walled cave
TOPOGRAPHY: In a collapsed pahoehoe tube, just south of a major ridgeline.
VEGETATION: Christmas-berry, alahe'e, lantana, fountain grass and air plant.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation
DIMENSIONS: 9.00 m by 2.50 m by 1.50 m average ceiling height

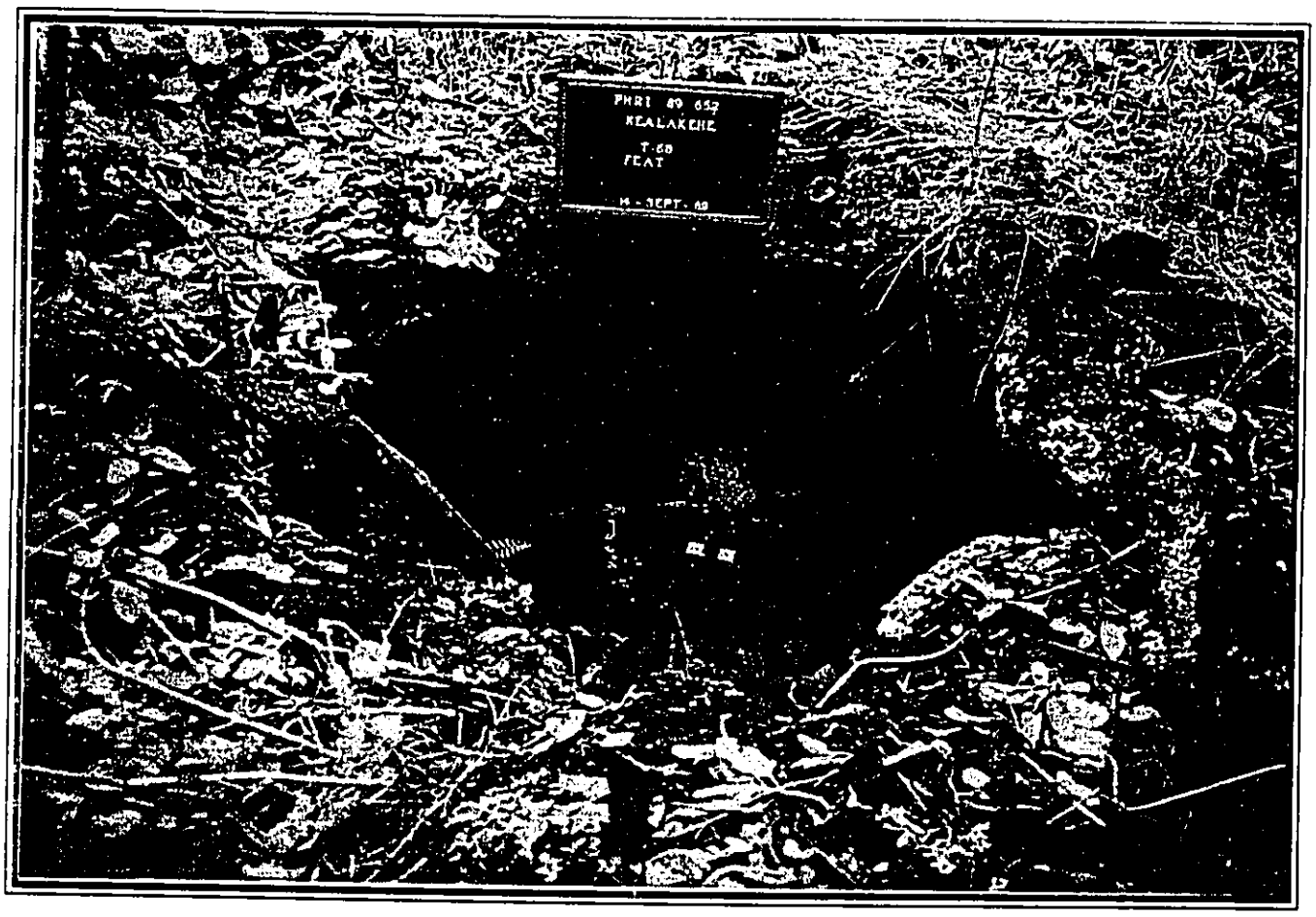

Figure A-13. SITE 13230, CAVE OPENING. VIEW TO WEST (PHRI Neg. 1301-21)

DESCRIPTION: This site is located in a narrow, partially collapsed lava tube oriented NE-SW along the prevailing slope. The floor of the collapsed section has been cleared and leveled and a retaining wall built across the narrow axis of the tube, 1.0 m to the southwest of the cave opening. The wall is 2.00 m long, 1.75 m wide and 1.10 m high. It consists of small boulders to large cobbles, stacked four to six courses high. The area NE of the opening may have been cleared of natural roof-fall, and a skylight northeast of the opening has been filled with some of this rubble. Loose pahoehoe rubble is also stacked within the tube 2.20 m northeast of the opening.

SITE NO.: State: 13231 PHRI: T-69
SITE TYPE: Complex (8 Features)
TOPOGRAPHY: Undulating pahoehoe flow sloping to the southwest.
VEGETATION: Alahe'e, Christmas-berry, koa-haole, noni, fountain grass and air plant.
CONDITION: Fair-good
INTEGRITY: Unaltered-some bulldozer damage
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: Eight rock mounds were identified at this site, including seven circular mounds and one linear mound. Overall complex area measures c. 30.0 m N-S by 20.0 m E-W.

FEATURE - : Rock mound (7)
FUNCTION: Agriculture
DESCRIPTION: These mounds consist of stacked basalt boulders and large cobbles. They are generally circular at the base with relatively vertical to collapsed sides. Average sizes range from is 2.00 by 2.00 m to 3.00 by 3.00 m at the base, and 0.60 to 1.25 m in height.

FEATURE - : Linear rock mound
FUNCTION: Agriculture
DIMENSIONS: 12.00 m by 4.00 m by 1.25 m maximum height
DESCRIPTION: The mound consists of loosely stacked basalt boulders and large cobbles.

SITE NO.: State: 13232 PHRI: T-70
SITE TYPE: Complex (10 Features)
TOPOGRAPHY: Undulating pahoehoe flow sloping to the southwest.
VEGETATION: Christmas-berry, alahe'e, low ferns, air plant, grasses, kukui nut and koa-haole.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: Ten pahoehoe excavations were identified within an area 40.00 m N-S by 30.00 m E-W at this site.

FEATURE - : Pahoehoe excavations (10)
DIMENSIONS: Average excavation is 4.00 m by 5.00 m by 1.25 m deep
DESCRIPTION: The majority of these excavations are into pahoehoe blisters; a few are along the faces of small crevices. In most cases, blocks removed from the depressions are loosely piled along the outer edges of the excavations. There seems to be a higher occurrence of piled stones along the southwestern perimeters of the excavations. Soil deposits were observed inside the excavations.

SITE NO.: State: 13233 PHRI: T-71
SITE TYPE: Complex (6+ Features)
TOPOGRAPHY: Undulating pahoehoe with a slight slope to the southwest.
VEGETATION: Alahe'e, Christmas-berry, guava, kukui nut, grasses and air plant.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: Three circular rock mounds and three linear rock mounds were identified within an area 30.0 m N-S by 25.0 m E-W at this site. It is likely additional features are present within the immediate vicinity.

FEATURE - : Rock mounds (3+)
FUNCTION: Agriculture
DESCRIPTION: The mounds consist of small, loosely piled basalt boulders and cobbles. These three mounds are roughly circular at the base, with average dimensions 2.0 m by 2.0 m by 0.75 m high.

FEATURE - : Linear rock mound (3+)
FUNCTION: Agriculture
DESCRIPTION: The linear mounds also consist of small basalt boulders and cobbles. Unlike the circular mounds, the three linear mounds are roughly faced along the east side. Average dimensions are 3.0 m by 2.0 m by 1.00 m.

SITE NO.: State: 13234 PHRI: T-72
SITE TYPE: Kerbstone trail
TOPOGRAPHY: Pahoehoe flow sloping to the southwest.
VEGETATION: Alahe'e, Christmas-berry, koa-haole, lantana, grasses and air plant.
CONDITION: Fair
INTEGRITY: Possible destruction by bulldozer at north end

PROBABLE AGE: Historic
FUNCTIONAL INTERPRETATION: Transportation
DIMENSIONS: 244.00 m by 3.00 m by 0.10 m (approx.)
DESCRIPTION: The trail was identified primarily on the basis of two parallel kerbstone alignments oriented N-S. The alignments are spaced 2.50 to 3.00 m apart and consist of pahoehoe boulders and cobbles. In some areas the trail is paved with large to medium cobbles on a roughly flat surface. Intermittent areas of the trail are natural bedrock and in some sections the surface is loose rubble. The trail passes beside several agricultural features. It is possible this section once connected with the Site 13244 kerbstone trail, located c. 300.00 m to the north. If these sections connected, the trail would have been nearly parallel with, and about 60.0 m downslope of the existing Palani Road.

SITE NO.: State: 13235 PHRI: T-73,74
SITE TYPE: Complex (33+ Features)
TOPOGRAPHY: Undulating pahoehoe flow sloping gently to the southwest.
VEGETATION: Christmas-berry, alahe'e, fountain grass, air plant, guava, low ferns and 'ilima.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: Atleast linear rock mounds, 10 circular rock mounds, and 10 pahoehoe excavations were identified within an area 85.00 m E-W by 50.00 m N-S at this site. The entire area has many pahoehoe blister areas which have been excavated with the quarried material piled or crudely stacked adjacent to the excavations.

FEATURE - : Circular rock mounds (10+)
FUNCTION: Agriculture
DESCRIPTION: The circular rock mounds consist of loosely piled pahoehoe blocks and cobbles. Average size is 3.00 m by 3.00 m at the base by 1.25 m high.

FEATURE - : Linear rock mounds (10+)
FUNCTION: Agriculture
DESCRIPTION: There are at least ten linear mounds on the site; average dimensions are 4.00 to 6.00 m by 1.00 m by .70 m high. Three unusually long mounds were observed and individually measured. These are listed below.

FEATURE - : Linear rock mound
DIMENSIONS: 25.00 m by 1.00 m by 0.75 m

FEATURE - : Linear rock mound
DIMENSIONS: 13.00 m by 1.00 m by 0.70 m

FEATURE - : Linear rock mound
DIMENSIONS: 10.00 m by 1.00 m by 0.75 m

FEATURE - : Pahoehoe excavation (10+)
FUNCTION: Agriculture
DESCRIPTION: There are over ten pahoehoe excavations ranging from 4.0 m by 5.0 m to 0.50 m by 0.50 m with an average depth of 0.60 m. Rubble removed from the excavations is scattered over the site surface between the excavations and the mounds.

SITE NO.: State: 13236 PHRI: T-75,77
SITE TYPE: Complex (6 Features)
TOPOGRAPHY: Pahoehoe flow sloping to the southwest.
VEGETATION: Christmas-berry, alahe'e, sparse fountain grass, air plant and koa-haole.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric/historic
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: Six rock mounds were identified within an area 30.0 m E-W by 25.0 m N-S. Pockets of dark brown loam were observed scattered over the site surface.

FEATURE - : Rock mound (6)
FUNCTION: Agriculture
DESCRIPTION: These mounds consist of loosely piled, small pahoehoe boulders and large cobbles. They average 2.00 m by 3.00 m at the base by 1.25 m in height. One of the mounds is larger and more linear. It measures 5.50 m by 2.25 m by 1.10 m high.

SITE NO.: State: 13237 PHRI: T-76 ***(Figure A-14)***
SITE TYPE: Enclosure
TOPOGRAPHY: Undulating pahoehoe flow with a slight slope to the southwest.
VEGETATION: Christmas-berry, alahe'e, 'ilima, fountain grass and koa-haole.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Recent historic
FUNCTIONAL INTERPRETATION: Agriculture (recent)
DIMENSIONS: 4.40 m by 5.30 m by 0.70 m maximum wall height
DESCRIPTION: This is a small, roughly circular structure consisting of pahoehoe slabs, boulders and cobbles. Major portions of the side walls are outlined along the interior with upright slabs. Pahoehoe boulders and cobble chunks are stacked and loosely piled against the exterior sides of the uprights. Wall width varies from 0.60 to 1.50 m.

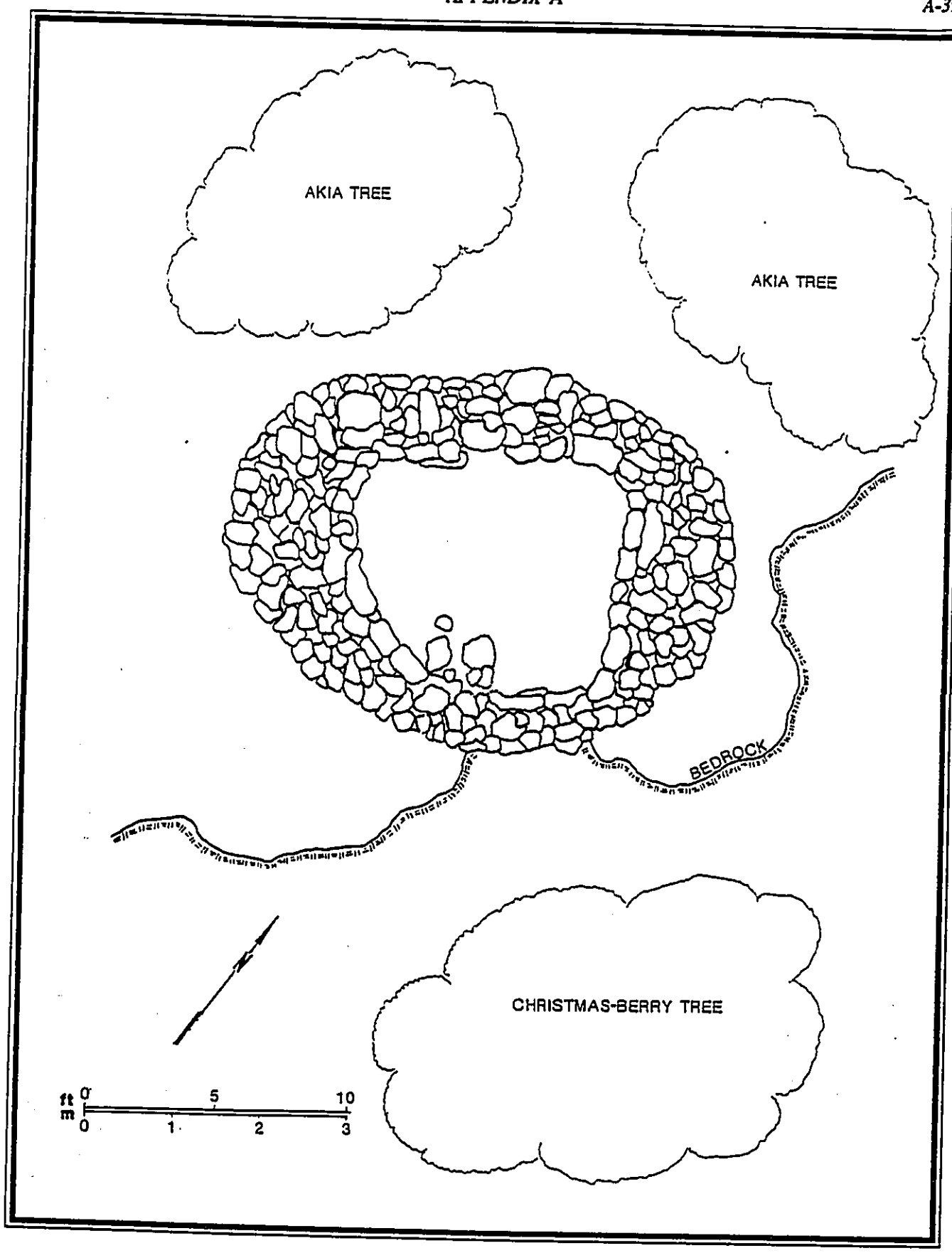

Figure A-14. SITE 13237

The interior area is 3.00 m E-W by 2.5 m N-S. It is cleared and the surface is flat and level, with a 0.10 m thick deposit of soil. The soil contains cinders and hapu fibers. Much of this soil may have been recently deposited and it is likely the enclosure was recently constructed. There are plastic seeding pots at the northeast edge of the enclosure and an old burlap bag on the western edge. Cut branches were also noticed around the perimeter.

SITE NO.: State: 13238 PHRI: T-78
SITE TYPE: Complex (20 Features)
TOPOGRAPHY: Undulating pahoehoe flow sloping gently to the southwest.
VEGETATION: Christmas-berry, alahe'e, guava, lantana, lauae, fountain grass and koa-haole.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: Ten pahoehoe excavations and 10 rock mounds were identified within an area 15.0 m N-S by 12.0 m E-W at this site. In general, the rock mounds are spatially associated with excavated pahoehoe blisters and crevices. Individual feature measurements could not be obtained at the time of survey. Pockets of dark brown loam were observed scattered over the site surface.

FEATURE - : Pahoehoe excavations (10)
FUNCTION: Agriculture

FEATURE - : Rock mounds (10)
FUNCTION: Agriculture

SITE NO.: State: 13239 PHRI: T-79 *(Figure A-15)*
SITE TYPE: Complex (33 Features)
TOPOGRAPHY: Gently sloping pahoehoe with scattered upthrusts and blisters.
VEGETATION: 'Ilima, Christmas-berry, koa-haole and alahe'e.
CONDITION: Good
INTEGRITY: Unaltered-possibly altered
PROBABLE AGE: Prehistoric/recent historic
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: A C-shaped wall (Feature A), a cairn (Feature B) and a terrace (Feature C) were identified within an area 13.00 by 13.00 m at this site. In addition, 20 pahoehoe excavations and 10 rock mounds were identified within an area 40.0 m N-S by 30.0 m E-W. The former area of three concentrated structures is within the overall area of feature enumeration. Portable remains observed on the site include a metal machete and a metal pick-axe with a wooden handle. These tools were lying next to Feature A. Soil deposits were observed in pockets across the site surface.

FEATURE A: C-shaped wall
FUNCTION: Agriculture
DIMENSIONS: 8.40 m by 1.50 m by 0.80 m maximum wall height
DESCRIPTION: Feature A consists of pahoehoe slabs loosely stacked and haphazardly piled in a curved, C-shaped arrangement. A small section of the wall is somewhat faced along the interior side, where slabs are piled up to 5 courses high. A single upright slab (1.20 m high) is positioned at the southern end of the wall. The wall is positioned to the west of a prominent pahoehoe outcrop, which has been modified with scattered pahoehoe cobbles. An area 5.40 m N-S by 4.80 m E-W is defined and mostly enclosed by the wall and outcrop. A deposit of very dark, cindery soil is present immediately inside the wall. A metal machete and metal pick-axe with wooden handle are on bedrock, inside the enclosed area.

FEATURE B: Cairn
FUNCTION: Agriculture
DIMENSIONS: 1.90 m by 1.40 m by 0.97 m maximum height
DESCRIPTION: Feature B is located 1.50 m west of Feature A. This is a collapsed cairn and the dimensions given above include both the cairn and the area of scattered rocks. The original shape may have been square with sides c. 0.90 m to 1.00 m long. It consists of pahoehoe slabs, stacked six courses high along the perimeters, with a core filling of cobble to pebble-size rocks. Two sides of the cairn appear to be intact. These sides form a rounded corner on the side facing Feature A.

FEATURE C: Terrace
FUNCTION: Agriculture
DIMENSIONS: 5.80 m by 5.00 m by 0.50 m maximum height
DESCRIPTION: This terrace is located 3.00 m north of Feature A. It consists of cobble and pebble fill built over a depression in pahoehoe. The north side is raised and faced to a maximum height of 0.50 m, with slabs stacked three courses high. The west perimeter of the terrace follows a pahoehoe outcrop and is also built up. The east perimeter is defined by an outcrop as well. Approximately half of the surface area is small boulder and cobble fill that is relatively level. The level portion of the surface is circular (1.90 m in diameter). Along the south edge of the terrace is a loosely stacked rock pile 0.90 m high.

FEATURE - : Pahoehoe excavations (20) and rock mounds (10)

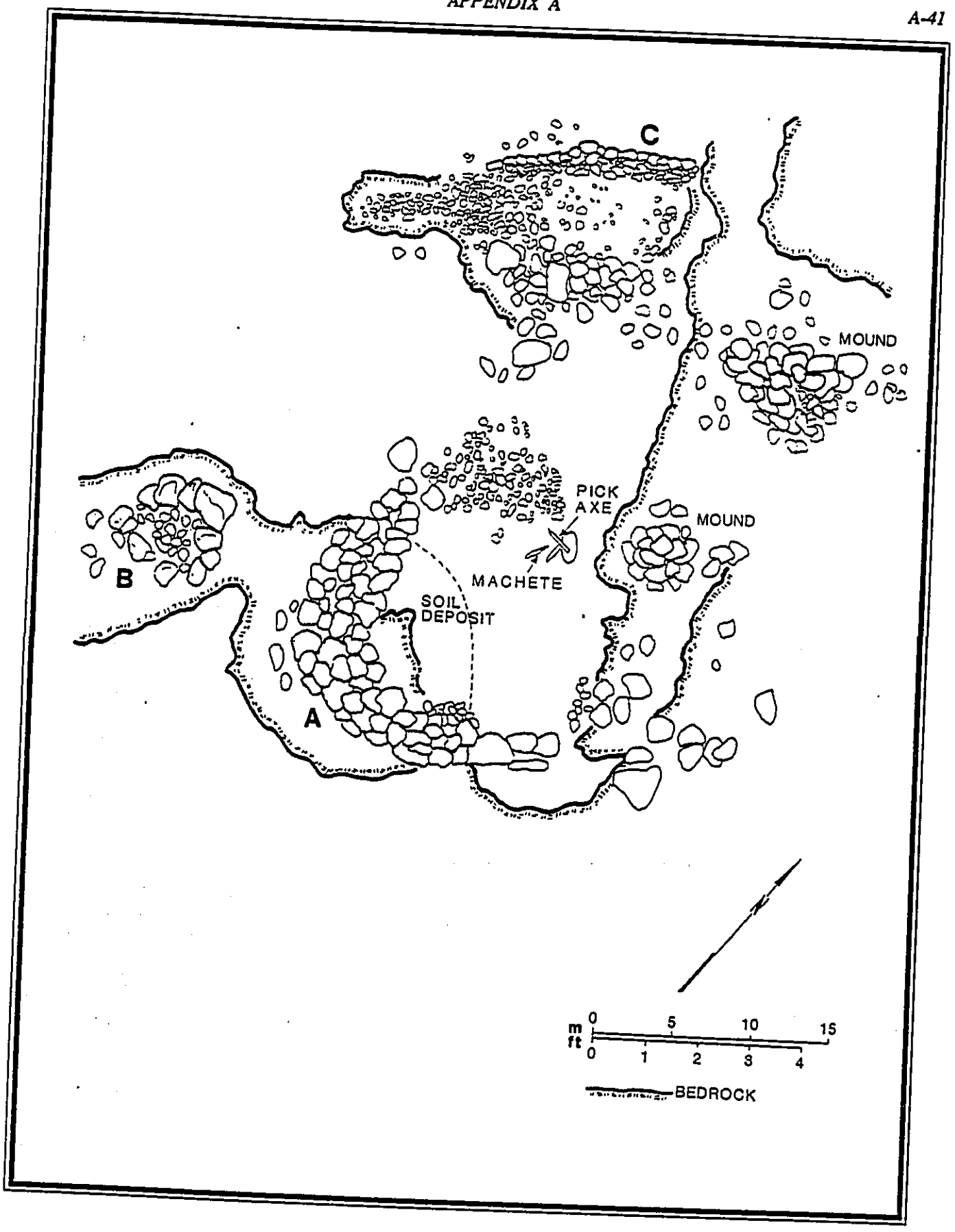

Figure A-15. SITE 13239.

FUNCTION: Agriculture
DESCRIPTION: There are probably additional minor modifications within and adjacent to the area delineated here for feature enumeration.

SITE NO.: State: 13240 PHRI: T-80
SITE TYPE: Complex (33+ Features)
TOPOGRAPHY: Pahoehoe flow sloping to the southwest.
VEGETATION: Christmas-berry, alahe'e, fountain grass, guava trees, lantana and air plant.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: Twenty rock mounds, 10 pahoehoe excavations and three faced mounds were identified within an area 50.0 m N-S by 30.0 m E-W. Scattered pahoehoe pieces, apparently removed from excavated areas, are present over most of the site surface.

FEATURE - : Rock mounds (20+)
FUNCTION: Agriculture
DESCRIPTION: The rock mounds at this site are generally circular at the base and somewhat conical. Average size of the mounds is c. 2.00 m by 2.00 m by 1.50 m high.

FEATURE - : Pahoehoe excavation (10+)
FUNCTION: Agriculture
DESCRIPTION: The average size of the pahoehoe excavations is c. 2.0 m by 3.0 m by 0.50 m. deep

FEATURE - : Faced rock mound (3+)
FUNCTION: Agriculture
DESCRIPTION: Three circular mounds exhibit faced sides. These mounds range from 1.00 to 2.00 m in diameter and have an average height of 0.60 m.

SITE NO.: State: 13241 PHRI: T-81
SITE TYPE: Complex (49 Features)
TOPOGRAPHY: Gently sloping pahoehoe with blisters. Major cultural modifications to flow.
VEGETATION: Christmas-berry, lantana, alahe'e, koa-haole, vines and thick grasses on Feature A.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture-possible habitation
DESCRIPTION: Two terraces (Features A and C), a modified outcrop (Feature B), an L-shaped mound (Feature C), 24 modified outcrops and 21 rock mounds were identified at this site. Overall area of the site is 69.0 m E-W by 59.5 m N-S. No portable remains were observed on the site. A small pocket of soil was observed at Feature B.

FEATURE A: Terrace
FUNCTION: Agriculture/possible habitation
DIMENSIONS: 7.60 m by 5.40 m by 0.30 m maximum height
DESCRIPTION: This rectangular terrace consists of pahoehoe boulders and cobbles, and incorporates portions of a naturally raised pahoehoe outcrop. The north and west sides are defined with straight alignments, and the north side is raised and stacked two to three courses high. The surface of the terrace is not formally paved, and exposed portions of the underlying outcrop are visible. Small rock piles up to 0.50 m high are present on the terrace surface. Additional linear rock piles extend off to the sides but they are generally distinct from the terrace.

FEATURE B: Cupboard
FUNCTION: Agriculture
DIMENSIONS: 1.10 m deep by 0.45 m wide by 0.30 m ceiling height
DESCRIPTION: This modified outcrop is located c. 10.0 m northwest of Feature A. It consists of a large slab placed on an upright square boulder and an outcrop, forming a protected cupboard. The cupboard is inside an excavated pahoehoe blister that has been cleared of loose rock. The area outside the cupboard and inside the pahoehoe excavation is 1.60 m by 0.67.m, and 0.35 m deep. Small rock piles are present around the perimeters of this cleared area. Very dark, cindery soil was noted inside the cupboard.

FEATURE C: L-shaped rock mound
FUNCTION: Agriculture
DIMENSIONS: 7.00 m by 5.80 m by 0.60 m average height
DESCRIPTION: Feature C is located 2.90 m west of Feature A. It is a loosely piled L-shaped mound of pahoehoe slabs and boulders. The mound incorporates a pahoehoe excavation and some sections are built up in circular perimeters around low spots. The N-S section is 5.80 m long and the E-W section is is 7.0 m long. Average width is 2.20 m and the average height is 0.60 m. There are three circular rock piles between Features A and C. Average size of the rock piles is 2.0 m by 1.8 m and 0.6 m high.

FEATURE D: Terrace
FUNCTION: Agriculture
DIMENSIONS: 4.47 m by 4.40 m by 0.85 m maximum height
DESCRIPTION: This terrace is 22.50 m from Feature C at 145 degrees Az. It consists of loosely stacked pahoehoe

blocks and is raised (but not faced) on the south side. The terrace surface is flat, but is not formally paved. Surface fill is generally loose, large cobbles. Pahoehoe excavations were noted around the perimeter.

FEATURE - : Modified outcrops (24)
FUNCTION: Agriculture

FEATURE - : Rock mounds (21)
FUNCTION: Agriculture

SITE NO.: State: 13242 PHRI: T-82 ***(Figure A-16)***
SITE TYPE: Steppingstone trail
TOPOGRAPHY: Undulating aa flow sloping to the southwest; a pahoehoe ridge is at the southwest side of the site.
VEGETATION: Christmas-berry, alahe'e and fountain grass.
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Transportation
DIMENSIONS: 70.00 m by 0.75 m by 0.10 m (approx.)
DESCRIPTION: The trail is oriented 250-70 degrees Az. It consists of a linear pattern of small pahoehoe slabs placed on an aa surface, forming steppingstones. The NE and SE ends of the trail are paved with tightly spaced slabs while parts of the central section of the trail have loosely spaced small and large slabs. The SW end of the trail segment as currently identified is at a pahoehoe ridge. The NE end is at a depression in the aa flow. Two cairns (Site 13245) are located c. 25.00 m to the east and may be associated with the trail.

SITE NO.: State: 13243 PHRI: T-83
SITE TYPE: Complex (4 Features)
TOPOGRAPHY: Partially set on an old Palani Road bed which is leveled with crushed basalt; on pahoehoe with a southwest slope.
VEGETATION: Christmas-berry, alahe'e and low ferns.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Recent historic
FUNCTIONAL INTERPRETATION: Habitation (recent)
DESCRIPTION: The site consists of a C-shape (Feature A), two hearths (Features B and C) and a wall (Feature D). Overall site area is c. 15.0 m N-S by 6.0 m E-W. These features may be of recent construction.

FEATURE A: C-shape
FUNCTION: Habitation (recent)
DIMENSIONS: 3.00 m by 2.25 m by 0.50 m maximum height
DESCRIPTION: The C-shape partially surrounds a fire pit and may have functioned as seating. It consists of thick pahoehoe slabs and is one to two courses high, with an opening to the east.

FEATURE B: Hearth
FUNCTION: Habitation (recent)
DIMENSIONS: 0.60 m by 0.60 m
DESCRIPTION: The C-shape (Feature A) partially surrounds the fire pit. The hearth appears to have had little use; recent rubbish is located in and around the feature.

FEATURE C: Hearth
FUNCTION: Habitation (recent)
DIMENSIONS: 0.90 m by 0.80 m by 0.40 m (approx.)
DESCRIPTION: A second hearth is present 2.50 m east of Feature A. The hearth appears to have had little use.

FEATURE D: Wall
FUNCTION: Habitation (recent)
DIMENSIONS: 2.25 m long by 0.85 m maximum height
DESCRIPTION: Three meters to the north of the C-shape (Feature A) is a stacked wall of large cobbles. It stands between two small alahe'e trees in a N-S direction. This wall lies across a section of the old Palani Road bed, which is oriented E-W.

SITE NO.: State: 13244 PHRI: T-85
SITE TYPE: Kerbstone trail
TOPOGRAPHY: Aa and pahoehoe flows sloping towards the southwest.
VEGETATION: Christmas-berry, alahe'e, fountain grass, low ferns, scrub lantana and koa-haole.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Historic
FUNCTIONAL INTERPRETATION: Transportation
DIMENSIONS: 350.00 m by 3.00 m by 0.75 m maximum height
DESCRIPTION: This is a cleared trail that has been graded to level across low-lying areas. The sides are defined by aligned cobbles and scattered boulders, and are very rough in places with minor construction. The trail is oriented in a generally E-W direction at the south end, then curves to a more N-S direction and continues to the project area boundary near Kealakehe Elementary School.

SITE NO.: State: 13245 PHRI: T-86
SITE TYPE: Complex (3 Features)
TOPOGRAPHY: In a depression between an aa flow to the west and a pahoehoe flow to the east. The aa flow may have been modified by bulldozer.

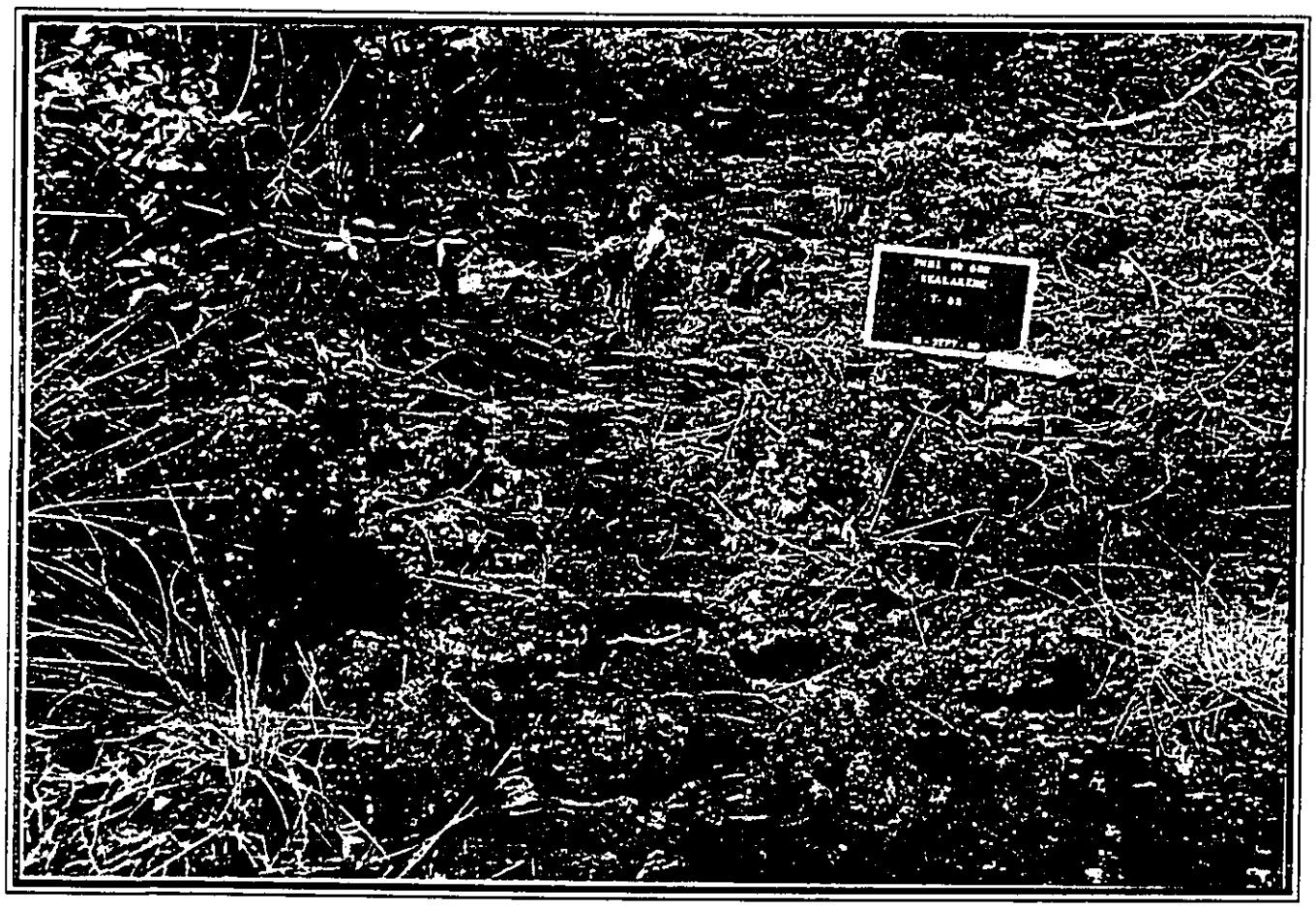

Figure A-16. SITE 13242. VIEW TO WEST-SOUTHWEST
(PHRI Neg. 1301-12)

VEGETATION: Christmas-berry, alahe'e, airplant and guava.
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Marker-agriculture
DESCRIPTION: Two cairns (Feature A) and a rock mound (Feature B) were identified within an area 6.00 by 1.00 m at this site. No portable remains or deposits were observed.

FEATURE A1: Cairn
FUNCTION: Marker
DIMENSIONS: 0.90 m by 0.85 m by 0.85 m maximum height
DESCRIPTION: This cairn is the northernmost of two cairns built in a slight depression that is paved with aa clinkers. The cairn consists of small to medium aa boulders and pebbles, and the top of the cairn is piled with three to four pahoehoe slabs. The cairn is pyramid-shaped and circular at the base.

FEATURE A2: Cairn
FUNCTION: Marker
DIMENSIONS: 1.15 m by 1.00 m by 1.10 m maximum height
DESCRIPTION: The cairn is located 5.00 m southeast of Feature A1. It has an identical construction style as Feature A1 and includes aa boulders and pebbles with stacked pahoehoe slabs on top.

FEATURE B: Rock mound
FUNCTION: Agriculture
DIMENSIONS: 1.90 m by 1.10 m by 0.75 m (approx.)

DESCRIPTION: This oval mound is located 1.00 m from Feature A1. It consists of loosely piled basalt boulders and cobbles, with a surface aa clinkers and cobbles.

SITE NO.: State: 13246 PHRI: T-87
SITE TYPE: Complex (6+ Features)
TOPOGRAPHY: Undulating pahoehoe flow sloping to the southwest; c. 15.0 m west of Palani Road.
VEGETATION: Alahe'e, Christmas-berry, guava, low ferns and noni.
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric/historic
FUNCTIONAL INTERPRETATION: Agriculture-transportation
DESCRIPTION: Features identified and recorded at this site include a historic roadbed (Feature A), three linear mounds (Features B, C and F), two alignments (Feature D), and a pahoehoe excavation (Feature E). Additional pahoehoe excavations were observed but not individually measured at the site. Overall site area is 25.00 m N-S by 15.0 m E-W, and it is c. 25.0 m west of Palani Road.

FEATURE A: Roadbed
FUNCTION: Transportation
DIMENSIONS: 30.00 m by 0.00 m by 0.50 m (approx. height)
DESCRIPTION: This machine-made roadbed is probably a former location of Palani Road. Additional sections were noted in other areas along the existing roadway. The section identified at this site was followed for 30.0 m; it connects with the shoulder area of the existing road.

FEATURE B: Linear rock mound
FUNCTION: Agriculture
DIMENSIONS: 4.20 m by 1.80 m by 1.05 m maximum height
DESCRIPTION: This is the northernmost of two linear mounds lying along the outer edges of a pahoehoe excavation. The south side of the mound is faced, with pahoehoe slabs stacked up to five courses.

FEATURE C: Linear rock mound
FUNCTION: Agriculture
DIMENSIONS: 6.00 m by 2.40 m by 0.90 m maximum height
DESCRIPTION: This mound is located immediately west of Feature A, along the western edge of a pahoehoe excavation. It consists of loosely piled pahoehoe cobbles and slabs.

FEATURE D: Depression with two alignments
FUNCTION: Agriculture
DIMENSIONS: 6.00 m long
DESCRIPTION: There is a linear depression which has two stone alignments running along the north and south top edges and joining at the west end. The north alignment is partial bedrock and the SW alignment is built up on the edge of the Feature A roadbed. The north alignment is 6.0 m long and the south alignment continues with some breaks along the road tract. There is a small rock mound at the south side of the depression connecting with the southwest alignment. It measures c. 3.5 m by 1.75 m and 0.85 m high.

FEATURE E: Pahoehoe excavation with alignment
FUNCTION: Agriculture
DIMENSIONS: 3.50 m by 1.75 m by 0.85 m maximum depth
DESCRIPTION: On the SW side of the site, adjacent to the road tract (Feature A) is another excavated depression with

the quarried material piled in an alignment on the western (downslope) side of the excavation. Some of this material is also piled on the south edge of the excavation.

FEATURE F: Linear rock mound
FUNCTION: Agriculture
DIMENSIONS: 3.10 m by 2.35 m by 0.75 m maximum height
DESCRIPTION: This linear mound is located on the north side of the roadbed (Feature A). This mound is possibly push from the road tract but also may be agricultural in nature.

SITE NO.: State: 13247 PHRI: T-88
SITE TYPE: Complex (4 Features)
TOPOGRAPHY: Irregular aa flow sloping to the west.
VEGETATION: Alahe'e, koa-haole, air plant, kukui, wiliwili, Christmas-berry, guava, shower tree, mamaki and scrub bushes.
CONDITION: Poor
INTEGRITY: Altered by bulldozing
PROBABLE AGE: Indeterminate
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: Two linear mounds (Feature A), a cleared depression (Feature B) and a stepped terrace (Feature C) were identified within an area c. 75.00 m E-W by 50.00 m N-S. The entire site area has been bulldozed and it is difficult to determine the extent of damage or alteration to the surface features.

FEATURE A: Linear rock mound (2)
FUNCTION: Agriculture
DESCRIPTION: There are many linear mounds in the area, most of which were obviously created by bulldozing. Two of the mounds appear to have been stacked by hand prior to disturbance. Current shape and dimensions are, however, affected by bulldozing.

FEATURE B: Cleared depression
FUNCTION: Agriculture
DIMENSIONS: 5.00 m by 5.00 m
DESCRIPTION: There is one aa depression which may be an excavation. Loose rubble surrounds this depression with no obvious facing. This feature has also been affected by bulldozing.

FEATURE C: Stepped terrace
FUNCTION: Agriculture
DESCRIPTION: One possible stepped terrace is located on the east side of the site, but it is surrounded by bulldozer activity and may be the result of just such an activity. The original dimensions are indeterminate.

SITE NO.: State: 13248 PHRI: T-89
SITE TYPE: Wall
TOPOGRAPHY: On relatively steep pahoehoe slope.
VEGETATION: Alahe'e, Christmas-berry, cactus, lauae, guava, air plants, lantana, low ferns and a'ali'i.
CONDITION: Good
INTEGRITY: Fair
PROBABLE AGE: Probable historic
FUNCTIONAL INTERPRETATION: Land division
DIMENSIONS: 134.00 m by 0.80 m by 1.60 m maximum height
DESCRIPTION: This double-faced, core-filled wall is located immediately west of Palani Road, at the junction of Kealakaa Street. It is oriented 340/160 degrees Az., and both ends have been broken by road construction. The wall is constructed with small pahoehoe boulders and aa rocks, and the core fill consists of small cobbles and pebbles.

SITE NO.: State: 13249 PHRI: T-90 ***(Figure A-17)***
SITE TYPE: Complex (7 Features)
TOPOGRAPHY: Along the crest and south facing slope of a pahoehoe ridge, and in the flat at the base of the slope. Scattered aa pockets on ridge crest.
VEGETATION: Thick air plants, immature koa-haole, lantana.
CONDITION: Poor-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: Four terraces (Features A, B1, C, D), a linear mound (Feature B2) and two rock mounds (Feature E, F) were identified within an area 30.00 m E-W by 17.00 m N-S at this site. No portable remains or cultural deposits were observed, but the surface was generally not visible at the time of survey. Soil was observed intermixed with terrace fill and at the base of the ridge slope.

FEATURE A: Terrace
FUNCTION: Agriculture
DIMENSIONS: 11.50 m by 6.00 m by 1.10 m maximum height
DESCRIPTION: The terrace is built along a naturally stepped slope of a pahoehoe ridge. It is generally elliptical, and follows the natural configuration of the outcrops along the slope. The east, south, and west sides of the terrace are raised and faced; height of the faced sides varies with natural contours. Maximum wall height is at the western corner, where a 1.00 m long section is faced with aa cobbles, stacked five courses high. The east end of the terrace is also nicely faced, stacked four courses high (0.94 m). The southern area of the terrace has aa cobbles piled c. 1.10 m back (north) from the edge of the slope.

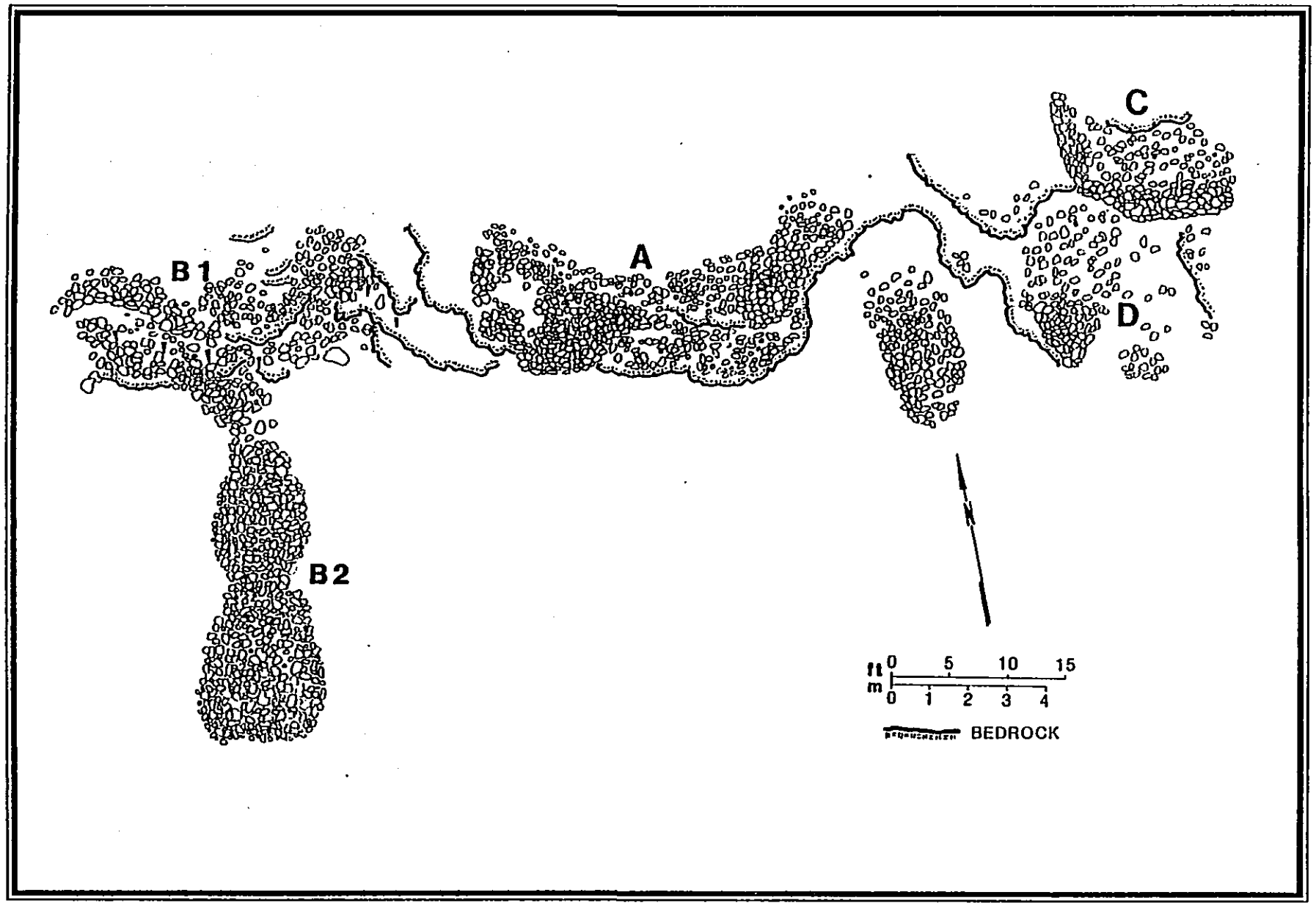

Figure A-17. SITE 13249

Flat, leveled surfaces are present on two levels. The upper level surface is on the edge of the ridge crest, at the western end of the terrace. This flat is c. 2.00 m E-W by 1.50 m N-S and paved with aa pebbles. The lower level is midway along the slope, 0.40 m above the base of the slope. Three relatively small flats are present at this level, the largest of which is 1.50 E-W by 0.80 N-S. These areas are also paved with aa pebbles.

FEATURE B1: Terrace
FUNCTION: Agriculture
DIMENSIONS: 6.20 m by 3.70 m by 0.50 m maximum height
DESCRIPTION: This terrace is located 4.25 m west of Feature A, along the same ridge slope formation. It is semi-circular, and follows the natural configuration of the ridge. The terrace consists of aa cobbles and pebbles, and has filled flat areas at two levels; the south side is raised, but no faced sections are present. Maximum perimeter height is one course. The terrace surface is filled with aa cobbles and pebbles, with portions of the natural outcrop protruding through the fill.

FEATURE B2: Linear rock mound
FUNCTION: Agriculture
DIMENSIONS: 9.50 m by 3.50 m by 0.32 m maximum height
DESCRIPTION: A linear rock mound extends southward from the terrace slope, near the center of the Feature. This mound has a maximum height of 0.32 m, which is at the southern end. Width varies from 1.00 m at the north end to 3.50 m at the south end. The northern end of the mound is incorporated into the lower level of the terrace.

FEATURE C: Terrace
FUNCTION: Agriculture
DIMENSIONS: 4.90 m by 2.50 m by 0.83 m maximum height
DESCRIPTION: Feature C is located 6.00 m east of Feature A, on the edge of the ridge crest. It is semi-circular, and incorporates an outcrop on the upper level of the pahoehoe ridge. It consists of aa cobbles, with the south and west sides crudely stacked three courses high. The raised sides vary from 0.30 to 0.83 m in height. The surface is loosely filled with aa cobbles. The terrace is partially collapsed in several areas.

FEATURE D: Terrace
FUNCTION: Agriculture
DIMENSIONS: 3.00 m by 2.52 m by 0.57 m maximum height
DESCRIPTION: This terrace is situated on a small natural shelf near the base of the ridge slope, 1.70 m south (and downslope) of Feature C. It consists of aa boulders and cobbles stacked two to three courses high along the east, west and south sides.

FEATURE E: Rock mound
FUNCTION: Agriculture
DIMENSIONS: 5.10 m by 3.20 m by 0.80 m maximum height
DESCRIPTION: Feature E is located 8.50 m from Feature C (330 degrees Az.), on a flat area along the ridge crest. The mound consists of loosely piled aa cobbles and pebbles. It is teardrop in plan view and width varies from 3.20 to 2.00 m. A depression is present in the fill at the widest area of the mound. The depression is 0.70 by 0.60 and has a maximum depth of 0.30 m. A slightly lower tier is located off the northwest side of the mound; a short faced section is situated along the side of the mound at this point.

FEATURE F: Rock mound
FUNCTION: Agriculture
DIMENSIONS: 4.00 m by 2.00 m by 0.30 m maximum height
DESCRIPTION: This low rock mound is located at the base of the ridge slope, midway between Features A and D. It consists of loosely piled aa cobbles and pebbles. No formal stacking or facing was observed.

SITE NO.: State: 13250 PHRI: T-91
SITE TYPE: Terraced rock mound
TOPOGRAPHY: Along the south-facing gradual slope of an aa ridge. The mound incorporates a natural face along the aa which is oriented E-W.
VEGETATION: Air plants, koa-haole and immature Christmas-berry.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 14.65 m by 1.30 m by 0.70 m maximum height
DESCRIPTION: This linear mound is oriented N-S along the south-facing slope of a naturally stepped aa ridge. Along the west side of the mound are three partially cleared and leveled terraces that incorporate the natural topography as well as the mound structure.

The mound consists of loosely piled aa boulders, cobbles and pebbles. A short section of the west side below the stepped terraces is somewhat faced. This is also the area of maximum height. The small stepped terraces have less than 1.00 sq m surface area each, and are an average of 0.40 high. The south perimeters of these small flats consist of natural outcrops with some modification.

SITE NO.: State: 13251 PHRI: T-92
SITE TYPE: Enclosure
TOPOGRAPHY: The terrain consists of pahoehoe and aa flows.
VEGETATION: Air plants, lantana, Christmas-berry, kiawe and koa-haole.
CONDITION: Poor
INTEGRITY: Considerable alteration by bulldozing
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture/ ranching
DIMENSIONS: 27.00 m by 28.00 m by 0.90 m maximum height
DESCRIPTION: The enclosure may have been roughly square; it is currently too disturbed to definitely determine original plan view. It consists of pahoehoe cobbles and boulders stacked with no core fill; however, original wall construction cannot be accurately determined. The north, south and west walls have been almost obliterated by bulldozing. The east wall is discernable primarily as a linear rubble pile. The interior area is totally bulldozed.

SITE NO.: State: 13252 PHRI: T-93 ***(Figure A-18)***
SITE TYPE: Complex (17 Features)
TOPOGRAPHY: Western slope of natural aa and pahoehoe outcroppings.
VEGETATION: Dense koa-haole, fountain grass, plants with small red and blue flowers, Christmas-berry, lantana, grass and lilikoi.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture-possible habitation
DESCRIPTION: Seventeen features were identified within a 50.00 by 50.00 m area at this site. This count does not represent the total number of features present or the total site area. Features present within the sampled area include three faced mounds (Features A, B, D), an enclosure (Feature C), three paved areas (Features E1, I, J), two cairns (Features E2, E3), a pahoehoe excavation (Feature E4), two rock mounds (Features E5, K), and two walls (Features E6, E7). No portable remains were observed; however, a medium brown, coarse loam deposit up to 0.10 m thick is present over most of the site surface.

FEATURE A: Faced rock mound
FUNCTION: Agriculture/possible habitation
DIMENSIONS: 5.40 m by 2.20 m by 0.70 m maximum height
DESCRIPTION: This rock mound consists of aa and pahoehoe boulders and clinkers, crudely stacked six to seven courses high along the southeast face. The north and west sides are loosely piled and unfaced. At the southeast corner of the mound there is a 2.5 m by 1.0 m paved area that has a deposit of dark brown loam beneath the aa gravel.

FEATURE B: Faced rock mound
FUNCTION: Agriculture/possible habitation
DIMENSIONS: 4.10 m by 2.80 m by 0.80 m maximum height
DESCRIPTION: Feature B is located 2.50 m from Feature A at 110 degrees Az. It consists of aa cobbles and is roughly faced on the western side; all other sides are sloping down to the ground surface. The faced side consists of larger cobbles stacked up to four courses high. Small soil pockets were observed within the mound.

FEATURE C: Enclosure
FUNCTION: Agriculture/possible habitation
DIMENSIONS: 6.20 m by 6.10 m by 0.45 m maximum height
DESCRIPTION: This feature is 4.60 m from Feature B at 148 degrees Az. It consists of a two-compartment enclosure with a faced rock mound along the northwest side. The feature incorporates a natural pahoehoe outcrop that has been modified by excavation along the south side. The southern compartment of the enclosure is defined by the pahoehoe excavation and by a loosely piled rubble wall, which delineates the north and south compartments. The north compartment may have been constructed by clearing loose pahoehoe and aa from a low area and piling the rubble around the edges of the depression.

The interior area of the south compartment is 2.1 m by 1.0 m by 0.45 m deep. The interior is clear except for scattered gravels, and contains a 0.08-0.11 m thick deposit of medium brown loam. The north compartment has an interior area 2.0 m by 2.70 m by 0.40 m deep. The floor has four or five large cobbles atop a layer of small cobbles and a thin (c. 0.01 cm) deposit of soil. A mound, which may be the result of clearing for this compartment, is present along the west side. The mound consists of small cobbles piled on a natural pahoehoe outcrop. It is 3.90 m by 2.60 m by 0.40 m high.

FEATURE D: Faced rock mound
FUNCTION: Agriculture
DIMENSIONS: 2.60 m by 2.20 m by 1.20 m maximum height
DESCRIPTION: This faced rock mound is located 19.0 m from Feature C at 220 degrees Az. It consists of pahoehoe slabs stacked four to six courses high on the north, faced side. Along the south side of the stacked slabs are loosely

Figure A-18. SITE 13252, FEATURE D. VIEW TO SOUTH (PHRI Neg.1306-30)

piled pahoehoe and aa cobbles. The mound slopes along the south side, with the exception of two possible upright pahoehoe slabs that are incorporated into the mound.

FEATURE E1: Walled pavement
FUNCTION: Agriculture/possible habitation
DIMENSIONS: 20.00 m by 14.60 m by 0.90 m maximum wall height
DESCRIPTION: This cleared paved area is located c. 4.50 m east of Feature C. The area is roughly rectangular, and bounded on two sides by walls (Features E6, E7). The cleared area incorporates natural terracing along the face of a rough pahoehoe outcrop. Pavement consists of aa pebbles and clinkers. Four features are located on the paved surface. These include two cairns (Features E2, E3), a pahoehoe excavation (Feature E4), and a rock mound (Feature E5).

FEATURE E2: Cairn
FUNCTION: Marker
DIMENSIONS: 0.60 m by 0.65 m by 0.50 m maximum height
DESCRIPTION: This cairn in the south portion of the paved area, midway between the two walls. It consists of aa cobbles stacked two to three courses high.

FEATURE E3: Cairn
FUNCTION: Marker
DIMENSIONS: 0.70 m by 0.40 m by 0.45 m maximum height
DESCRIPTION: This cairn is 8.00 m west of Feature E2, on the paved area. It consists of three large aa cobbles stacked two courses high.

FEATURE E4: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 3.00 m by 2.50 m by 0.60 m deep
DESCRIPTION: A semicircular pahoehoe excavation is located at the northwestern end of the Feature E1 paved area. It is partially cleared with some cobbles tossed along the outside on a ledge. Several small cobbles remain inside the excavation.

FEATURE E5: Rock mound
FUNCTION: Agriculture
DIMENSIONS: 4.90 m by 2.50 m by 0.50 m maximum height
DESCRIPTION: The mound is situated in the center of the paved area, between the cairns and the pahoehoe excavation. It consists of loosely piled pahoehoe cobbles. Six pahoehoe boulders are aligned along the northeast side of the mound.

FEATURE E6: Wall
FUNCTION: Agriculture
DIMENSIONS: 9.70 m by 2.70 m by 0.90 m maximum height
DESCRIPTION: This wall is oriented north-south and defines the eastern edge of the paved area. It consists of pahoehoe boulders and cobbles, and is roughly faced on the western side.

FEATURE E7: Wall
FUNCTION: Agriculture
DIMENSIONS: 14.20 m by 1.10 m by 0.45 m maximum height
DESCRIPTION: Feature E7 is oriented east-west and defines the southern edge of the paved area. It consists of large pahoehoe boulders and cobbles, loosely piled one to two courses high. The wall is not faced, and portions of the wall appear to be collapsed.

FEATURE F: Terrace with central depression
FUNCTION: Agriculture
DIMENSIONS: 8.20 m by 6.00 m by 0.70 m (approx.)
DESCRIPTION: This feature is located 2.00 m north of Feature E6. It is oval in plan view and raised on the west side. It consists of pahoehoe and aa cobbles, and paved with aa gravel. A natural depression 2.0 m in diameter is present in the center of the terrace. The depression contains several large pahoehoe cobbles, and a soil deposit. Soil was also observed mixed with the gravel paving fill on top of the terrace.

FEATURE G: Terrace
FUNCTION: Agriculture
DIMENSIONS: 5.30 m by 5.50 m by 0.95 m maximum wall height
DESCRIPTION: Feature G is located just south of Feature F. It consists of pahoehoe and aa cobbles and raised along the southwest side. The terrace incorporates a natural pahoehoe shelf. A stacked perimeter is present along the northwest side of the terrace, following a flow edge. The surface is paved with aa gravel that is intermixed with loamy soil deposits.

FEATURE H: Wall
FUNCTION: Agriculture
DIMENSIONS: 29.00 m by 7.10 m by 1.20 m maximum height
DESCRIPTION: This wall is located c. 7.00 m southwest of Feature E1. It is L-shaped, and is partially faced. The wall is subdivided into three sections, each exhibiting a

different construction technique. The northeastern section is 5.40 m long, 2.00 m wide and 1.20 m high. It is faced on the south side only; the top of this section is flat and triangular. The second section (to the southwest) is 3.10 m long, 1.00 m wide and 0.55 m high. It is also faced on the south side, but is considerably lower and narrower than the adjacent section. Section three is 19.70 m long, 2.00 m wide and an average of 0.50 m high. This section consists of loosely mounded pahoehoe boulders and cobbles.

FEATURE I: Pavement
FUNCTION: Agriculture
DIMENSIONS: 4.30 m by 3.30 m
DESCRIPTION: Feature I is adjacent to the west side of the Feature H wall, in a natural pahoehoe flat. The pavement consists of aa clinkers, intermixed with a loamy soil deposit 0.01 to 0.03 m thick.

FEATURE J: Pavement
FUNCTION: Agriculture
DIMENSIONS: 10.40 m by 6.80 m
DESCRIPTION: This pavement is located on the east side of the Feature H wall, on a natural pahoehoe flat that has been cleared of large pieces of rubble and scattered with aa gravel. The feature is also covered with a deposit of brown, coarse loamy soil 0.01 to 0.05 m thick.

FEATURE K: Rock mound
FUNCTION: Agriculture
DIMENSIONS: 3.00 m by 2.00 m by 0.60 m maximum height
DESCRIPTION: Located 15.00 m from Feature C at 305 degrees Az, this mound consists of loosely piled pahoehoe and aa cobbles, two to four courses high.

SITE NO.: State: 05011 PHRI: T-94
SITE TYPE: Wall
TOPOGRAPHY: Aa and pahoehoe lava flows sloping to the southwest.
VEGETATION: Christmas-berry, koa-haole, lantana, akia, grasses, lauae and scrub brush.
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric/historic
FUNCTIONAL INTERPRETATION: Land division
DIMENSIONS: 2220.00 m by 0.70 m by 1.50 m average height
DESCRIPTION: This wall follows the ahupuaa boundary between Kealakehe and Keahuolu. It consists of aa and pahoehoe, small to medium boulders and small to large cobbles. The wall is bifaced and core-filled. The wall is oriented an average of c. 220/40 degrees Az. and has a few bends in the eastern section. The east and west ends are currently defined by the boundaries of developed areas, and do not represent the original ends of the wall.

SITE NO.: State: 13254 PHRI: T-95 *(Figure A-19)*
SITE TYPE: Complex (74+ Features)
TOPOGRAPHY: The terrain is irregular pahoehoe with a gentle southwest-facing slope.
VEGETATION: Dense Christmas-berry, noni, air plants, succulents, alahe'e, fountain grass and other varieties of grass, shower tree, koa-haole, 'ilima, vines and lantana.
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation-agriculture-transportation-possible burial
DESCRIPTION: Twenty-nine features were recorded and a total of 74 features were enumerated within an area 140.0 m E-W by 100.0 m N-S at this site. Recorded features include 17 terraces, six faced mounds, three walls, a steppingstone trail, a platform and an enclosure. An additional 30 rock mounds and 15 pahoehoe excavations were counted within the sampled area. There are additional features beyond the boundaries of the sample area, which does not represent the entire site area.

FEATURE A: Terrace
FUNCTION: Agriculture
DIMENSIONS: 2.81 m by 2.77 m by 1.27 m maximum height
DESCRIPTION: Feature A incorporates a pahoehoe outcrop, and is raised and faced along the west side. The terrace consists of small pahoehoe boulders to cobbles. It consists of loosely stacked rocks at the base with the top filled with smaller rocks. The south side of the terrace appears to have four steps leading up to the terrace surface. Two steps are natural rock shelves and two are paved cobble surfaces.

FEATURE B: Terrace
FUNCTION: Agriculture
DIMENSIONS: 6.20 m by 2.60 m by 1.46 m maximum height
DESCRIPTION: The terrace is located 17.0 m from Feature A at 54 degrees Az. It is L-shaped, and is located on the side of a steep outcrop face. It consists of small aa boulders to pebbles, and paved with aa cobbles and pebbles. The feature may have been affected by bulldozer activity.

FEATURE C: Terrace
FUNCTION: Agriculture
DIMENSIONS: 33.50 m by 3.50 m by 1.50 m maximum height

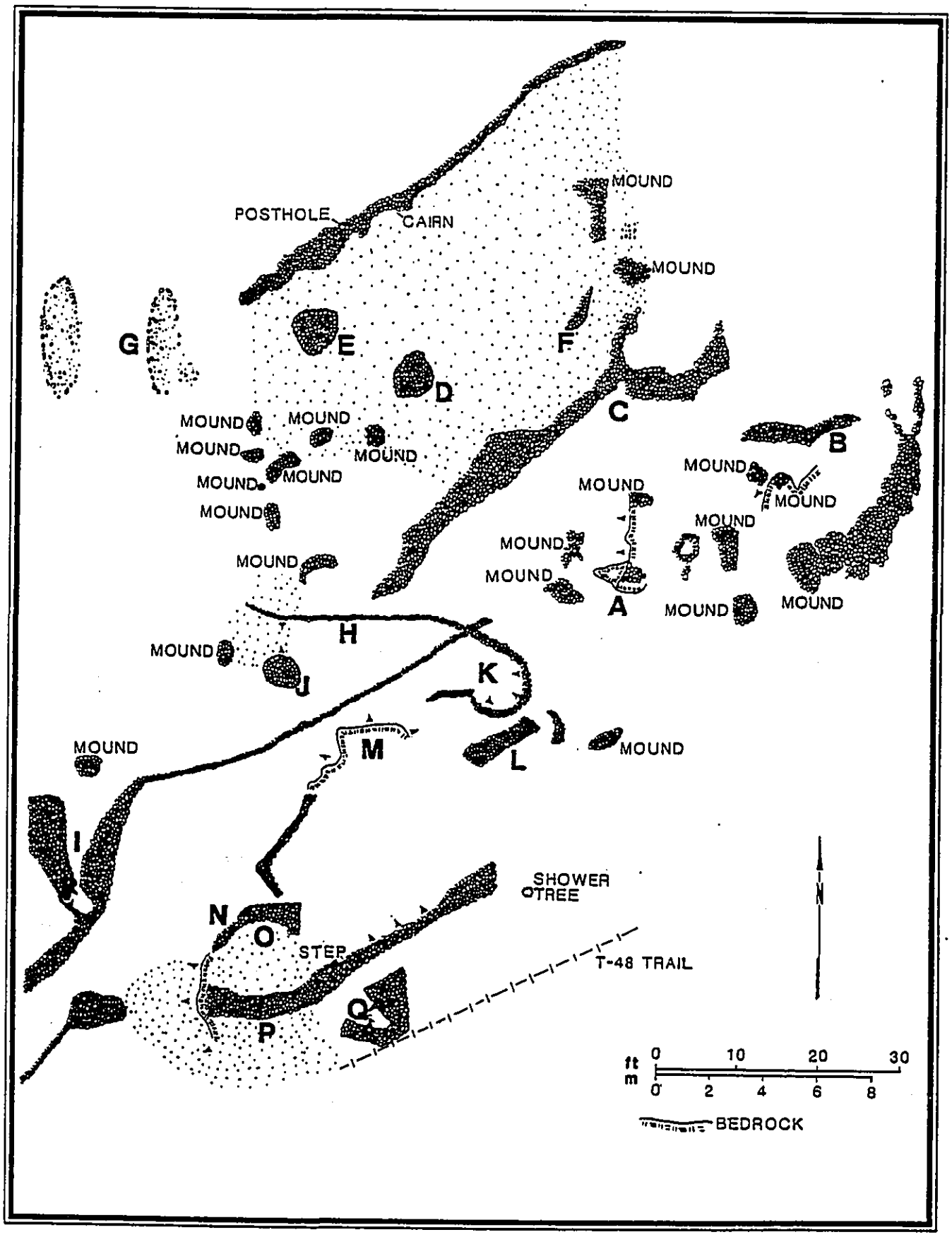

Figure A-19. SITE 13254

DESCRIPTION: Feature C is located 6.5 m west of Feature B. It is a collapsed terrace/retaining wall consisting of small aa boulders to pebbles. It follows the east-facing edge of an aa flow, which is an average of 1.00 m above the surrounding surface to the east.

FEATURE D: Faced mound
FUNCTION: Agriculture/possible burial
DIMENSIONS: 4.68 m by 3.50 m by 0.65 m maximum height
DESCRIPTION: Located 8.0 m from Feature C at 318 degrees Az, Feature D consists of tightly stacked aa boulders, cobbles and pebbles. The northeast and south walls may have been faced, but the remainder of the structure has collapsed.

FEATURE E: Faced mound
FUNCTION: Agriculture
DIMENSIONS: 4.00 m by 3.50 m by 0.85 m maximum height
DESCRIPTION: Feature E is located 8.00 m from Feature D at 286 degrees Az. It is a collapsed mound consisting of small aa boulders to cobbles. The north and east walls are faced with the remaining walls collapsed. The surface is not flat with the center being the highest point. A possible post hole is situated toward the center of the north side.

FEATURE F: Terrace
FUNCTION: Agriculture
DIMENSIONS: 6.00 m by 3.00 m by 0.50 m maximum height
DESCRIPTION: The terrace is located 5.00 m north of Feature C. It consists of small aa boulders to pebbles. The terrace surface is paved and the east side is raised and faced two to three courses high.

FEATURE G1: Terrace
FUNCTION: Agriculture
DIMENSIONS: 10.00 m by 3.10 m by 1.00 m maximum height
DESCRIPTION: Feature G1 is generally oval. It consists of small to large aa boulders stacked three to six courses high. The southeast side of the terrace is partially collapsed. The terrace is oriented in a northerly direction. It is c. 6.0 to 7.0 m away from the widened portion of the Site 13216 wall.

FEATURE G2: Terrace
FUNCTION: Agriculture
DIMENSIONS: 12.00 m by 3.50 m by 0.70 m maximum height
DESCRIPTION: This terrace is located c. 3.5 m west of Feature G1. It is oval and is built with small to medium aa boulders piled c. three courses high. The east side of the terrace is slightly faced. Feature G2 is also oriented in a northerly direction.

FEATURE H: Terrace
FUNCTION: Agriculture
DIMENSIONS: 16.00 m by 3.00 m by 0.40 m maximum height
DEESCRIPTION: Feature H is located 6.00 m from Feature C at 40 degrees Az. It consists of small aa boulders to pebbles. It is raised on the south side and the terrace surface is paved with aa pebbles.

FEATURE I: Wall
FUNCTION: Agriculture
DIMENSIONS: 103.00 m by 1.50 m by 0.60 m average height
DESCRIPTION: The wall connects with the eastern edge of Feature H and is 3.00 m south of Feature J. It is oriented NE-SW and consists of aa rocks. No faced sides or stacked sections were observed.

FEATURE J: Faced mound
FUNCTION: Agriculture
DIMENSIONS: 3.25 m by 3.00 m by 0.92 m maximum height
DESCRIPTION: Feature J is located 3.00 m from Feature H at 172 degrees Az. It consists of small aa boulders to cobbles. There is evidence of facing on all four sides, but it is currently in a deteriorated condition.

FEATURE K: Terrace (3)
FUNCTION: Agriculture
DIMENSIONS: 7.00 m by 4.50 m
DESCRIPTION: These terraces are located at the north end of Feature I, 6.00 m southwest of Feature A. They are interconnected and incorporate naturally terraced features along exposed pahoehoe outcrops. They consist principally of aa cobbles and pebbles. The upper level terrace is oriented east-west and is 7.00 m long. The second terrace is on a slightly lower level; it is C-shaped, 4.50 m wide and 1.00 m long. This terrace connects with a rectangular terrace which is mostly natural, 4.00 m long by 3.5 m wide. Additional modifications may be present along the face of this natural terrace, which continues to the south.

FEATURE L: Terrace
FUNCTION: Agriculture
DIMENSIONS: 7.00 m by 6.00 m by 0.30 m maximum height
DESCRIPTION: This terrace is located 1.00 m south of Feature K. It is rectangular and consists of small aa boulders and cobbles. The northwest side is raised one to two courses high.

FEATURE M: Terrace
FUNCTION: Agriculture
DIMENSIONS: 5.60 m by 2.90 m by 0.20 m maximum height
DESCRIPTION: Feature M is located 3.00 m west of Feature L. It consists of small aa boulders to pebbles. It is raised on the west side, and the north side of the terrace is a bedrock outcrop.

FEATURE N: Terrace wall
FUNCTION: Agriculture
DIMENSIONS: 12.00 m by 1.00 m by 0.95 m maximum height
DESCRIPTION: This terrace wall extends southwest from the southwestern edge of Feature M, and connects with the northern edge of Feature O. It consists of aa boulders and cobbles stacked 3-4 courses high. The north side of the wall is faced. The south side is soil and paving, which is filled level with the top of the wall.

FEATURE O: Terrace
FUNCTION: Habitation
DIMENSIONS: 10.00 m by 4.60 m by 1.10 m maximum height
DESCRIPTION: The terrace consists of small to medium boulders and cobbles. It is faced on both the north and east sides. The central portion of the terrace contains a depression. The terrace abuts bedrock on the west side.

FEATURE P: Wall
FUNCTION: Possible agriculture
DIMENSIONS: 44.00 m by 1.05 m by 1.05 m maximum height
DESCRIPTION: Feature P is located along the southern perimeter of Feature N, and is oriented NE-SW. It consists of aa boulders and cobbles, stacked 2-3 courses high. Portions of the north side of the wall are faced but mostly it is collapsing. The southwest end of Feature P joins with and abuts the Feature N terrace wall.

FEATURE Q: Terrace
FUNCTION: Agriculture
DIMENSIONS: 8.00 m by 1.60 m by 0.85 m maximum height
DESCRIPTION: The terrace is located 1.00 m south of Feature P, near the center of the wall alignment. It is C-shaped, and opens to the northwest. The interior side of the wall is faced with large aa cobbles and varies in height from 0.10 m to 0.85 m. The area inside the wall is paved with level, tightly compacted aa pebbles. The top of the wall is level with the ground surface on the exterior side. Some collapse is shown in the facing but overall the terrace is in good shape.

FEATURE R: Steppingstone trail
FUNCTION: Transportation
DIMENSIONS: 20.00 m by 1.50 m (approx.)
DESCRIPTION: The trail is oriented E-W and located 15.00 m northeast of Feature S. It consists of a linear pattern of pahoehoe slabs placed on the aa flow. There are at least four mounds present in the area around the trail.

FEATURE S: Wall with associated terrace
FUNCTION: Agriculture
DIMENSIONS: 38.00 m by 2.00 m by 0.60 m average height
DESCRIPTION: The wall passes within 15.00 m to the southwest of Feature R. It consists of medium to small aa boulders stacked three to five courses high, and has a core filling of small, compacted cobbles and pebbles. The eastern end of the wall forms a U-shaped curve, in which is located a terrace. The terrace is 11.90 m long and 5.40 m wide at the western (widest) end. The terrace is raised and faced along the western side with 4-5 courses of medium to small boulders. The surface of the terrace slopes downhill toward the southwest.

FEATURE T: Faced mound
FUNCTION: Agriculture/possible burial
DIMENSIONS: 3.00 m by 2.30 m by 1.00 m maximum height
DESCRIPTION: The mound is located at the southern end of Feature S. It consists of aa cobbles and occasionally small to large aa boulders, and may have been built on a small level area of soil. The southeastern side is faced; all other sides are currently sloping, which may be due to collapse. The surface is paved and leveled, and facing is evident on the southeast portion.

FEATURE U: Faced mound
FUNCTION: Agriculture/possible burial
DIMENSIONS: 4.00 m by 4.00 m by 1.50 m maximum height
DESCRIPTION: Feature U is located 10.00 m from Feature T at 160 degrees Az. The mound consists of aa boulders and cobbles and is faced on the southwest side, where boulders are stacked four courses high. The southeast wall is partially collapsed. The surface of the feature is mounded with aa cobbles.

FEATURE V: Platform
FUNCTION: Habitation/ceremonial/agriculture
DIMENSIONS: 4.00 m by 3.90 m by 1.20 m maximum height
DESCRIPTION: This platform is located 2.00 m west of Feature T. The roughly rectangular platform is faced on all

sides. The east and west walls are partially collapsed. It consists of small aa boulders to cobbles, crudely stacked five to six courses high. The platform fill is aa cobbles to pebbles and the surface is roughly level.

FEATURE W: Terrace
FUNCTION: Agriculture
DIMENSIONS: 6.00 m by 2.80 m by 0.80 m average height
DESCRIPTION: The terrace is located 1.00 m south of Feature S. It consists of large aa cobbles and pebbles, and is raised on the east side. This side is faced with large cobbles, crudely stacked four to five courses high. The terrace surface is level and paved with aa pebbles. No soil was observed here.

FEATURE X: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 7.50 m by 7.50 m by 0.40 m average wall height
DESCRIPTION: The circular enclosure is located 5.00 m north of Feature U. It consists of aa cobbles and boulders, stacked three to four courses high. Maximum wall width is 2.30 m. The interior of the enclosure wall was probably faced, but it is presently collapsed. The interior floor may have been paved with aa cobbles and pebbles. The interior area is 2.90 m in diameter.

Along the SW edge of the enclosure is a small C-shaped structure consisting of medium to small aa boulders. There may have been a paved interior floor but there is presently a lot of loose rubble. It measures c. 2.3 m (N-S) by 2.4 m (E-W) by 0.75 m in height. There is also a pahoehoe excavation and a rock mound in the immediate area.

FEATURE Y: Faced mound
FUNCTION: Possible burial/agriculture
DIMENSIONS: 3.70 m by 1.80 m by 0.60 m (approx.)
DESCRIPTION: Feature Y is located 5.00 m from Feature X at 170 degrees Az. It is rectangular, and may be a collapsed platform. It consists of large aa cobbles, small boulders, and slabs of aa, and is faced on four sides. The south and east faces incorporate upright stone slabs. The surface is slightly mounded. The south side lies on exposed bedrock that may extend under the feature.

SITE NO.: State: 13253 PHRI: T-96
SITE TYPE: Complex (11 Features)
TOPOGRAPHY: In a shallow ravine, at the base of a major aa flow to the south; a high pahoehoe slope to the north.
VEGETATION: Christmas-berry, fountain grass and other varieties of grass, koa-haole, and 'ilima
CONDITION: Fair-good
INTEGRITY: Minor alteration to Feature A; Feature K bulldozed
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Burial-transportation
DESCRIPTION: Three platforms (Features A,B,J), seven terraces (Features C-I), and a steppingstone trail (Feature K) were identified at this site, within an area 35.00 m N-S by 43.00 m E-W. The complex was previously identified as a burial site (Site 1) by Soehren (1977) during a survey in the adjacent parcel at Honokohau 2. Soehren located the northern portion of the trail in Honokohau and mapped the location of the complex, but did not record descriptive data on individual features, since the complex was beyond his study area.

Immediately east of the site is an area that has been filled and leveled by bulldozing. The portion of the trail that crossed this area from the north is obliterated. If additional features were present to the west of the existing features, they would also now be destroyed.

The intact features are patterned in a linear arrangement along the base of a high aa flow. The north face of the flow is nearly vertical and raises an average of 2.00 m above the level of the features. The steppingstone trail follows the upper edge of the flow and has branch trails winding down the face of the flow to various features. To the north of the site is a high, relatively steep pahoehoe hill.

FEATURE A: Platform
FUNCTION: Burial
DIMENSIONS: 4.80 m by 4.80 m by 0.73 m maximum height
DESCRIPTION: This platform is the westernmost of the complex as it is currently identified. It is 32.50 m south of the Kealakehe/Honokohau 2 boundary, and 1.00 m north of the vertical face of the aa flow. The platform is five-sided, and length of the sides ranges from 2.60 to 2.95 m. Height of the sides ranges from 0.42 along the south face to 0.73 along the north face. It has a faced perimeter consisting of aa boulders and a few pahoehoe slabs. The platform is filled with small aa boulders and cobbles and paved with aa pebbles and small cobbles.

The surface of the platform is level and compacted, except where disturbed by a pothole. The pothole is 1.70 m from the east side of the platform. It is 0.90 by 0.50 m at the top and is excavated to a maximum depth of 0.45 m. Rocks removed from the hole are scattered over the platform surface. Portable remains observed on the feature consist of a deflated balloon on a string, apparently left quite recently.

FEATURE B: Platform
FUNCTION: Burial
DIMENSIONS: 3.46 m by 2.50 m by 0.50 m maximum height
DESCRIPTION: This small platform is located 5.60 m from Feature A at 115 degrees Az, and 6.00 m north of the vertical face of the aa flow. It is amorphous, determined primarily by natural rock features on which it is located. The perimeter of the platform consists of aa and pahoehoe boulders, stacked up to three courses high. Fill is aa and pahoehoe cobbles, with some pebbles on the surface. The surface is not formally paved or leveled by compaction. A 2.20 m long section of the platform abuts an outcrop shelf.

FEATURE C: Terrace
FUNCTION: Burial
DIMENSIONS: 5.00 m by 3.00 m by 1.00 m maximum height
DESCRIPTION: This D-shaped terrace is located 3.00 m from Feature B at 155 degrees Az, and abuts the vertical face of the aa flow. It looks like it has been constructed on a natural pahoehoe shelf. The north side is curved and raised, with a stacked aa boulder perimeter 0.80 to 1.00 m high. The surface is filled with aa cobbles and boulders. The southern side of the surface has been cleared of loose aa rubble, which is arranged in an alignment along the southern perimeter.

FEATURE D: Terrace
FUNCTION: Burial
DIMENSIONS: 3.50 m by 2.50 m by 0.70 m maximum height
DESCRIPTION: Feature D is a roughly rectangular terrace located 3.60 m from Feature C at 85 degrees Az. It incorporates a natural aa outcrop and is raised and faced on the south and west sides. The faced perimeter consists of aa cobbles, and fill is small cobbles and pebbles. The northern side of the feature is defined by an alignment, which delineates the terrace surface from an area which may have been artificially cleared of large aa rubble. This area is 2.00 m E-W by 0.92 m N-S.

FEATURE E: Terrace
FUNCTION: Burial
DIMENSIONS: 5.00 m by 3.50 m by 0.60 m maximum height
DESCRIPTION: This terrace abuts the vertical face of the aa flow, 14.50 m from Feature D at 90 degrees Az. It is rectangular and raised and faced on the north side. All other sides grade into the surrounding aa surface. The northern perimeter consists of aa cobbles stacked up to three courses high. This side follows the edge of a natural outcrop shelf. The surface is paved with somewhat compacted aa pebbles. Although it was not examined further, in general, the fill appears to be shallow. A small, recently constructed (?) cairn is located on the terrace, near the center. It consists of four small aa cobbles and is 0.32 m high.

FEATURE F: Terrace
FUNCTION: Burial
DIMENSIONS: 3.90 m by 3.90 m by 0.75 m maximum height
DESCRIPTION: Feature F abuts the vertical face of the aa flow, 3.50 m from Feature E at 70 degrees Az. It is circular and is built on the same natural outcrop shelf occupied by Feature E. The perimeter is faced along approximately 80% of the terrace circumference; the remaining 20% grades into surrounding aa surfaces. Height along the raised sides varies from 0.10 m on the west side to 0.75 m on the southeast side, where the perimeter is stacked to five courses. The terrace surface is nicely paved with packed and leveled aa pebbles. Exposed portions of the underlying bedrock surface can be seen through the pavement in places.

To the southeast of the terrace is a small cleared area against the aa scarp. It is 1.65 m N-S by 0.90 m E-W and is paved with aa pebbles.

FEATURE G: Terrace
FUNCTION: Burial
DIMENSIONS: 2.70 m by 2.64 m by 0.80 m maximum height
DESCRIPTION: This terrace is situated near the center of the ravine, 15.00 m north of the vertical face of the aa flow, and 6.20 m from Feature F at 65 degrees Az. It stands on a natural bedrock shelf which is mixed aa and pahoehoe. The north, west and south sides are raised and faced; the east side grades into the natural outcrop. Overall plan of the surface is oblong, but there are no squared corners. The perimeter consists of pahoehoe and aa boulders and cobbles. Fill is primarily aa with a surface paving of slightly packed aa pebbles and small cobbles. Portions of underlying bedrock are exposed through the pavement in places.

FEATURE H: Terrace
FUNCTION: Burial
DIMENSIONS: 1.90 m by 1.14 m by 0.25 m maximum height
DESCRIPTION: This small D-shaped terrace is built on a natural bedrock shelf at the base of the aa flow. It is 11.70 m from Feature G at 135 degrees Az. The ravine is quite narrow here and begins to slope uphill immediately north of the terrace. The northern, curved side of the terrace is raised and faced with aa cobbles stacked up to two courses high.

The fill is aa pebbles and the surface has no formal leveling or packing. Portions of natural bedrock are exposed through the fill. Present on the terrace is a fragment of a double-knit polyester shirt.

FEATURE I: Terrace
FUNCTION: Burial
DIMENSIONS: 5.70 m by 4.50 m by 0.65 m maximum height
DESCRIPTION: Feature I is situated on a natural shelf along the face of the aa flow, 5.5 m from Feature H at 140 degrees Az. It is raised and faced on the northeast, northwest and southeast sides. The perimeter consists of aa boulders and cobbles, and fill is aa pebbles and small cobbles. The terrace surface is nicely leveled and packed, and is recessed slightly lower than the perimeter walls.

Immediately to the south of the terrace, along the aa cliff, is a small overhang which may have been cleared and paved with aa pebbles. The floor area is 1.90 m E-W by 1.10 m N-S. The Feature K trail approaches this feature from the west along the aa scarp, and appears to terminate at this feature.

FEATURE J: Platform
FUNCTION: Burial
DIMENSIONS: 2.54 m by 2.40 m by 0.30 m maximum height
DESCRIPTION: This small oval platform is at the base of the aa flow, 3.70 m from Feature I at 120 degrees Az. It is the easternmost of the identified features. The platform incorporates a natural bedrock shelf. The perimeter consists of large aa cobbles and some pahoehoe pieces. Fill is small aa cobbles with no formal paving. Portions of natural bedrock are exposed through the fill in places. The feature has been affected by large Christmas-berry trees, growing immediately to the south.

FEATURE K: Steppingstone trail
FUNCTION: Transportation
DIMENSIONS: 38.00 m by 0.8 maximum width
DESCRIPTION: The trail consists of a narrow corridor of crushed and packed aa clinkers with variously-spaced, inset pahoehoe slabs. The slabs average 0.30 m in diameter and are spaced from 0.40 to 2.00 m apart along the intact section of the trail. The western end of the trail is currently at the eastern edge of an extensive bulldozed area, 35.00 m from Feature A at 310 degrees Az. At the time of Soehren's survey (1975), the trail continued west to the coastal ponds at Honokohau (Soehren 1977:2).

The intact portion of the trail follows a generally east-west orientation, while following the upper, northern edge of the aa flow. At the west end, orientation is c. 50 degrees Az., then shifts to 80 degrees near the eastern end, at Feature I. Along the course of the trail, there are two branches that cut north, down the face of the flow to Features E, F and G. These branches do not have steppingstones. There is an unmarked survey datum pipe in the center of the trail, above Feature E.

APPENDIX B

HISTORICAL DOCUMENTARY RESEARCH

by Helen Wong Smith, B.A.
Historical Researcher

Most of the project area lies in the ahupua'a of Kealakehe, District of North Kona. Kealakehe means literally "the winding path" (Pukui and Elbert 1986). A small portion of the project area is in the ahupua'a of Keahuolu. Pukui et al. (1974:101) translates Keahuolu literally as "the heap of Lu." Although there is no explanation, we can assume "Lu" is a person's name. Emerson surveyed Keahuolu in the 1880s, and his map (Reg. Map 1280) denotes "rough pahoehoe, little vegetation" in the ahupua'a. Perhaps "the heap of Lu" refers to one of the many rock piles scattered throughout the region.

Few legends refer specifically to Kealakehe. Handy and Handy write of the Kona district in general:

> The most interesting mythological and legendary materials relating to Kona have to do directly or indirectly with Lono....The story of the origin of the Makahiki rain and harvest festival...bring Lono from Kahiki, whither he returns....From Kona we have the written record of a myth of Kumuhonua, whose writer says that Lono was a fisherman and yet ends his story by stating that the events related occurred before men peopled the earth....Disregarding the inconsistencies in orally transmitted lore, the point of interest with respect to Lono is that he is plainly identified with Kona, Hawaii, and is said to have introduced the main food plants, taro, sweet potato, yams, sugar cane and bananas to Hawaii, and also 'awa. Hogs were likewise identified with Lono, but there is no mention of his having brought them to Hawaii (Handy and Handy 1972:522).

Legends concerning Keahuolu are also scant. In his report of a reconnaissance survey of the Old Kona Airport area, which is now a state park in Keahuolu, Neller cites one:

> The area around the old Kona airport may also have some connection with the legendary Hawaiian chief Kuali'i. He was said to have been born at Kalapawai in Kailua, and defied the oppression of Lono-ikaika during the dedication of the heiau at Kawaluna. He is associated with Ku-kaili-moku, the god of victory in battle. Perhaps by coincidence, all of these place names are found in the beach park area (Neller 1980).

Two archaeological surveys conducted in the earlier part of the century describe several prehistoric sites in and around the project area. During a reconnaissance survey of Keahuolu, J.F.G. Stokes described the following religious structure:

> Heiau of Palihiolo, at Waikilohi, at or near the boundary of Keahuolu and Lanihau, North Kona; on the beach in an old coco-palm grove; this is an insignificant pen, 25 by 29 feet in size with small, thin walls built on the upper slopes of the beach. Coral has been spread over the floor as a paving. The only interest attaching to the place is the account given by a very old native living in the grove. He said that Palihiolo was formerly a heiau for human sacrifice, and that it was rebuilt by Kalakaua's orders before the latter left for the United States (about 1890). The old native also said that Kalakaua promised to have a sacrifice at Palihiolo on his return from America, but that he died in that country. The old native was very insistent on the truth of his statements. It might be mentioned that the surrounding grove of palms is where Kalakaua's grandfather was hanged for murder. Other information from the old native is given here for convenience, that this king ordered the rebuilding of the two heiaus of Kawaluna and Palihiolo where human sacrifices were formerly offered, and the ko'as of Halepa'u and Maka'eo....It might be remarked that these four structures have the appearance of having been rebuilt in recent times (Stokes 1919).

In reference to heiau committed to human sacrifice, Kamakau (1976) writes that these 'ohi'a ko "would...cause holding the breath (in fear)."

Reinecke's survey of Hawaiian sites on the Big Island (1930) gives this notation for Keahuolu: "Site 4. A group of masonry platform graves on the sand beach." Neller (1980) notes that this is referred to as "graves of chiefs" in Jackson's 1883 Field Notes, p.32.

Reinecke describes Hale o Lono Heiau in Kealakehe. He writes:

> Site 33. Hale o Lono Heiau, Kealakehe Homesteads. A plain platform originally about 4' high, sloping decidedly makai (north) perhaps 4' in 40'; length east and west 3-1/2-38', north and south 40'. It is built largely of water-rounded boulders of a size convenient for one man to carry. It may have been built in a double terrace, accounting for the slope, but it is hard to tell now. There is a slight terrace on the eastern side, 3 1/2' wide (1930:9-10).

Hale o Lono Heiau is depicted on a USGS map (1959), in addition to Hale o Mano Heiau. Although Reinecke does not locate the following sites, it is assumed that they are nearby, and Site 35 may be Hale o Mano:

> **Site 34.** A small shallow bay with an excellent canoe landing on the sand. At the west side is a platform with a great pile of boulders. There are a number of sites in the sand at the head of the bay, ending at the east in a platform; exact number cannot be told, [but it] is about six (ibid:10).
>
> **Site 35.** A heiau, name unknown, situated between the bay and a group of brackish pools. It is remarkable for the size of the stones used in its facing and for two great stone slabs, -kuula- fixed in the west or makai side. One slab is 7' x 3 1/4' x 12-15", the other 8' x 4 3/4' x 12-15". But one of the larger stones in the wall is no less than 5 x 4 x 1. The heiau is very carefully constructed the stones being joined with care, and only the S.E. corner being broken down.
>
> The length north and south is 53' with a slight slope to the south. It is built against the lava slope at the north. The width at the north is 25 1/2 x 9', there being a drop of 2 1/2' on the east; the width at the south is 35' — the identity being planned at 6', tho it is slightly less on the makai side. On the N.E. it is 4 1/4 x 2 1/2', the terrace being only about 16' long and merging into the main platform.
>
> At the north end is a house site or more probably a grave, marked by lava and coral pebbles, c. 13 x 10.
>
> Stretching back of the heiau in two directions are pools of brackish water, which have been rather carefully walled into compartments. Between the two arms is a house site, or platform resembling one. A well-built pen about 50 x 50 cuts across the southern arm. There is an entrance, and it must have been used as a stock pen close to a water supply (ibid).

Thrum, who reported on heiau on all the islands, has no entry for Hale o Mano, and the only Haleolono he lists is in the ahupua'a of Kahaluu, south of the project ahupua'a.

Bonk recently conducted a walk-through survey of the approximate locale of the present project area. His notes include the following:

> ...Makaopi'o Heiau with its pools and terraces, Hale o Kane Heiau, lines of water-worn stones set on pahoehoe lava, burials and platforms house sites, pens and perhaps shrines.
>
> ...mauka of the highway and running parallel to it is the important Mamalahoa trail or "King's Highway." This is the historic horse trail that can be followed from North Kona to South Kohala. Inland of this trail Soehren (1075) mentions an ancient foot trail with stepping stones terminating at eight graves at the north end of the ahupua'a 500 ft mauka of the present highway.
>
> There are some historic walls, rough roadways, one water tank and some fencing in the area between the 240' elevation and the mauka boundary of the study area (Bonk 1987).

An island-wide description of sites was published by Henry Kinney in the earlier part of this century. He describes the shoreline in the vicinity of Keahuolu and Kealakehe as follows:

> From the trail running north towards Makalawaena a side trail runs makai to the Honokahau village, which consists of about a dozen houses by the beach. Here is a large cement pan, formerly used for the manufacture of salt from the sea water, north of which are some rock drawings. Makai thereof, by a couple of cocoanut stumps, are the scant remains of a heiau, "Hale o Kane." Directly in front of the houses are some excellent specimens of the papa konane, or checker boards used by the ancient Hawaiians. This was quite a complicated game, played with black and white pebbles on a board carved on flat pahoehoe rocks (Kinney 1913:57).

Little has been written describing the landscape in this area. Owing to the inhospitable conditions of much of the terrain, most travel among foreigners between Kawaihae and Kailua was conducted by ship or by canoe, with short stops along the coast as needed (Silva 1987:7). Reverend William Ellis, who toured the island in 1823, wrote of the North Kona District:

> The northern part, including Kairua, Kearake'kua and Honaunau, contains a dense population, and the sides of the mountain are cultivated to a considerable extent; but the south part presents a most inhospitable aspect. Its population is thin, consisting principally of fishermen, who cultivate but little land, and that at the distance of from five to seven miles from the shore (1963:95).

Additional information on the North Kona area comes from modern writers and historians. Handy and Handy comment:

> In North Kona dry taro flourishes only in the uplands, which are now largely given over to ranching, though some Hawaiians still have taro plantations above Kalaoa....
>
> The walls (pa aina), seen today in Kona lowlands running across old boundary lines, were built to keep cattle out of the planting areas after they became a pest early in the 19th century.
>
> Kona, like eastern Maui, with its decomposing lava mixed with humus and with intermittent rainfall which soaks away quickly in the porous soil and rock, is ideal for sweet potato cultivation...
>
> Today sweet potatoes are planted by many Hawaiians living along the coast of Kona, either in the sandy soil near the shore at places like Hookena, Kealia, and Honaunau, or in spots where there is sufficient soil in the midst of the dry lava. Two sizable plantations were visited in 1935 on the dry slopes half to a mile inland in the Kailua section. Sweet potato flourished at the government experiment station at Kainaliu, at an altitude of 1,500 feet in North Kona; and patches were seen at various points both above and below the "Belt Road," in North and South Kona at altitudes of 1,800 feet. On the plantation zone up to altitudes of more than 2,000 feet, no sweet potatoes were seen (Handy and Handy 1972:523-4, 526-8).

At the time of the Mahele, the ahupua'a of Kealakehe was set aside as government land, while preserving the rights of native tenants. It is from the testimony of these tenants that we obtain data on land use during the mid-1800s. As government land, Kealakehe was constantly being appraised and re-appraised when petitions for lease or purchase were received by the Interior Department (Silva 1987). Excerpts from Land Commission Award (LCA) testimonies and descriptions of letters addressed to the Minister of the Interior follow (NT denotes Native Testimony):

> **LCA 8608 to Kaahui, for 3.90 acres; NT 4:540, Jan. 2, 1849** - Mioi sworn He has seen the ili at Kaohia of Kealakehu [sic] ahupuaa, 4 taro kihapais, 3 potato kihapai and 2 house lots. (Boundaries of six sections given) Old time resident since Kamehameha I., land from Kapau now, no one has objected.
>
> **LCA 7897 to Kahuenui, for 4.9 acre; NT 4:546** - Kaahui sworn, (Kahuenui is in error in claiming a whole ili.) Kaahui has seen the land Kahuenui has cultivated in Kukuiomino of Kealakehe ahupuaa, four sections in Kauluulu 1, Kaoki 2, Kealaloa 3, and 2 places in Kukuiominonui. He does not know the boundaries but the surveyor will determine the true boundaries. The land is partially cultivated and there is a house for Kahuenui. This old land had been from Kahuenui's grandparents to his parents and now it is for him, no one has objected to him.
>
> **LCA 10322 to Nuhi, for 4.75 acres; NT 4:543** - Kaahui sworn (the whole ili claim is in error) the true claim is the area on which Nuhi has worked with his hands, Kaahui has seen in the ili land of Makakiloia of Kealakehe ahupuaa, 5 areas of which he has cultivated—1 in Kaluulu, 2 in Kaaki, 3 in Kealoha, 4 in Kumau and 5 in Kaeamaia. The boundaries are doubtful, but the surveyor will establish the correct boundaries. These kihapais and enclosures are partially completed. One house is for Nuhi. The land is from Kaahui in 1844, Nuhi is living there and no one has objected to him.
>
> **LCA 10306 to Nuole, for 5.25 acres; NT 4:542** - Kaahui sworn (error in claiming a whole ili from upland to sea) Nuole's true claim is the area he has cultivated with hiw own hands. Kaahui [has seen] in the ili of Kaniohale of Kealakehe ahupuaa four places he had cultivated of which the boundaries

are in doubt. This has been partially cultivated and it had been for his grandparents since Kamehameha I, now it is for Nuole and no one has objected to him.

LCA 10671 to Pepe, for 4.96 acres; NT 4:544 - Kaahui sworn he has seen the place Pepe had cultivated, in the ili land Ililoa, 2 kihapais, Haleolono ili, 2 kihapais, Kamohale ili, 2 kihapais and in Kukuuimino, 1 kihapai. These have all been cultivated and the surveyor will establish their true boundaries. Keawe had given this land in 1844, no one has objected to Pepe.

Keawe sworn they both have known in the same way for the land of Pepe. House lot section....Two houses for Pepe and enclosed, house lot from Kaahui in 1846, no one has objected to him again.

LCA 10692 to Paai, for 2.80 acres; NT 4:545 - Kauhai, sworn he has seen in the ili land of Puohe, 10 kihapais, in Ililoa, 1 kihapai and in Kaohia, 2 kihapais. Kauhai does not know for certain, the boundaries. The surveyor will establish the true boundaries. These lands have been cultivated. Kaahui had given this interest in 1843, altho he had been a resident there since Kamehameha I, and no one has objected to him.

LCA 10597 to Puou, for 4.12 acres; NT 4:452 - Mioi sworn, He has seen in the ili land of Kukuioninonui in Kealakehe ahupuaa 6 kihapais, 4 kihapais, are in Kukuiominoike ili. The surveyor will determine clearly the boundaries. One house is for Puou and the kihapais have been partially cultivated. Kaahui has given him the land now altho he has lived there since Kamehameha I. No one has ever objected to him.

LCA 10950 to Waiwaiole, for 2 acres; NT 4:545 - Kahuenui 2, sworn (there is an error in the ili land claim), Waiwaiole had cultivated 4 sections in Kaohia ili of Kealakehe ahupuaa and this is the true claim although Kahuenui does not know the boundaries. The surveyor will establish the boundaries of Waiwaiole's kihapais, not all of them have been cultivated.

A house site is in Puohe with no fence, but there is a house for Waiwaiole, where he is now living. They are old-time residents since Kamehameha I, no one has objected.

LCA 9252 to Kauhai, for 5.78 acres; NT 4:545 - Kaahui sworn He has seen in Puohu ili of Kealakehe ahupuaa, 7 kihapais and in Kaohia ili, 2 kihapais....Kauahi's kihapais have been cultivated. There also is a house lot in Kaniohale ili land....

LCA 7483 to Kulua, for 2.6 acres; NT 4:541, Jan. 2, 1849 - 3 cultivated kihapai, one house lot

LCA 10070 to Mioi, for 4.40 acres; NT 4:547, Jan. 2, 1849 - cultivated kihapai but does not say in what.

From the testimonies it was determined by Silva (1987) that:

> ...claimants listed numerous cultivated parcels (kihapai) planted in taro and sweet potatoes. At least 10 houses, some enclosed with fencing, others not....A fair-sized banana patch was situated in the uplands; two claimants mention this patch (Kaeamai'a) as mauka boundaries.
>
> Eight of these natives trace their use and occupancy of the land from their grandparents during the time of Kamehameha I, making them at least third-generation residents and farmers. Only three claimants acquired their lands since—all three receiving parcels in the early 1840's.
>
> Thus, it can be said that Kealakehe supported a fairly stable native population that extended back in time probably to the late 1700's and possibly earlier.

Correspondence to the Minister of the Interior often provides additional background on land use and related transactions:

> **Int Dept. - Aug. 3, 1853**
> In letter from Governor of Hawaii (Kapeau) to the Land Commission giving a list of names of persons who have paid their Land Claims...In Statement of land sales showing that Kaahui had paid $15 as part payment for his land in Kealakehe, containing 153 acres (April 1854)
>
> **Int Dept. - Sept. 5, 1865**
> In letter from S.C. Wiltse to the Minister of Interior giving a list of names & description of Government lands which is attached, stating that the above land contains about 2000 acres in all, mauka of the

government road some 400 acres covered with auki, fern & scattering Ohia. 2nd rate soil for this part of Kona. Makai of Government Road, 200 acres of same had been surveyed & sold to Kahenui &c. Within this 200 acres are 10 kuleanas containing in all 43 acres. Makai of this, approximately 1400 acres, 300 acres of which will do for a goat pasture, balance nothing but rocks.

Int. Dept. - April 25, 1866
In letter by J.H. Kalaiheana showing that Kealakehe ahupuaa belongs to the government, excepting the mauka portion which has been sold.

Int. Dept. - July 22, 1874
In letter from H.N. Greenwell to the Minister of Interior enclosing his yearly rental account of Government lands in Kona, Hawaii to June 30, 1874 which is attached, showing that $51 had been received from Keelikolani for 1 year's lease of a piece of land in Kealakehe.

Int. Dept. - MISC, Aug. 7, 1878
Receipt for $76.35, refund for land purchased by him in 1862, on which no patent had been issued him, Nakaukuaana.

Int. Dept. - Bk.35.p.604, July 2, 1888
Acknowledging receipt of his favor of the 30th of June, inquiring as to who owns the coffee growing on the above Government land. Informing him that said land is under lease to His Majesty the King.

Int. Dept. - Dec. 29, 1894
W.P. Fennell to Minister of the Interior. To purchase Government land in Kealakehe, lying between Keahuolu & Honokohau, containing from 400 to 500 acres at $1.50 an acre, &c. Report to Government Survey Office attached.

Int. Dept. - April 3, 1895
J. H. Waipuilani to Min. of Int. Acknowledging receipt of letter of Mar. 22, 1895, regarding Land Claim 10306 to Nuole & Land Claim 10671 to Pepe in the above place. A dispute has arisen amongst the heirs of Nuole; Mrs. Waipuilani claims she is the heir of Nuole, but the children of Pepe claim they are the heirs too, &c.

While conducting a routine survey of the North Kona lands for the Government in 1882, J.S. Emerson noted the following:

> /Honokohau/-iki is bounded on the South by the ahupuaa of Kealakehe of comparatively small value owned by Gov't. & rented by S. Kaai (Silva 1987).

Homesteading was seen as a way to provide a diversified and therefore less vulnerable agricultural economy in Hawaii. The Homestead Act of 1884 directed the Minister of the Interior to lay out portions of available and suitable government lands in lots of not over twenty acres, and to offer them as homesteads. Persons taking the lots were allowed five years in which to comply with the conditions for obtaining fee simple titles (Kuykendall and Day 1948:204-205). Silva (1987) presents the following parlay between the King and the Minister of the Interior for such lands. In August of 1886, King Kalakaua entered into a lease agreement with the Minister of the Interior for North Kona lands, including Kealakehe. His lease, No. 364, was limited by a special proviso:

> Each and every of the above mentioned lands are let subject to the express condition that at any time during the term of this lease /20 years/, the Minister of the Interior may at his discretion peaceably enter upon, take possession, and dispose of such piece or pieces of land included in the lands hereby devised, as may be required for the purpose of carrying out the terms and intent of the Homestead Laws now in force, or that may hereafter by enacted during the term of this lease.

Consequently, on Jan. 17, 1889 the Minister of the Interior informed Kalakaua:

> ...that as the Government proposes to utilize the lands described in Government Lease #364 for Homestead purposes, the Minister of the Interior desires to take possession of said lands under the terms of the lease and therefore requests that the same may be surrendered to him.

Kalakaua's Chamberlain replied:

> His Majesty the King, is willing, for the purpose of assisting in carrying out the Homestead Act, to accede to the terms of the lease, so far, as to give up only such portions of the lands, as are suitable to be apportioned off, for Homestead purposes.
>
> It has come to the knowledge of His Majesty, that several of the applicants for portions of the above lands, are already in possession of lands elsewhere, and living in comfortable homes. They are not

poor people, nor are they entitled to the privilege of obtaining lands, under the Homestead Act, but are desirous of obtaining more of such property, for the purpose of selling or leasing to the Chinese, which class is beginning to outnumber the native in nearly every district.

This is the most objectionable feature, to the fair working of this Act, and, were the policy, of promiscuously disposing of lands to anybody applying for the same, more especially to those who are already large land owners, without considering the intent of the Homestead Law, carried out, it would be treating unjustly those who are entitled to protection under that Act. A number of applications were refused by the late administration, for that reason.

The policy of allowing native or persons of other nationalities, who are really in need of Homestead lots, to obtain land for that purpose, is a correct and good one.

To ask his Majesty the King, the present lessee of the lands, described in the above lease, to surrender the whole of them, when only a portion of them are suitable for Homestead purposes, is rather an unjust request.

> At the time the lease was made out, it was understood, between His Majesty, and the then Minister of the Interior, that only such portions of the lands required for Homestead purposes, were to be surrendered, should the Government, at any time require them, for the purpose of carrying out the terms and intent of the Homestead Act and a clause to that effect was inserted in the lease.
>
> His Majesty is desirous of retaining the balance of lands, that may be left after the apportionment has been completed; and also desires to lease the remnants of other Government lands in that section of the Island.

Despite Kalakaua's protestations, his lease was cancelled on Aug. 2, 1889 (Int. Dept. 1/22/1889).

George McDougall submitted several applications for the purchase of Kealakehe. His request of March 9, 1893 stated:

> There is a remnant of Government land of Kealakehe, left unsold - Kealakehe lies north of Kailua about 3 miles in North Kona, Hawaii. The unsold part that I refer to above, extends from the homesteads to the seashore and contains an area of 15 or 16 hundred acres, fully one half of that is pure pahoehoe, almost without a crack, and is worthless. The mauka half consists of large beds of black aa, with a few bushes between and is of very little value, but what makes it valuable to me, my land is on both sides of it. I pay rent by the quarter at present to the Government agent.
>
> I beg to offer $300 - as an upset price if the Government will put it up for Sale - more on account of its situation than its real value, as it would take more than all it is worth to fence it in (Int. Dept, 3/9/1893).

The Government Surveyor recommended in response that the land not be sold unless $500 be offered for it. The description stated, "There is much barren lava on this tract and some rocky pasture" (Int. Dept. 3/15/1893).

The ahupua'a of Keahuolu was awarded to Ane Keohokalole (d. 1857), who numbered among her offspring King David Kalakaua, Queen Lydia Liliuokalani, and William Pitt Leleiohoku (who was adopted by Ruth Keelikolani). Her youngest daughter, Miriam Likeleke, was the mother of Kaiulani, who was proclaimed heir apparent in 1891 after her aunt, Liliuokalani, took the throne following the death of Kalakaua. Keohokalole was the great-granddaughter of Kameeiamoku, one of the most important of the chiefs supporting Kamehameha I. Approximately half of the lands that Keohokalole received in the mahele were on the island of Hawaii, and two-thirds of those were lands in Kona District (Kelly 1983:31).

Ane Keohokalole's award in Keahuolu was LCA 8452, Apana 12 (Royal Patent 6851). This parcel was 4,071 acres. Keohokalole commuted some of her holdings in order to keep certain lands, including Keahuolu. Excerpts to the Minister of the Interior provide us with this information:

> To Highness, John Young
> Minister of Interior
> Greetings:
>
> This is to inform you and the Privy Council of my desire to convey some of my lands for the Governments one third in the land which remain as mine. Grant me this, of course, with the approval of the Privy council. Below is a list of the lands I wish to convey to the government. (Native Test. 10:326)

To Your Highness, John Young
Minister of Interior
Greetings:

Here is a list of names of my lands which has been left for me pending for an approval of its distribution.

...Keahuolu ahupuaa, Kona, Hawaii...

With appreciation,
A. Keohokalole (Native Test. 10:327)

The following testimony was given by Awahua, to verify Keohokalole's holdings for this LCA in Kona:

Awahua, sworn, says he knows the house lots claimed by Keohokalole at Kaawaloa, Hawaii. The first one is fenced all round with a stone wall. It is bounded makai by the sea shore, on Kailua side by the Government land, mauka by the land of Nahaku, and Awahua, and on the other side by the road. Claimant derived this lot from her ancestors, who held it from very ancient times. There is a stone house and several grass houses in it belonging to claimant, besides a tomb.

The second lot is called "Awili," and is fenced all round. It is bounded makai by government road, on Kailua side by the same, mauka the same, on the side next the pali by the road.

Claimant derived this lot from her ancestors, who held it from older times.

Witness knows the three house lots in Kealakekua, claimed by Keohokalole. The first lot is called "Kulou" and is fenced in. It is bounded Makai by the sea beach, Kaawaloa side by government land, mauka by the road, south Kona side by a lot belonging to T. Cummings.

The second lot is called "Kaahaloa" it is enclosed all round, and bounded on Kona Hema by a lot belonging to T. Cummings, mauka by the lot of Nakoko, North Kona by an old heiau, makai by the road.

The third lot is called "Wailokoalii" and is bounded on the South Kona side by an old Heiau, mauka by a Government lot and the lot of Ialua, makai by the sea beach, on the other side by a pali.

Claimant inherited these lots from her ancestors by the mother's side, who possessed them from ancient times. Kekaalua, sworn, says he knows these lots perfectly and confirms in full the testimony by Awahua (Foreign Test. 3:573).

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, could continue to cultivate and reside on their parcels. The following testimonies are for awards that were granted within Keahuolu:

LCA 11071 to Aki, for 0.6 acres; NT 4:527 - Kuia sworn He has seen Aki's land that which he had cultivated himself, it is in the ili land of Pauaaiki of Keohoeolu [sic] ahupua'a in Hawaii. Section 1, 5 cultivated kihapais. Section 2, 1 kihapai not cultivated. Section 6, 4 cultivated kihapai. Section 7, 1 cultivated kihapai. These interests have been made from Kaea, Nahaalualu and Kalekahi at the time of Kamehameha I.

LCA 10303 to Maa, for 2.25 acres; NT 4:526 - *Mahu sworn, He has seen a whole section of land,* however, it is just as he has indicated in his claim in that there are 11 taro kihapais, and 10 potato kihapais in the ili land at Maili of Keahuolu ahupuaa. The land is not cultivated completely, but, Maa had planted 7 palm trees. The fruit is for Samuela, both Maa and Samuela have joint interest in the 7 fan palm trees. There is also a coconut grove which had been planted by Maa's grandparents for the Chings who owned the land, they were the caretakers. The same had applied to Maa's parents and to him at the present time. The coconuts went to Keohokalole upon the death of Keoua and it has been that way to the present time.

One whole section is salt land and it is still yielding salt...Land passed down to Maa's parents, these to him now. Maa's grandparents received the ili land Maili of Keahuolu during the time of Kamehameha I. Kamauoha had given to Maa the land sections of Lanihau ahupuaa in 1848, no one had objected to him.

LCA 10345 to Nahaalualu (Naalualu), for 2 acres; NT 4:527 - Kuia swom, He has seen (Naalualu) place that he had cultivated himself in the ili land of Puuokaliu of Keahuolu ahupuaa in Hawaii.

Section 1 (boundaries given) 1 section cultivated. Section 2, 4 cultivated kihapais, Section 3, 1 cultivated kihapai, Section 4, 4 cultivated kihapais....

LCA 10198 to Hailewalewa (Kailewalewa), for 1.30 acres, NT 4:525 - Mahu sworn He has seen the place on which Hailewalewa had cultivated with his own hands, it is in Ulelele ili of keahuolu ahupuaa. Section 1 Taro. Section 2, Kaluulu. Land has been cultivated, 1 land section. On land from Haeilewalewa's parents to him. Uncertainty for 1 section.

LCA 8012 to Apiki, for 1.10 acres; Foreign Testimony [FT] 8:676 - Mahu, sworn, says he knows the kuleaña of Claimant in Kailua, Kona. It consists of 5 patches of Kalo and a lot of patches of potatoes. The kalo patches form 1 piece, bounded on Kau side by Lanihau, Makai by Papaula's land, Kohala side the same, mauka by Hai's land. The potato land is bounded mauka by Haino's land, Kau side by Lanihau, makai by Kahili's land, Kohala side the same. Claimant derived the land from the Konohiki, before the death of Kuakini, and has held it ever since without disputes.

LCA 7351 to Kahuanui, for 2.9 acres; FT 8:682 - Papaula, sworn says I know the claim of Kahuanui. It is in the ahupuaa of Keahuolu, Kona. It consists of one piece of kalo land, 5 patches - all lying together. One of these patches is planted with coffee. It is bounded mauka by the land of Kahookohukaneole, Kau by Lanihau, Makai by the land Nahaalualu, Kohala by the konohiki. Claimant received this land from his brother in 1846, and his title has never been disputed.

In a report by J.H. Kalaiheana, dated April 25, 1866, Keahuolu is documented as belonging to Keohokalole. A letter dated July 8, 1869 from David K. Kalakaua to his sister, Liliuokalani, contains a detailed description of Keahuolu:

> "This land is situated in the District of North Kona, bounded by the ahupuaa of Lanihau (in Kailua) belonging to Prince Lunalilo on the Ka'u side, and on the Kohala side, by Kealakehe, a government land and Honokohaniki belonging to Keelikolani. Keahuolu runs clear up to the mountains and includes a portion of nearly one half of Hualalai mountains. On the mountains the koa, kukui and ohia abounds in vast quantities. The upper land or inland is arable, and suitable for growing coffee, oranges, taro, potatoes, bananas &c. Breadfruit trees grow wild as well as the Koli oil seed. The lower land is adopted for grazing cattle, sheep, goat, &c. The fishery is very extensive and a fine grove of cocoanut trees of about 200 to 300 grows on the beach. The flat land near the sea beach is composed chiefly of lava, but herbs and shrubbery grow on it and [it is] suitable for feed of sheep and goats. It is estimated at 15,000 to 20,000 acres or more.

A letter from Liliuokalani to the Minister of the Interior dated Oct. 6, 1894 gives permission to build a road through Keahuolu, to be fenced on both sides.

On a map drafted by J.S. Emerson in the 1880s (Reg. Map 1280), a narrow band of shading that runs in a north-south direction crosses through Keahuolu. This band is at an approximate distance of 6,250 to 7,250 feet inland of the coast. In Emerson's Field Notebook sketches, this line is identified as the "Commencement of the Forest." The notebook notes that ma uka of the forest line, the land is "lava covered with scattering forest and dense masses of ki [ti] root" (Kelly, 1983:58).

The Honokohau Small Boat Harbor is located in the ahupua'a of Kealakehe. The following history of the harbor is taken from Clark's Beaches of the Big Island:

> Honokohau Small Boat Harbor was authorized by the River and Harbor Act of 1965, but the actual construction of the complex was not completed until March 1970. During the summer of 1978 an expansion project was initiated to enlarge the harbor basins and to provide additional boat ramps, loading docks, and moorings. The excess excavated material was deposited in a large depression in a state-owned lava field 1,000 yards south of the harbor. Contractors completed the expansion project in 1980.

On the southern side of the entrance to Honokohau Harbor, behind a small, protected cove, are several brackish-water ponds and a number of archaeological sites that are known as the 'Alua Bay Complex. The cove shelters a crescent of white sand speckled with fragments of black lava - a secluded spot for sunbathing and for viewing the boat traffic moving in and out of the harbor. With its shallow ocean bottom of sand and rock, the cove is also a good place for swimming. Snorkeling and nearshore scuba diving are excellent along the rocks bordering the beach. A small stand of keawe [kiawe] and ekoa in the backshore

provide a little shade. Places of fresh water intrusion are frequently encountered in the deeper waters offshore in Honokohau Bay. Most local residents know this little cove as 'Alula Beach (Clark 1985:114).

During the present research, a question was posed concerning the possibility that the project area may fall under the classification of ceded land. Ceded lands are those lands that the Provisional Government acquired from the Monarchy of Hawaii, including Crown and Government lands. These lands were ceded to the United States when Hawaii achieved territorial status. Upon statehood, it became Hawaii State lands. The Land Inventory printout, courtesy of the Land Management Department, confirms that the Title Status of the project area is ceded land.

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Report 652-051090

Addendum Report: Archaeological Inventory Survey Kealakehe Planned Community Project Area

Lands of Kealakehe and Keahuolu North Kona District, Island of Hawaii

(TMK:7-04-08:17,Por.12)

by

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Prepared for

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May 1990

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CONTENTS

ILLUSTRATIONS

Figure

TABLES

Table

BACKGROUND

This addendum report, prepared at the request of Belt, Collins & Associates, on behalf of their client, the Housing Finance and Development Corporation - State of Hawaii, presents findings and conclusions regarding archaeological sites within an area added to the original proposed Kealakehe Planned Community project area. The original project area was reported on in Donham (1990a). The area that has been added (see Figure 1) is a portion of a project area that has already been surveyed (inventory-level) (Queen Liliuokalani Trust Property project area [Donham 1990b]). This report, therefore, consists primarily of findings and conclusions taken from Donham 1990b. The background information (scope of work, project area description, documentary and research, previous work, etc.) relevant to the added project area has already been presented in Donham 1990a and is not repeated here. Specifically, this report only thoroughly describes and summarizes sites, includes general significance assessments and recommended treatments for each site, and discusses sites in terms of the conclusions reached in Donham 1990a.

FINDINGS

SURFACE FINDINGS

Within the area that has been added, Donham (1990b) identified 24 sites. The sites are summarized in Table 1 in terms of State Inventory of Historic Places (SIHP) site number, formal type, functional interpretation, PHRI CRM (Cultural Resource Management) value mode assessment, and recommended field work tasks. Detailed descriptions for individual sites are presented in the following Site Descriptions section, which includes for each site:

(a) site number - PHRI temporary site number or SIHP number;

(b) a site type designation - provides formal feature type for sites consisting of a single feature, or designates the site as a complex if site is comprised of more than one feature. Also lists total number of features present;

(c) a description of site topography - a brief description of the terrain in the area of the site;

(d) a listing of site vegetation - lists principal components of the vegetation within and in the vicinity of the site;

(e) a statement of site condition - overall state of preservation of the site (poor, fair, good, or excellent);

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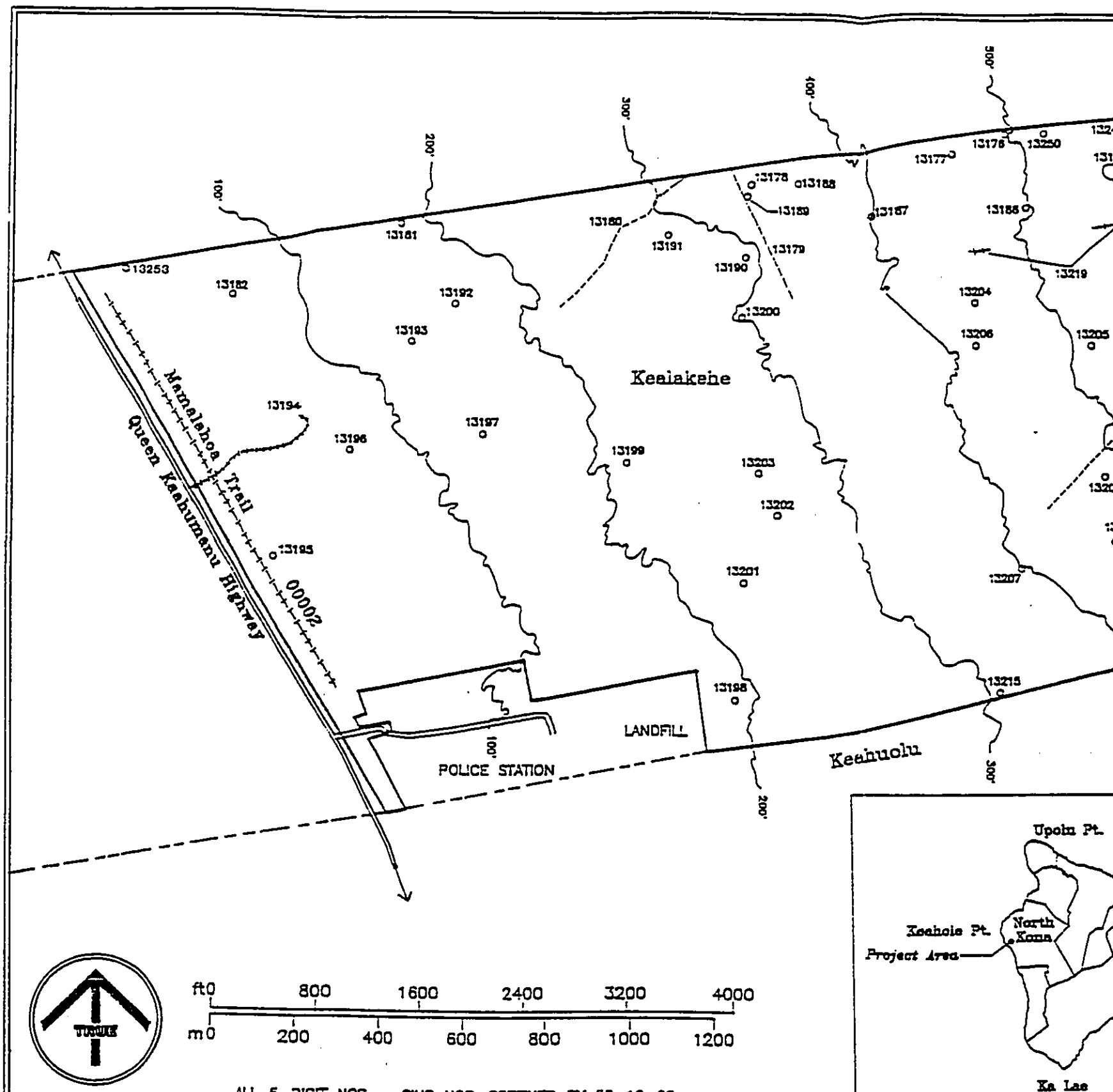
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Manalahoa Trail
Queen Kaahumanu Highway
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POLICE STATION
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200'
300'
400'
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Keahuolu
Upolu Pt.
Kaahole Pt.
North Kona
Project Area
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PHRI PAUL H. ROSENDAHL, PhD., INC
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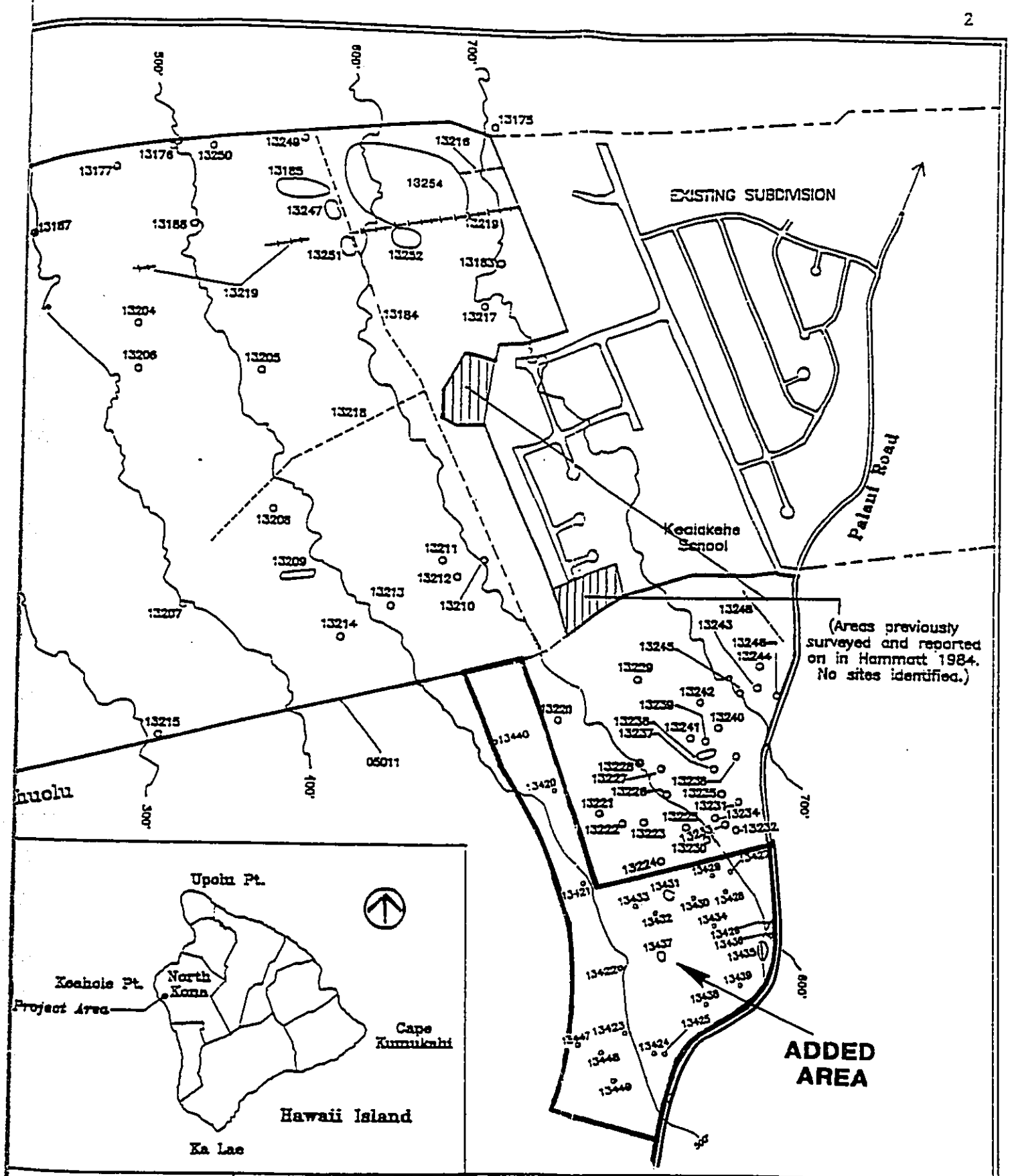
LEGEND
WALL
AHUPUAA BOUNDARY
TRAIL
PROJECT AREA BOUNDARY



Addendum Report: Archaeological Inventory Survey
Kealakehe Planned Community Project Area
PHRI Project No. 89-652

FIGURE 1.
Project Area and
Site Location Map

Table 1.

SUMMARY OF IDENTIFIED SITES AND FEATURES

*SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	#CRM Value Mode Assess. R	I	C	+Field Work Tasks DR	SC	EX
13420	Complex (8)	Agriculture	M	L	L	+	–	–
–	Rock mound							
13421	Complex (18+)	Agriculture-habitation	M	L	L	+	–	–
A-C	Cairn (3)							
D	Cave							
–	Pahoehoe excavation (10+)							
–	Paved area (4)							
13422	Complex (8+)	Agriculture	M	L	L	+	–	–
–	Pahoehoe excavation (7+)							
–	Cairn							
13423	Complex (80)	Agriculture-temporary habitation	H	M	M	+	+	+
–	Mound (59)							
–	Pahoehoe excavation (8)							
–	Modified outcrop (8)							
–	Alignment (2)							
–	Overhang							
–	Modified cave							
–	Modified pahoehoe blister							

*State Inventory of Historic Places (SIHP) numbers. SIHP numbers are five-digit numbers prefixed by 50-10-27 (50=State of Hawaii; 10=Island of Hawaii; 27=USGS 7.5' series quad map ["Keahole Pt., Hawaii"]).

#Cultural Resource Management
Value Mode Assessment--Nature: R = scientific research,
I = interpretive,
C = cultural;
--Degree: H = high, M = moderate, L = low.

+Further Data Collection Field Work Tasks: DR = detailed recording (scaled drawings, photographs, and written descriptions), SC = surface collections, EX = limited excavations.

(#) Number of component features within complex.

Table 1. (Cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13424	Complex (3)	Agriculture	L	L	L	-	-	-
A	Pahoehoe excavation							
B	Modified outcrop							
C	Cairn							
13425	Complex (4)	Agriculture-habitation	M	L	L	+	-	+
A	Modified blister							
B	Modified outcrop							
C	Cave							
D	Mound							
13426	Roadbed	Transportation	L	L	L	-	-	-
13427	Complex (17)	Agriculture	M	L	L	+	-	-
A-C	Mound (3)							
-	Pahoehoe excavation (10)							
-	Mound (4)							
13428	Complex (43)	Agriculture	M	L	L	+	-	-
A-E	Faced mound (5)							
F	Alignment							
G	Platform							
H	Terrace							
-	Pahoehoe excavation (25)							
-	Mound (10)							
13429	Complex (9)	Agriculture	M	L	L	+	-	+
A	Terrace							
B	Terrace							
C	Modified blister							
D-I	Mound (6)							
13430	Complex (15)	Agriculture-habitation	M	L	L	+	-	+
A	Platform							
B	Mound							
C	Mound							
-	Pahoehoe excavation (5)							
-	Mound (6)							
-	Collapsed blister							

Table 1. (Cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13431	Complex (6)	Agriculture-habitation	M/H	M	M	+	+	+
A	Cave							
B	Enclosure							
C	Enclosure							
D	Pahoehoe excavation							
E	Pahoehoe excavation							
F	Terrace and alignment							
13432	Mound	Agriculture	L	L	L	-	-	-
13433	Cairn	Indeterminate marker	L	L	L	-	-	-
13434	Complex (4)	Agriculture	M	L	L	-	-	-
A	Faced mound							
B	Faced mound							
C	Pahoehoe excavation							
D	Faced mound							
13435	Complex (10)	Agriculture	M	M	M	+	-	+
A-F	Enclosure (6)							
G	L-shape wall							
H	Modified outcrop							
I	Modified outcrop							
J	Enclosure							
13436	Wall	Land division	M	M	M	+	-	-
13437	Complex (7)	Agriculture-marker	M	M	M	+	-	+
A	Stepped terrace							
B	Pavement							
C	Faced outcrop							
D	Terrace							
E-G	Cairn (3)							

Table 1. (Cont.)

SIHP Site No.	Formal Site/Feature Type	Tentative Functional Interpretation	CRM Value Mode Assess. R	I	C	Field Work Tasks DR	SC	EX
13438	Complex (10)	Agriculture-transportation	M	M	M	+	-	+
A	Terrace							
B	Mound							
C	Terrace							
D	Terrace							
E	Pahoehoe excavation							
F	Terrace							
G	Trail							
H	Roadbed							
I	Mound							
J	Cairn							
13439	Cairn	Indeterminate marker	L	L	L	-	-	-
13440	Complex (3)	Agriculture	M	L	L	+	-	-
A	Terrace							
B	Filled crevice							
C	Pahoehoe excavation							
13447	Complex (19)	Agriculture-possible habitation	M	L	L	+	-	+
A	Platform							
-	Filled blister (9)							
-	Pahoehoe excavation (6)							
-	Modified blister (3)							
13448	Complex (7)	Agriculture	M	L	L	+	-	+
-	Pahoehoe excavation							
13449	Complex (3)	Habitation-transportation-possible ceremonial	M	L	M	+	-	+
A	Lava tube cave							
B	Cairn							
C	Steppingstone trail							

(f) an assessment of site integrity - degree of historic modification by human agencies (unaltered, partially altered, and completely altered) and nature of modifications, if any;

(g) a probable age - indicates probable/possible (?) age of the site (i.e., historic or prehistoric);

(h) a functional interpretation - probable or possible (?) functions for each site; or, if function cannot be determined, assigns indeterminate function. For sites with multiple functions, functions separated by "/";

(i) feature dimensions - maximum length, width, and height or depth; and

(j) a site description - a brief overall description of the site listing types of constituent features, portable remains present, if any, and other site data.

SITE DESCRIPTIONS

SITE NO.: State: 13420 PHRI: T-203
SITE TYPE: Complex (8 Features)
ELEVATION: c. 515 feet
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: This complex consists of eight rock mounds

SITE NO.: State: 13421 PHRI: T-204
SITE TYPE: Complex (18+ Features)
TOPOGRAPHY: Pahoehoe and aa flows on gentle sloping terrain.
VEGETATION: Christmas-berry, lantana, and fountain grass.
ELEVATION: c. 496 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture-habitation
DESCRIPTION: The overall complex area measures 30.0 m (E-W) by 15.0 m (N-S). It is located 50.0 m at 350 degrees from Site 13422.

The site consists of three rock cairns (Features A through C) one cave shelter (Feature D), ten pahoehoe excavations three of which are filled with pahoehoe cobbles, and four small paved areas. Also, several naturally collapsed blisters are in the area.

FEATURE A: Cairn
FUNCTION: Indeterminate
DIMENSIONS: 0.80 m by 0.73 m by 0.45 m

Two pahoehoe boulders and eight pahoehoe cobbles are stacked, two courses high, on a pahoehoe flow. The largest boulder is on top.

FEATURE B: Cairn
FUNCTION: Indeterminate
DIMENSIONS: 1.05 m by 0.75 m by 0.45 m

This cairn is located c. 12.00 m southeast from Feature A. It consists of three courses high of pahoehoe boulders with one pahoehoe slab on top. It is built atop a pahoehoe excavation.

FEATURE C: Cairn
FUNCTION: Indeterminate
DIMENSIONS: 0.60 m by 0.45 m by 0.43 m

Feature C is built on the edge of a pahoehoe ledge excavation, 11.00 m northwest from Feature B. It is constructed with three pahoehoe blocks measuring c. 30x40x14 cm stacked two courses high.

FEATURE D: Cave
FUNCTION: Agriculture/habitation
DIMENSIONS: 60.00 m by 1.90 m by 1.10 m

Feature D is a lava tube adjacent to Feature A, oriented at 260 degrees Az. The entrance measures 3.2 m wide and 1.1 m high. Portable remains observed include Cellana shell, feral goat bones, and wood.

SITE NO.: State: 13422 **PHRI:** T-205
SITE TYPE: Complex (8+ Features)
ELEVATION: c. 500 feet
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The site consists of at least seven pahoehoe excavations and a cairn. The cairn is collapsed.

SITE NO.: State: 13423 **PHRI:** T-206
SITE TYPE: Complex (80 Features)
TOPOGRAPHY: Gently sloping pahoehoe with areas of natural disturbance.
VEGETATION: Thick Christmas-berry, small koa-haole, and scattered lantana.
ELEVATION: c. 498 feet
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Agriculture-habitation
DESCRIPTION: This site is located c. 67.00 to 70.00 m from Site 13422 at 315 degrees Az. The overall complex area measures 133.25 m at 180 degrees Az. by 78.0 m at 255 degrees Az. It consists of 36 small rock mounds/piles, 23 large rock mounds, eight pahoehoe excavations, eight modified outcrops/depressions, two alignments, one overhang shelter, one modified cave and one modified blister with a few pieces of Cypraeidae shell and small pockets of soil.

The modifications are made with pahoehoe blocks with no formally faced walls. The construction is mostly of loose stacks and loosely piled mounds of rocks.

The features may continue beyond the present identified boundaries. The vegetation makes it very difficult to determine accurately.

SITE NO.: State: 13424 **PHRI:** T-207
SITE TYPE: Complex (3 Features)
TOPOGRAPHY:
VEGETATION: Christmas-berry, air plants, guava, koa-haole and fountain grass.
ELEVATION: c. 511 feet
CONDITION: Poor-fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture/possible ceremonial
DESCRIPTION: The overall complex area measures c. 23.0 m at 350 degrees by 17.3 m at 80 degrees.

FEATURE A: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 10.75 m by 3.52 m by 0.54 m

A blister type of pahoehoe excavation in which the excavated area has been filled in with angular pahoehoe pebbles, cobbles and boulders and with an alignment of possible steppingstone slabs of pahoehoe. Roughly rectangular shape in plan, cobbles and pebbles have been placed on the northern corner, 1-2 courses high, and measures 2.1 m by 0.72 m and 0.2 m high.

The SE corner of the entire excavated area has cobbles strewn haphazardly about. The excavated area at the SE corner, also blister type has been filled in with large boulders, cobbles and pebbles. This excavated blister measures 3.0 m by 2.48 m. A Christmas-berry tree is growing out of this excavation.

A pahoehoe finger divides the blister into two excavations and measures 1.75 m by 0.57 m. Approximately 1.58 m apart, pahoehoe slabs and cobbles have been placed oriented south in a linear direction, but slabs are laying flat on top of the pahoehoe finger. The largest slab is 0.57 m and the smallest is 0.34 m in length.

FEATURE B: Modified outcrop Figure 2
FUNCTION: Agriculture
DIMENSIONS: 9.00 m by 3.90 m by 0.35 m

This feature is a shallow excavated blister that has been filled with pahoehoe blocks and cobbles. The surface of the filled area is relatively level and contains three areas of pebble pavement, outlined with larger cobbles. Two of the pebble areas are adjacent to one another in the western half of the blister. They are roughly circular

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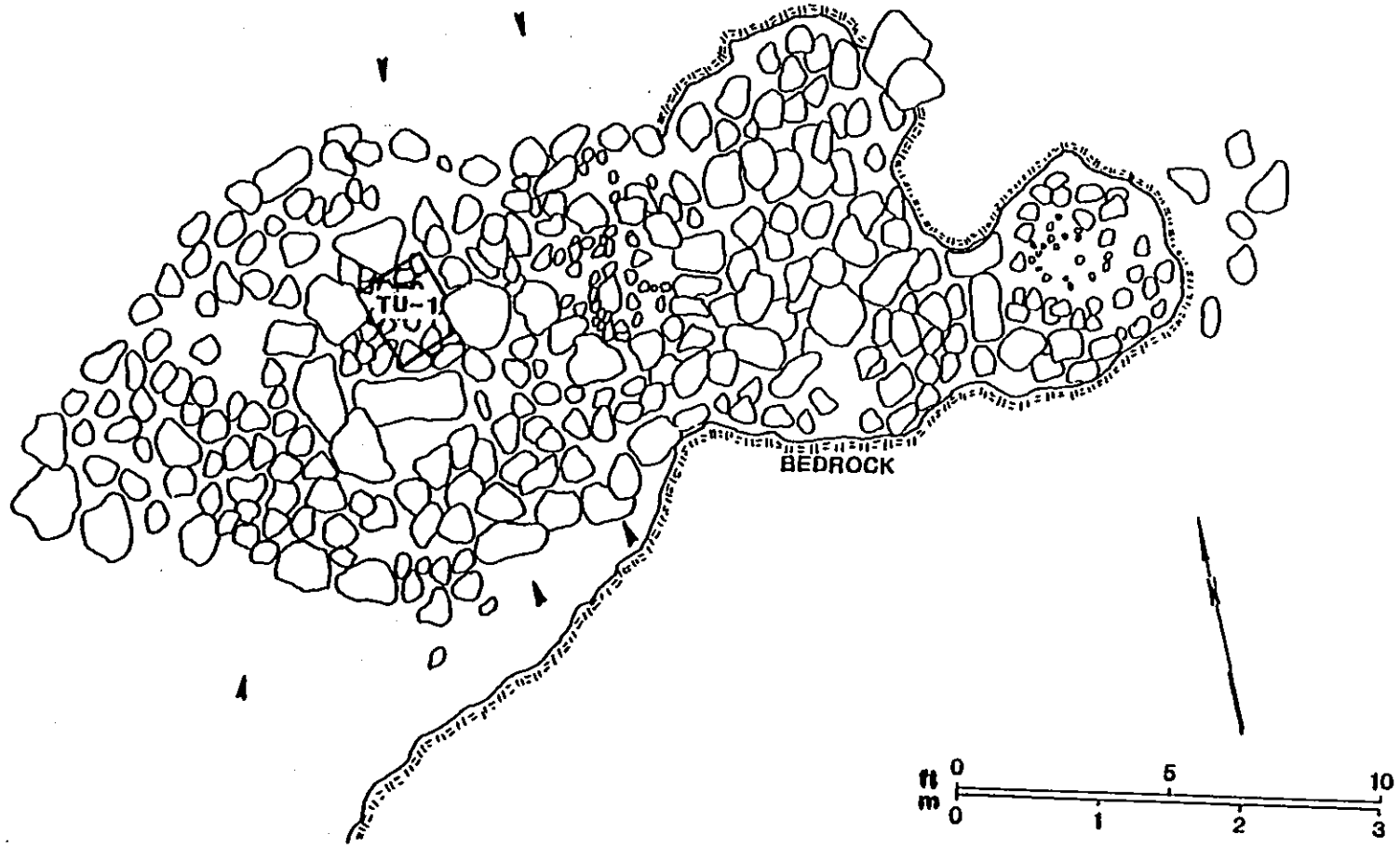

Figure 2. SITE 13424, FEATURE B

in plan, with interior areas 0.75 m in diameter. The third pebble area is at the eastern end of the blister, in a deeper section (0.27 m below surface). The surface area of this pebble plot is 1.50 by 1.40 m.

A 0.50 by 0.50 m sq test unit was excavated into the westernmost pebble-paved plot, in order to determine the nature of the fill, and if subsurface features were present. The pebble fill was found to be 0.26 m thick and overlying a 0.05 m thick deposit of silty loam. No cultural deposits or portable remains were located in the test unit. The soil deposit was sampled for further analysis (see subsurface findings).

FEATURE C: Cairn
FUNCTION: Indeterminate marker
DIMENSIONS: 0.85 m by 0.80 m by 0.47 m

The cairn is located 15.00 m northwest from Feature B. It is generally circular shape in plan, and constructed with pahoehoe cobbles and slabs stacked two courses high. It is built on ropy pahoehoe with large cobbles at the base of the structure and smaller cobbles on top. The cairn is presently collapsed.

SITE NO.: State: 13425 PHRI: T-208
SITE TYPE: Complex (4 Features)
TOPOGRAPHY: Terrain consists of a gentle westward slope, irregular and disturbed pahoehoe flow with a northwestern exposure.
VEGETATION: Christmas-berry, lantana, noni, and sparse grass.
ELEVATION: c. 521 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Agriculture-habitation
DESCRIPTION: The overall complex area measures 38.50 m at 225 degrees Az. by 23.90 m Identified features include two modified outcrops (Features A and B), a cave (Feature C), and a rock mound (Feature D).

FEATURE A: Modified blister
FUNCTION: Agriculture
DIMENSIONS: 9.25 m by 6.90 m by 0.87 m

This feature is a collapsed blister that was modified to form boulder alignments and pavement fill. In the eastern portion of the blister is a pavement of pebble size pahoehoe pieces. Abutting the eastern wall of the outcrop, boulder alignments surround the western edge and divide the pavement into two areas. The pavement measures 3.50 m (E-W) by 2.00 m on the north side of the boulder alignment. On the south side of the alignment the pavement measures 3.20 m E-W by 3.0 m N-S at its widest point. It is a C-shape with a wall of boulders and cobbles on the northwest edge of the terrace and a circular alignment. The rock wall measures 0.62 m from the outcrop to the north. It is 1.00 m at its widest point and 0.61 m at its highest. The circular alignment is 1.20 m wide on the interior.

FEATURE B: Modified outcrop
FUNCTION: Agriculture
DIMENSIONS: 8.50 m by 5.50 m by 1.15 m

Feature B is 6.00 m from Feature A at 310 degrees Az. It is an oval-shaped depression in pahoehoe that has been cleared of loose cobble and boulder size rubble. The cleared area measures 4.80 m by 2.20 m. Cleared stones are placed in various haphazard alignments along the base perimeter of the broken pahoehoe, some are along the rim slope and more are in piles.

The most formal arrangement is a small wall at the southwest corner between a small cave opening and at the base of the depression. It measures 1.50 m long, 0.50 m wide and 0.40 m high. The sides of the depression are sloping uphill.

There are three cave openings along the west side. The cave openings were examined and no portable remains were visible except for Feature C which has its opening along the southwest side of the Feature B blister rim. Most of the cleared blocks are along the eastern side of the slopes.

A soil area at the base of the depression measures 4.60 by 2.10 m. Average thickness is 0.06-0.08 m; it is black to dark brown granular loam.

FEATURE C: Cave
FUNCTION: Habitation
DIMENSIONS: 8.30 m by 3.00 m by 1.20 m

It is situated along the southern rim of Feature B (modified outcrop) 2.00 m from the cleared area. The cave entrance is vertical with the chamber tube extending to the northwest at 220 degrees. The opening measures 1.25 m by 0.70 m with a height of 0.94 m.

The cave is generally unmodified with some evidence of moving large pieces of roof fall towards the edges of the chamber, along a shelf that defines the crawlspace. Four to six large blocks are in loose alignment at the east side of the chamber.

Portable remains consists of kukui nut, a waterworn basalt slab with one side possibly used for grinding, a possible coral abrader, a piece of coral and a large piece of charcoal. Dark brown, granular soil is present in pockets.

FEATURE D: Mound
FUNCTION: Indeterminate/possible agriculture
DIMENSIONS: 3.60 m by 3.20 m by 0.65 m

Feature D is 12.00 m northeast from Feature A. It is constructed with aa and pahoehoe cobbles that range in size from 0.03 by 0.04 m to 0.20 by 0.30 m.

SITE NO.: State: 13426 PHRI: T-209
SITE TYPE: Roadbed
TOPOGRAPHY: Gently to steeply sloping irregular pahoehoe and aa.
VEGETATION: Thick lantana, agave, guava, grasses, koa-haole, and kiawe.
ELEVATION: c. 600 feet
CONDITION: Good
INTEGRITY: Unaltered except by present roadway.
PROBABLE AGE: Historic
FUNCTIONAL INTERPRETATION: Transportation
DIMENSIONS: 220.00 m by 6.20 m by 2.00 m
DESCRIPTION: The roadbed is stacked and faced along both sides, up to three courses high in places. The road surface is on a relatively level grade with retaining walls filling in the low places. The west side is also built up to maintain the grade. Most of the roadbed looks like rock fill covered with gravel size pieces of aa and some soil. The height of the roadbed ranges from 0.7 m to 2.0 m. This section of the road goes through the center of Site 13435, Possible Agriculture Complex. The feature appears to be an abandoned section of Palani Road.

SITE NO.: State: 13427 PHRI: T-210
SITE TYPE: Complex (17 Features)
TOPOGRAPHY: The terrain consists of pahoehoe lava flow with large boulders scatters on the surface, many of which appear to be quarried material.
VEGETATION: Christmas-berry, koa-haole, lantana, and fountain grass.
ELEVATION: c. 590 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area is 50.0 m by 50.0 m. Three rock mounds were individually recorded (Features A-C) and four additional mounds and ten pahoehoe excavations were identified. There are additional agriculture features in the area consisting of rock mounds, pahoehoe excavations and rock alignments. The area is covered with thick vegetation and extensive clearing is required before an accurate count of features can be obtained.

FEATURE A: Mound
FUNCTION: Agriculture
DIMENSIONS: 2.36 m by 1.40 m by 0.88 m

The mound is constructed with large boulders stacked three courses high on top of smooth pahoehoe.

FEATURE B: Mound
FUNCTION: Agriculture
DIMENSIONS: 2.00 m by 1.90 m by 0.95 m

This mound is c. 30.00 m northwest from Feature A. It is constructed with large boulders (some upright) around the base and is filled with small cobbles, piled four courses high.

FEATURE C: Mound
FUNCTION: Agriculture
DIMENSIONS: 2.30 m by 1.40 m by 1.30 m

Semicircular shape in plan, it is constructed with stacked boulders and cobbles. Large boulders are used along the perimeter and faced with cobbles on the interior. This mound is adjacent to Feature B.

SITE NO.: State: 13428 **PHRI:** T-211
SITE TYPE: Complex (43 Features)
TOPOGRAPHY: The terrain consists of irregular pahoehoe.
VEGETATION: Christmas-berry, lantana, and grass.
ELEVATION: c. 575 feet
CONDITION: Poor-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 48.0 m at 250 degrees Az. by 20.0 m. Eight features were individually recorded at the site, including five faced mounds (Features A-E), an alignment (Feature F), a platform (Feature G), and a terrace (Feature H). In addition, 25 pahoehoe excavations and 10 rock mounds were enumerated.

FEATURE A: Faced mound
FUNCTION: Agriculture
DIMENSIONS: 1.55 m by 1.50 m by 1.20 m

Generally circular shaped in plan, it is constructed with stacked and faced boulders with smaller cobbles as fill. A cleared pahoehoe excavation is present 0.70 m at 60 degrees from Feature A. The excavation may have been a quarry source for building material.

FEATURE B: Faced mound
FUNCTION: Agriculture
DIMENSIONS: 1.80 m by 1.60 m by 0.95 m

Feature B is c. 4.4 m at 190 degrees to Feature E and 6.9 m at 280 degrees to Feature B. Generally circular shape in plan, it is constructed with stacked boulders along the perimeter and filled with pahoehoe cobbles. Feature B is bounded on all sides by pahoehoe excavations.

FEATURE C: Faced mound
FUNCTION: Agriculture
DIMENSIONS: 1.85 m by 1.80 m by 1.27 m

Circular shape in plan, it is constructed with stacked pahoehoe boulders along the perimeter and cobble filled. Several boulders have fallen, but for the most part this mound appears to be in good condition. A pahoehoe excavation is adjacent to the east side of the mound.

The center fill of the mound was removed in order to determine if subsurface features were present. The fill was found to consist of undifferentiated cobbles and pebbles, with a slightly higher proportion of pebbles toward the base of the mound. A 0.10 m thick deposit of silty clay loam was encountered beneath the core fill. The soil was directly on unbroken bedrock and contained no portable remains or indications of a cultural deposit. A sample of the soil was collected for further analysis (see subsurface findings).

FEATURE D: Faced mound
FUNCTION: Agriculture
DIMENSIONS: 1.25 m by 1.20 m by 0.45 m

Circular shape in plan, it is constructed with large boulders along the perimeter and filled with cobbles and pebbles. The mound is 7.40 m northwest from Feature B.

FEATURE E: Faced mound
FUNCTION: Agriculture
DIMENSIONS: 1.80 m by 1.80 m by 0.95 m

Generally circular shape in plan, the perimeter is built up with boulders and the interior is filled with cobbles. Feature E has collapsed along the eastern side with other fallen boulders surrounding the mound. It is located 4.2 m east from Feature A.

It is constructed on the very edge of a pahoehoe excavation located on the northern side of the mound. This excavation may have been a quarry source for building material.

The center core filling of the mound was removed in order to determine if subsurface features or deposits were present. The fill was found to be an undifferentiated mixture of pebbles and small cobbles, with slightly more small pebbles toward the base of fill. The bedrock surface under the mound was broken and a soil deposit up to 0.30 m thick was present in the surface hole. No cultural materials or portable remains were located in the soil, however, a single kukui nut was located at the base of the pebble fill, 0.57 m below the present top of the mound. A sample of the soil was collected for further analysis (see subsurface findings).

FEATURE F: Alignment
FUNCTION: Indeterminate
DIMENSIONS: 16.00 m by 1.00 m by 0.50 m

Feature F is a boulder alignment that connects and incorporates adjacent mounds. The alignment begins at the eastern end with a rock mound that measures 3.00 m by 3.00 m. It continues 5.10 m to a second mound that measures 1.90 m in diameter. The alignment continues 6.00 m to the Feature G platform. It continues along the western edge of the platform for 10.00 m to the Feature H terrace. Feature F varies from a single boulder alignment to stacked boulders, two high and three wide, with smaller cobbles used as fill.

FEATURE G: Platform
FUNCTION: Agriculture
DIMENSIONS: 3.50 m by 3.25 m by 0.85 m

Figure 3

The platform is roughly rectangular in plan, with convex sides. It is constructed with a stacked pahoehoe boulder perimeter and with pahoehoe boulder and cobble fill. The platform surface was apparently leveled at one time and covered with a pavement of small cobbles and pebbles. Presently, the northern portion is covered with a deposit of large pahoehoe cobbles and slabs, piled to 0.40 m above the exposed portion of the original pavement.

Adjacent to the east side of the platform is a D-shaped terrace, constructed from large cobbles and boulders. The terrace is 2.50 m N-S by 1.50 m E-W and is connected to the Feature F alignment. Large cobbles and boulders are scattered to the east and north of this feature. The terrace surface is very irregular and it resembles a truncated mound.

A 1.00 by 1.00 m square test unit was excavated into the center of the platform in order to determine if subsurface features, such as a human interment, were present. The test unit confirmed that the original paved surface had covered the platform, and that the larger cobbles and slabs had been added later, possibly reflecting a different use phase of the feature. The small pavement fill consisted of only 1-2 layers of pebbles overlying larger cobble and boulder fill. The cobble/boulder fill varied in thickness from 0.30 to 0.70 m, depending on the underlying bedrock, which was a sloping blister formation. At the base of the large fill layer was a layer of small pebbles and fragments of rock, some of which apparently filtered down through the larger matrix. A layer of silty loam occurred directly on the bedrock surface; it varied in thickness for less than 0.01 m to 0.06 m. A single kukui nut (complete but fragmented) was located in the soil zone. No other portable remains were observed. A soil sample was collected for further analysis (see subsurface findings).

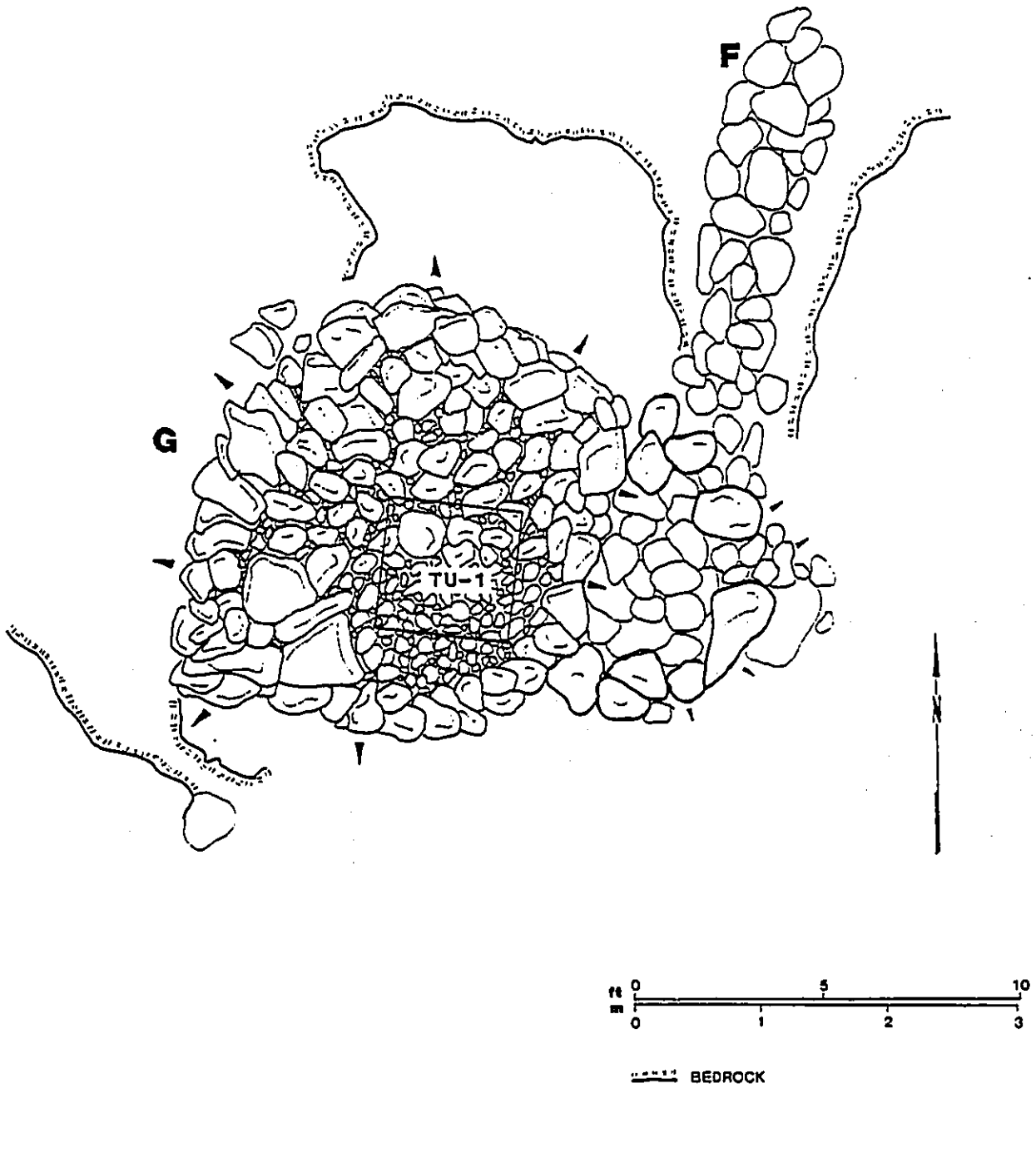

Figure 3. SITE 13428, FEATURE G

FEATURE H: Terrace
FUNCTION: Agriculture
DIMENSIONS: 7.00 m by 5.10 m by 0.80 m

The terrace is located 13.60 m southwest from Feature G. It is constructed with a stacked boulder perimeter and loose boulder and cobble fill. A cleared pahoehoe excavation is located 2.20 m west of the northeast corner of the terrace.

SITE NO.: State: 13429 PHRI: T-212
SITE TYPE: Complex (9 Features)
TOPOGRAPHY: Natural smooth pahoehoe flow with many rock mounds and pahoehoe blister excavations.
VEGETATION: Lantana, Christmas-berry, impatiens, koa-haole, and wild 'ilima.
ELEVATION: c. 575 feet
CONDITION: Fair-good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 35.00 m at 45 degrees Az. by 16.00 m. The site consists of two terraces (Features A and B), a modified blister (Feature C) and six mounds (Features D-I). All individual features are oriented in a NE-SW pattern.

FEATURE A: Terrace
FUNCTION: Agriculture
DIMENSIONS: 3.37 m by 2.61 m by 0.70 m

Feature A is a low paved terrace that is rectangular shape in plan. It is built on a bedrock outcrop and faced on the east side. The paved area is 1.88 m by 1.2 m with a semicircular retainer built around the paved area. The retaining wall is stacked three courses high. Large boulder and cobble fill make up the terrace interior.

Excavated blocks have been strewn haphazardly on the southeast side. Another terrace (Feature B) is located to the southeast.

FEATURE B: Terrace
FUNCTION: Agriculture
DIMENSIONS: 2.55 m by 1.40 m by 0.48 m

The terrace is semicircular shape in plan. Cobbles outline the semicircle with larger cobbles and boulders on top. It is faced and stacked three courses high with boulders and cobbles. The interior is paved with pahoehoe slabs and cobble fill; it measures 1.81 by 1.0 m.

FEATURE C: Modified blister
FUNCTION: Agriculture
DIMENSIONS: 5.57 m by 2.90 m by 0.57 m

The northeast corner of a pahoehoe blister area is paved and filled with small cobbles. This paved area measures 1.79 m by 0.95 m.

An alignment built with large boulder size slabs is 1.50 m to the southwest. It is oriented NE-SW and measures 2.84 m by 0.61. In the center of the alignment along the exterior is an upright that measures 0.55 m by 0.43 m. The other slabs vary slightly in dimensions. Ten pahoehoe slabs make up this linear alignment.

In the center of the blister and the alignment is an excavated area with cobbles haphazardly placed. It contains soil with lantana bushes and measures 1.93 by 1.72 m.

FEATURE D: Mound
FUNCTION: Agriculture
DIMENSIONS: 2.20 m by 2.00 m by 0.70 m

Feature D is 5.0 m at 215 degrees Az. from Feature A. It consists of a rock mound constructed along an excavated blister. The mound is built with stacked cobbles two to three courses high. The cobbles appear to derive from the pahoehoe excavation.

FEATURE E: Mound
FUNCTION: Agriculture
DIMENSIONS: 3.00 m by 2.60 m by 0.80 m

Feature E is 3.0 m at 215 degrees Az. from Feature D. It is a rock mound consisting of irregular stacked cobbles. Boulders are at the base of Feature E with smaller cobbles stacked on top.

FEATURE F: Mound
FUNCTION: Agriculture
DIMENSIONS: 1.60 m by 1.40 m by 0.65 m

Feature F is situated 2.00 m at 215 degrees Az. from Feature E. It is faced with large upright boulders with cobble fill, three to four courses high.

FEATURE G: Mound
FUNCTION: Agriculture
DIMENSIONS: 2.30 m by 2.00 m by 1.00 m

Feature G is 6.0 m at 40 degrees Az. from Feature H. It is semicircular shape in plan and is constructed with large boulders, some upright, surrounding the base. Cobbles are used as interior fill.

FEATURE H: Mound
FUNCTION: Agriculture
DIMENSIONS: 2.30 m by 1.60 m by 0.45 m

Semicircular shape in plan, it is constructed with stacked boulders and cobbles one to two courses high.

FEATURE I: Mound
FUNCTION: Agriculture
DIMENSIONS: 2.24 m by 1.40 m by 0.80 m

Circular in shape at the base, it narrows at the top. Large boulders are at the base with cobbles piled and stacked on top, two courses high. Feature I is built on top of a natural pahoehoe flow.

SITE NO.: State: 13430 PHRI: T-213
SITE TYPE: Complex (15 Features)
TOPOGRAPHY: The terrain consists of a smooth pahoehoe flow.
VEGETATION: Christmas-berry, lantana, wild 'ilima, and koa-haole.
ELEVATION: c. 549-550 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture-habitation
DESCRIPTION: The overall complex area measures 24.5 m at 245 degrees Az. by 6.50 m. Three structures were given feature designations. They consist of a platform (Feature A) and two mounds (Features B and C). In addition to the measured features, six mounds, a collapsed blister and five pahoehoe excavations were enumerated. The features are patterned in a linear formation, oriented NE-SW.

FEATURE A: Platform
FUNCTION: Possible habitation/agriculture
DIMENSIONS: 4.90 m by 4.30 m by 0.60 m

Rectangular shape in plan, it is outlined with large boulders and filled with cobbles and pebbles. A soil deposit is visible in the center of the platform. On the southwest edge are pahoehoe slabs extending the length of the feature.

FEATURE B: Mound
FUNCTION: Indeterminate/agriculture
DIMENSIONS: 1.60 m by 1.35 m by 0.70 m

Feature B consists of slab boulders and large cobbles, stacked three to four courses high in an irregular fashion. To the south of the mound (1.50 m) is a small rock pile that measures 1.30 by 1.10 m. Another rock pile or possible alignment is 3.00 m to the southwest; it measures 2.10 m (N-S) by 1.0 m (E-W). A collapsed blister with some piled rock is 6.00 m southwest. Surrounding this collapsed blister are several pahoehoe excavations.

FEATURE C: Mound
FUNCTION: Possible agriculture
DIMENSIONS: 2.00 m by 1.90 m by 0.95 m

The mound is roughly faced on the southeast side. It is constructed with boulders and cobbles stacked five courses high. Large boulders (some upright) surround the base; cobbles are used as interior fill.

Within a 10.0 m range are additional features consisting of five pahoehoe excavations and four rock mounds.

SITE NO.: State: 13431 **PHRI:** T-214
SITE TYPE: Complex (6 Features)
TOPOGRAPHY: The terrain consists of a pahoehoe flow that has been extensively altered by agricultural activities
VEGETATION: Christmas-berry, koa-haole, lantana, and kiawe.
ELEVATION: c. 540 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture-habitation
DESCRIPTION: The overall complex area measures 20.0 m at 65 degrees Az. by 24.40 m. This site consists of a blister type cave with modifications (Feature A), two enclosures (Features B and C), a pahoehoe excavation (Feature E) and a terrace (Feature F). Portable remains consisting of Cypraeidae, Isognomonidae, kukui nut shell fragments, coral and charcoal were observed in Feature A. In addition there are c. 5-7 pahoehoe excavations within a 10.0 m range around the complex.

FEATURE A: Cave
FUNCTION: Habitation
DIMENSIONS: 4.40 m by 3.30 m by 1.08 m

The overall feature measures 8.00 by 3.30 m. The interior dimensions are 4.4 m (N-S) by 3.3 m (E-W) with an average ceiling height of 0.95 m.

Preceding the entry of the cave is a paved area that measures 3.60 m by 3.00 m. The entry is partially closed with stacked pahoehoe boulders. It is 0.90 m wide, 1.00 m high and faces 250 degrees Az. Immediately to the right of the entry is a small shelf constructed of pahoehoe boulders and paved with small cobbles.

The rear of the cave has been modified with large pahoehoe boulders and small cobbles. To the right rear of the cave is a small enclosure measuring 1.13 m by 0.70 m. It is constructed with large boulders and small cobbles with the floor covered with large cobbles. At the left rear of the cave is a collapsed enclosure of pahoehoe cobbles. The floor of this enclosure is covered with a sandy gravelly loam with kukui nuts. This area measures 1.20 m by 0.85 m.

Portable remains observed in the cave include Cypraeidae and Isognomonidae shells, coral and a partially burned piece of wood, in addition to the kukui nut shell.

FEATURE B: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 11.00 m by 5.40 m by 0.60 m

The enclosure is adjacent to Features A and C. It is oval to rectangular shape in plan. The wall of the enclosure is built with stacked pahoehoe boulders for an average width of 0.20 m. The interior of the enclosure is covered with a gravelly loam and scattered cobbles. The southern end of the enclosure wall rests on top of Feature A entrance. The western wall is shared with the Feature C enclosure. This shared wall is presently higher and in better condition compared with the remaining walls.

FEATURE C: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 12.50 m by 10.00 m by 0.80 m

Oval shape in plan, it is constructed with large pahoehoe boulders and slabs with cobble fill. It is two to three courses high and the wall is approximately 0.40 m wide. The floor interior contains a 0.03 to 0.04 m thick deposit of sandy, gravelly loam with scattered pahoehoe boulders and cobbles.

The northwest section of this enclosure seems to be leveled with smaller cobbles and gravel. Within this area are 5 to 6 filled depressions/possible pahoehoe excavations ranging in size from 0.70 m to 1.50 m across.

FEATURE D: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 3.30 m by 2.85 m by 0.55 m

A cleared blister type pahoehoe excavation. It is bordered on the north by the Feature C enclosure wall. The quarried boulders have been removed from the excavation, with several remaining around the perimeter. Small cobbles remain in the bottom of the excavation.

Directly west at 0.60 m is another blister type pahoehoe excavation. It is 1.40 m wide and 0.50 m deep.

FEATURE E: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 4.80 m by 4.00 m by 0.57 m

A blister type pahoehoe excavation. The excavated boulders and cobbles have been haphazardly strewn in the immediate excavated area. An upright is present next to the excavation.

FEATURE F: Terrace and alignment
FUNCTION: Agriculture
DIMENSIONS: 11.05 m by 38.00 m by 0.42 m

Feature F consists of a circular aligned paved terrace. It measures 4.28 m at 115 degrees Az. by 1.20 m. The paved area is filled with cobbles and gravels and may be a filled blister. An alignment made up of large pahoehoe boulders and aa cobbles, stacked two courses high, is connected to the terrace. It is oriented N-S and collapsed along sections.

SITE NO.: State: 13432 **PHRI:** T-215
SITE TYPE: Mound
TOPOGRAPHY: Pahoehoe finger flows.
VEGETATION: Christmas-berry, fountain grass, and koa-haole.
ELEVATION: c. 227 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DIMENSIONS: 1.60 m by 1.60 m by 0.70 m
DESCRIPTION: This site consists of a rock mound with an associated pahoehoe excavation. The rock mound is constructed with loosely piled pahoehoe boulders and is situated 6.00 m east of the excavation.

SITE NO.: State: 13433 **PHRI:** T-216
SITE TYPE: Cairn
TOPOGRAPHY: Smooth pahoehoe flow and an aa flow southeast of the site.
VEGETATION: Fountain grass, air plants, and Christmas-berry.
ELEVATION: c. 520 feet
CONDITION: Fair
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Indeterminate marker
DIMENSIONS: 0.66 m by 0.54 m by 0.48 m
DESCRIPTION: An oval shaped cairn that is stacked two courses high. Large pahoehoe boulders and cobbles make up the structure. It is collapsing along the north side. The total area of scattered rocks measures 1.69 by 0.92 m.

SITE NO.: State: 13434 **PHRI:** T-217
SITE TYPE: Complex (4 Features)
TOPOGRAPHY: The terrain consists of aa flows surrounding the complex area with large mounds of aa and large aa boulders.
VEGETATION: Christmas-berry, laua'e fern, air plant, lantana, and koa-haole.
ELEVATION: c. 552 feet
CONDITION: Good

INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 46.40 m at 170 degrees Az. by 18.0 m. The site consists of three circular faced mounds (Features A, B and D) and a pahoehoe excavation (Feature C).

FEATURE A: Faced Mound
FUNCTION: Agriculture
DIMENSIONS: 1.50 m by 1.30 m by 0.80 m

It is constructed with a stacked and faced perimeter of pahoehoe boulders, two to three courses high. Cobbles are used as interior fill.

The northern quarter of the mound was disassembled in order to determine if subsurface features were present. The fill was determined to be undifferentiated cobbles, placed directly on an artificially built-up surface of aa pebbles and cobbles. This surface was penetrated and found to be 0.68 m thick, overlying a 0.02 m thick deposit of loamy soil with aa pebbles intermixed. A 0.10 m thick layer of coarse soil and disintegrating pahoehoe bedrock was beneath this soil/pebble layer. No portable remains or cultural deposits were observed. A sample of the soil was collected for further analysis (see subsurface findings).

FEATURE B: Faced mound
FUNCTION: Agriculture
DIMENSIONS: 1.00 m by 1.00 m by 0.70 m

Feature B is located 8.00 m at 105 degrees Az. from Feature A. It is constructed with large pahoehoe boulders stacked two to three courses high in a circular fashion. Smaller cobbles are used as interior fill.

FEATURE C: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 4.40 m by 3.10 m by 0.35 m

Oval shaped in plan, it contains aa cobbles on the floor and in the surrounding area. Portions of the excavation look natural.

A mound is located 2.40 m north of the excavation. It measures 4.30 m by 3.8 m and 1.13 m in height. The mound is loosely constructed with large aa and some pahoehoe cobbles. The northern portion of the mound is collapsing.

FEATURE D: Faced mound
FUNCTION: Agriculture
DIMENSIONS: 1.20 m by 1.00 m by 0.69 m

Circular shape in plan, it is constructed with aa boulders at the base and aa cobbles as interior fill. The mound is stacked three courses high.

SITE NO.: State: 13435 PHRI: T-218
SITE TYPE: Complex (10 Features)
TOPOGRAPHY: The terrain consists of gently sloping to irregular pahoehoe and aa flows.
VEGETATION: Lantana, Christmas-berry, agave, guava, koa-haole, kolu, grass, and numerous sisal plants.
ELEVATION: c. 580-600 feet
CONDITION: Good
INTEGRITY: Unaltered to possibly altered by road construction
PROBABLE AGE: Historic/possibly prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The overall complex area measures 147.90 m N-S by 36.00 m E-W. The site consists of seven enclosures (Features A-F and Feature J), a L-shape wall (Feature G), and modified outcrops (Features H and I). The enclosures are all built using a similar construction technique. Features A-F abut the retaining wall of the Site 13426 roadbed which defines either the east or west side of each enclosure. Some (or all) of these features appear to have been constructed after the roadway was built. There may be additional features in the area; vegetation is extremely thick.

The location of this site is c. 500 m east (upslope from) the mapped location of a commercial sisal mill which operated during the late nineteenth and early twentieth centuries. The enclosures may be associated with this mill.

FEATURE A: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 4.80 m by 3.80 m by 0.70 m

This enclosure is east and adjacent to the old Palani Roadbed (Site 13426). The wall is constructed with loosely stacked boulders and cobbles, two to three courses high and two to three wide. Feature B is directly west on the other side of the roadbed. Inside the enclosure is a deposit of reddish brown silty loam mixed with aa pebbles.

FEATURE B: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 16.50 m by 7.20 m by 1.70 m maximum height

The enclosure is built abutting the west side of the old Palani Roadbed. It is keyhole shape in plan, with the narrow section at the southern end. This portion measures 5.20 m long by 2.20 m wide. The walls at the narrow end are 0.85 m high and 1.10 m wide. At the wider section, the enclosure is 7.20 m wide and 1.70 m high. At the northern end is another narrow section 7.00 m long. Near the center of the northern narrow section is an oval hole with the perimeter outlined with boulders. The hole measures 2.50 m across by 1.20 m deep. The construction of all walls are loosely stacked. The roadbed retaining wall here is 1.70 m high. The enclosure walls here are intact up to and against the retaining wall.

FEATURE C: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 24.00 m by 6.20 m by 1.40 m

Feature C also abuts the western side of the old roadbed, and is immediately south of Feature B. It is similar in plan to Feature B, with minor variation. There is a wide central section and narrow extensions to the north and south. The extensions are 5.00 m long, 1.20 m wide with 1.00 m wide walls. At the northern end of the northern extension is an area of rock fill, which extends nearly to the edge of Feature B. The wall is open at the south end. with a c. 1.00 m wide gap between the end of the wall and the roadbed retaining wall.

The main section of the enclosure is 14.00 m long, 6.20 m wide and averages 1.40 m high. The wall in this section includes some massive boulders, and wall width is up to 2.38 m in places. The interior surface of the enclosure is 2.00 m below the level of the roadbed.

FEATURE D: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 9.50 m by 2.40 m by 1.30 m

Feature D is located 20.00 m south of Feature C, along the west side of the old Palani Roadbed. It consists of a sectioned enclosure that connects with a larger enclosure (Feature E) immediately to the south. The northernmost section is 4.50 m long and 2.40 m wide, with an average wall width of 0.60 m, and an exterior wall height of 0.90 m. The south section is 5.00 m long and 1.80 m wide with an interior wall height of 1.30 m. the northern end of the enclosure is intact up to and against the roadbed retaining wall; the south end is open. The area between the Feature D and E enclosures is filled with cobbles and boulders, as is the opening in the enclosure D wall.

FEATURE E: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 11.30 m by 7.10 m by 0.70 m

Feature E abuts the west side of the old roadbed, and is situated between Features D and F. Overall shape of the enclosure is keyhole, with a narrow extension to the south side. This enclosure wall is double faced and core filled, unlike Features A-D. It is built with aa boulders and cobbles, and the wall averages 2.50 m wide and 0.70 m high. The interior is divided into two sections by a low wall, 0.40 m high, that is oriented perpendicular to the old roadbed. The narrow extension of this feature is joined to a similar narrow extension of Feature F to the south by a 2.20 m wide area of rock fill. The filled area is flat and ramp-like, and slopes downhill from the roadbed surface, permitting access from the road to both Features E and F. One broken green bottle base (c. 1920-1940) was observed on the roadbed near the ramp.

FEATURE F: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 12.40 m by 6.65 m by 1.20 m

Generally keyhole shape in plan, it is located 5.00 m north from the shoulder rip-rap of the existing Palani Highway, and abuts the old Palani Roadbed. The walls are constructed with stacked boulders and cobbles five courses high, and 0.75 m wide.

FEATURE G: L-shape wall
FUNCTION: Agriculture (probably recent)
DIMENSIONS: 2.80 m by 1.77 m by 1.20 m

Feature G is c. 8.00 m east of the old Palani Roadbed and is probably not functionally related to the enclosure features built along the road. The wall is loosely stacked along perimeter the of a pahoehoe outcrop, abutting high areas of pahoehoe and forming a small enclosed area. This enclosed area is 3.20 m (N-S) by 5.30 m (E-W). It is constructed with generally squarish blocks of pahoehoe, loosely stacked, with some sections along the interior faced.

A rock pile is located at the east end interior of the enclosed area. It is c. 1.45 m in diameter at the base, with a maximum height of c. 0.5 m at the center. The pile is haphazard with some cobbles scattered around the base.

A deposit of black loam resembling potting soil is present, and arrears to have been brought to the site. Several plastic plant bags (some containing soil), buckets, water containers and a gardening trowel were found in the immediate area.

FEATURE H: Modified outcrop
FUNCTION: Agriculture
DIMENSIONS: 4.50 m by 2.50 m by 2.29 m

Feature H consists of cleared aa under a natural overhang with a loosely stacked wall. The cleared area is 0.450 m deep from the ground surface. Aa boulders and cobbles have been cleared away and piled to the south in a crude wall-like formation abutting the natural outcrop face. The wall measures 2.40 m (NE-SW) by 1.60 m. The west side is faced two to four courses with a maximum height of 0.70 m. A tin can was found inside the cleared area. This feature is adjacent to the east side of the old roadbed, across from Feature C.

FEATURE I: Modified outcrop
FUNCTION: Quarry/possible agriculture
DIMENSIONS: 3.50 m by 2.10 m by 1.20 m

This modified outcrop is immediately adjacent to the east side of the old Palani Roadbed, between Features A and H. It appears to be a quarry site, possibly used during construction of the roadbed. Chunks of rough pahoehoe and aa are cleared out along face of an outcrop. A small overhang occurs along the south and east sides of the clearing with a crawlspace underneath the overhang. The crawlspace has a floor of aa pebbles. A pile of cobbles and boulders are against the interior north side of the clearing. Other boulders are loosely stacked in a linear pile along the exterior northern perimeter of the clearing. In addition there is a rock pile inside of the clearing that measures 1.06 m (E-W) by 1.20 m (N-S) and 0.30 m in height. Approximately 12 rusted tin cans, a broken food jar and a tobacco can are scattered in the feature.

FEATURE J: Enclosure
FUNCTION: Agriculture
DIMENSIONS: 8.90 m by 7.00 m by 1.57 m

Feature J is 2.50 m north from Feature A, on the east side of the old Palani Roadbed. The enclosure is roughly C-shape in plan with the major axis oriented N-S. The walls are constructed with large stacked boulders and average 1.20 m in width. Wall height varies from 1.57 m along the northeast side to 0.85 m along the west side. The northeast portion of the wall (4.90 m long) connects to the entrance of a 3.71 m wide overhang. Ceiling height in the shallow overhang is 1.61 m. Extending east is an overhang ceiling which is 1.61 m. There is a shelf inside of the overhang which is 0.39 m in height and 0.64 m in length and filled with basalt gravels. A 0.10 m thick deposit of brown silty loam is present; no portable remains were observed.

SITE NO.: State: 13436 **PHRI:** T-219
SITE TYPE: Wall
TOPOGRAPHY: Irregular pahoehoe with a relatively steep slope.
VEGETATION: Sisal, Christmas-berry, guava, koa-haole, lantana, and various grasses.
ELEVATION: c. 605 feet
CONDITION: Poor-fair
INTEGRITY: Unaltered except by roadway construction
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Land division
DIMENSIONS: 134.80 m by 1.30 m by 0.60 m

DESCRIPTION: This site is a bifaced and core filled wall. It is constructed with stacked boulders, one to six high, and cobble filled. The height varies from 0.30 m to 1.30 m, and width averages 0.60 m. Both ends of the wall have been terminated at the shoulder of the existing Palani Highway. The road is oriented generally NE-SW and roughly parallels the old Palani Roadbed, located c. 12.00 m to the east. There are four minor angles (20-40 degrees) along the length of the wall. Pahoehoe excavations occur c. 2.0-3.0 m to the east of the wall and may be a probable source for building material.

SITE NO.: State: 13437 PHRI: T-220
SITE TYPE: Complex (7 Features)
TOPOGRAPHY: Undulating pahoehoe and aa surface flows.
VEGETATION: Christmas-berry, lantana, air plants, and laua'e.
ELEVATION: c. 515-518 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: *Prehistoric*
FUNCTIONAL INTERPRETATION: Agriculture-marker
DESCRIPTION: The overall complex area measures 56.40 m at 330 degrees Az. by 24.00 m. The site consists of a stepped terrace (Feature A), a pavement (Feature B), a faced outcrop (Feature C), a terrace (Feature D), and three cairns (Features E-G).

FEATURE A: Stepped terrace
FUNCTION: Agriculture
DIMENSIONS: 45.90 m by 13.58 m by 1.48 m

The terrace is oriented NW-SE. It begins as a single stacked wall and then it proceeds to five courses then seven courses high. The stepped terrace is constructed with pahoehoe and aa boulders and cobbles and paved with angular aa gravel. Portions of the retaining wall are stacked and portions are collapsed.

The northernmost and upper terrace measures 45.90 m by 4.20 m. The retaining wall is raised on the south side and is stacked three to six courses high for a maximum height of 0.94 m. The lower and southernmost terrace measures 34.20 m by 9.30 m. It is stacked six courses high, and is 1.10 m in height, where it joins with the upper terrace.

FEATURE B: Pavement
FUNCTION: Agriculture
DIMENSIONS: 7.80 m by 3.80 m by 1.50 m

This pavement is east of and adjacent to Feature A. It is constructed with rough cobbles and outlined with aa cobbles that are stacked in places. North and adjacent to the paved area is a depression bordered on three sides by the built-up area and on the fourth side by a rock ledge. The depression measures 5.00 m by 3.00 m and is 1.80 m deep. The base of the depression is cleared and has a 0.02 m thick soil deposit that covers an area 2.80 m by 0.90 m.

FEATURE C: Faced outcrop
FUNCTION: Agriculture
DIMENSIONS: 2.50 m by 0.00 m by 1.00 m

Feature C is 22.00 m south and 5.70 m east of Feature A. It consists of a natural ledge that has been stacked with aa boulders and cobbles to form a crude retaining wall. In areas along the natural ledge occasional cobbles can be found placed along the top edge.

FEATURE D: Terrace
FUNCTION: Agriculture
DIMENSIONS: 14.00 m by 10.00 m by 0.80 m

This terrace is in the immediate vicinity of Features A and B. Large pahoehoe boulders are stacked two to three courses high around the perimeter, with smaller pahoehoe cobbles filling the interior. This terrace is roughly L-shaped with the major axis oriented E-W, and the extension to the south at the east end. The extension is 4.00 m N-S and 3.50 m E-W. On the west end of the terrace is a small circular platform, constructed on the edge and on top of the perimeter wall. It is 0.70 m in diameter and two courses (0.38 m) high. A 0.08-0.10 m thick deposit of sandy loam is present on the terrace.

FEATURE E: Cairn
FUNCTION: Marker
DIMENSIONS: 0.85 m by 0.85 m by 0.65 m

This cairn is the westernmost of an alignment of three cairns (with F and G). It is 10.00 m south from the west end of Feature D. It is circular at the base and constructed with aa boulders and cobbles with three courses of single pahoehoe cobbles on top. To the north of the cairn alignment is a linear rock mound that extends 11.50 m at 100 degrees Az.

FEATURE F: Cairn
FUNCTION: Marker
DIMENSIONS: 0.85 m by 0.85 m by 0.70 m

Circular at the base and constructed with aa boulders and cobbles with three courses of single pahoehoe cobbles on top. Feature F is the center cairn. Feature E and Feature G are in line at 100 degrees Az. and are on either side of Feature F, which is 4.20 m from Feature E and 3.80 m from Feature G.

FEATURE G: Cairn
FUNCTION: Marker
DIMENSIONS: 0.90 m by 0.90 m by 0.85 m

Circular at the base and constructed with aa boulders and cobbles with three courses of single pahoehoe cobbles on top. Feature G is the easternmost cairn.

SITE NO.: State: 13438 *PHRI:* T-221
SITE TYPE: Complex (10 Features)
TOPOGRAPHY: Aa flows with some pahoehoe.
VEGETATION: Christmas-berry, lantana, air plant, ferns, grass, and noni.
ELEVATION: c. 529 feet
CONDITION: Poor-good
INTEGRITY: Unaltered
PROBABLE AGE: Historic/Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture-transportation
DESCRIPTION: Overall complex area measures 200.0 m (N-S) by 40.0 m (E-W). The site consists of four terraces (Feature A, Features C and D and Feature F), two mounds (Features B and I), three terraces (Features C, D and Feature F), a pahoehoe excavation (Feature E), a trail (Feature G), a roadbed (Feature H) and a cairn (Feature J).

FEATURE A: Terrace
FUNCTION: Agriculture
DIMENSIONS: 5.10 m by 5.00 m by 0.50 m

The terrace wall is built with stacked aa cobbles and the surface interior is paved with aa gravels. The terrace boundary is distinguished by large cobbles and boulders to the north and the south and by a downward slope to the east. In addition, there is an oval shaped, cleared aa depression west and adjacent to the terrace wall.

FEATURE B: Mound
FUNCTION: Agriculture
DIMENSIONS: 2.50 m by 2.40 m by 0.70 m

This mound is 5.00 m north from Feature A. It is built with a loosely stacked perimeter of aa cobbles and filled with gravel and a few cobbles.

FEATURE C: Terrace
FUNCTION: Agriculture
DIMENSIONS: 7.50 m by 2.30 m by 0.65 m

The terrace is 14.80 m west from Feature B. It is roughly rectangular shape, and raised on the southwest side. The riser wall is constructed with stacked aa boulders and cobbles and the terrace surface is paved with cobbles and gravels. It is collapsing at the southeast end where collapse extends 1.80 m to the exterior of the terrace wall.

Immediately to the northeast of the terrace are two cleared depressions in the natural aa flow. The largest of these is at the northern edge of the terrace; it is 3.90 by 2.20 m and 1.05 m deep. The second depression is 2.00 m to the south. It is 2.90 by 1.60 m and 0.75 m deep.

FEATURE D: Terrace
FUNCTION: Agriculture
DIMENSIONS: 5.00 m by 4.00 m by 0.20 m

Feature D is in the immediate vicinity of Feature C. It is an oval shaped terrace with a perimeter of large aa cobbles, and is filled with aa gravels. The surface is level and flat. The perimeter may have been stacked at one time, but it is presently collapsed.

FEATURE E: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 4.70 m by 2.00 m by 0.90 m

An excavated pahoehoe ledge with stacked angular pahoehoe boulders and cobbles on top of the ledge. Smaller cobbles cover the interior. On the eastern ledge of this feature is a rock mound that measures 1.20 m by 1.00 m by 0.40 m high. Large pahoehoe boulders are at the base with smaller cobbles on top, two to three courses high.

FEATURE F: Terrace
FUNCTION: Agriculture
DIMENSIONS: 8.40 m by 3.30 m by 1.20 m

This terrace is adjacent to Features C and D, and the east end abuts the retaining wall of the old Palani Roadbed (Feature H). The terrace is roughly crescent shape in plan and constructed with a perimeter of large aa boulders stacked two to three courses high. It is filled with aa gravel.

FEATURE G: Trail
FUNCTION: Transportation
DIMENSIONS: 50.00 m by 1.20 m

The trail section is oriented northwest and west from the Feature F terrace. It has a flattened, packed surface of aa gravel and a perimeter of larger aa cobbles. The trail alignment is nonlinear.

FEATURE H: Roadbed
FUNCTION: Transportation
DIMENSIONS: 200.00 m by 4.30 m by 2.00 m

This feature is an abandoned section of Palani Road. It is identical in construction to the section described above (SIHP Site 13426). The south end of this section is at the shoulder riprap of the existing Palani Highway alignment. The north end is terminated at Site 13434.

FEATURE I: Mound
FUNCTION: Indeterminate
DIMENSIONS: 7.30 m by 2.00 m by 1.00 m

The rock mound is located 10.00 m west from Feature E. It is generally linear in plan and constructed with boulders from an adjacent pahoehoe flow. Height varies from 0.50 to 1.00 m. A somewhat discrete rock concentration occurs at the southeast end of this linear mound. The concentration is 1.20 m by 0.90 m and is two courses high.

FEATURE J: Cairn
FUNCTION: Indeterminate
DIMENSIONS: 0.60 m by 0.55 m by 0.70 m

Feature J is situated 8.0 m west of Feature E. It is built with two stacked pahoehoe boulders. The top boulder is slightly smaller than the boulder base.

SITE NO.: State: 13439 PHRI: T-222
SITE TYPE: Cairn
TOPOGRAPHY: The terrain consists of aa and pahoehoe flows.
VEGETATION: Christmas-berry, air plants, and grass.
ELEVATION: c. 555 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Indeterminate marker
DIMENSIONS: 1.15 m by 1.00 m by 1.00 m
DESCRIPTION: The cairn is constructed with stacked aa cobbles.

SITE NO.: State: 13440 PHRI: T-223
SITE TYPE: Complex (3 Features)
TOPOGRAPHY: Irregular and undulating terrain consisting of aa and pahoehoe flows.
VEGETATION: Christmas-berry, koa-haole, lantana, and fountain grass.
ELEVATION: c. 506 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric-early historic
FUNCTIONAL INTERPRETATION: Agriculture

DESCRIPTION: The overall complex area measures 23.0 m at 330 degrees Az. by 13.20 m. The site consists of a terrace (Feature A), a filled crevice (Feature B) and a pahoehoe excavation (Feature C).

FEATURE A: Terrace
FUNCTION: Agriculture
DIMENSIONS: 4.20 m by 3.40 m by 0.00 m

A terrace built up on the edge of a pahoehoe outcrop with pahoehoe boulders and cobbles.

FEATURE B: Filled crevice
FUNCTION: Agriculture
DIMENSIONS: 3.40 m by 1.60 m by 0.00 m

Feature B is located 5.60 m northwest from Feature A. The crevice is filled with pahoehoe boulders and cobbles.

FEATURE C: Pahoehoe excavation
FUNCTION: Agriculture
DIMENSIONS: 13.20 m by 2.60 m by 0.00 m

Located 16.20 m northwest from Feature A. Pahoehoe cobbles and gravels are haphazardly strewn in a concave area along a pahoehoe flow edge. In the southwest end of the feature is a circle of pahoehoe boulders on the north flow edge measuring 1.90 m (N-S) by 1.20 m (E-W). A loam deposit is present 1.00 m north; it covers an area 2.50 by 1.2 m (N-S).

SITE NO.: State: 13447 **PHRI:** T-230
SITE TYPE: Complex (19 Features)
TOPOGRAPHY: Pahoehoe finger flows.
VEGETATION: Christmas-berry, lantana, grasses, guava, and koa-haole.
ELEVATION: c. 475 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture-possible habitation
DESCRIPTION: Overall area of this complex is 68.00 m (E-W) by 40.00 m (N-S). Features identified at the site include a platform (Feature A), six pahoehoe excavations, three modified blisters, and nine filled blisters.

FEATURE A: Platform
FUNCTION: Habitation
DIMENSIONS: 4.60 m by 4.30 m by 0.50 m

Feature is a platform with a large upright in the northwest corner. The perimeter consists of single pahoehoe boulders. The platform is roughly paved with pahoehoe cobbles and gravels. A pahoehoe excavation is located 2.00 m south of the platform. Also, piled pahoehoe boulders are 4.00 m to the southwest of the platform.

SITE NO.: **State:** 13448 **PHRI:** T-231
SITE TYPE: Complex (7 Features)
TOPOGRAPHY: A flat to gentle westward sloping terrain consisting of pahoehoe outcroppings.
VEGETATION: Christmas-berry, koa-haole, various grasses, lantana, and guava.
ELEVATION: c. 485 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Agriculture
DESCRIPTION: The site consists of a series of five interconnecting and two separate pahoehoe excavations. The five connecting pahoehoe excavations are cleared hollows in an area covered by large pahoehoe blocks and small boulders.

These five features are located on the south side of the complex. The overall measurement is 8.50 m at 290 degrees Az. by 10.00 m. The excavations range in size from 0.90 by 0.70 m to 2.00 by 0.90 m. Some visible pavement of pebbles and at least 0.14 m of soil are present within the excavations.

An L-shaped pahoehoe ledge excavation consists of some pahoehoe blocks placed along the upper pahoehoe flow. The interior is paved with pebbles and small cobbles. It measures 9.00 m at 18 degrees Az. by 4.5 m. The thickness of the excavated pahoehoe layer is 0.30 m and the maximum depth of the excavation is 0.53 m. Soil is visible at the base.

Another pahoehoe excavation is lined and filled with large pahoehoe cobbles and small boulders. It measures 4.60 m at 304 degrees Az. by 7.6 m. Soil is present in a small paved area on the west side of the Feature.

SITE NO.: **State:** 13449 **PHRI:** T-232
SITE TYPE: Complex (3 Features)
TOPOGRAPHY: Gentle sloping pahoehoe and aa flows.
VEGETATION: Christmas-berry, kiawe, koa-haole, ferns, air plants, and lantana.
ELEVATION: c. 480 feet
CONDITION: Good
INTEGRITY: Unaltered
PROBABLE AGE: Prehistoric
FUNCTIONAL INTERPRETATION: Habitation-transportation-possible agriculture
DESCRIPTION: The overall complex area measures 50.00 m NE-SW by 12.0 m NW-SE. The site consists of a lava tube cave (Feature A), a cairn (Feature B) and a steppingstone trail (Feature C).

FEATURE A: Lava tube cave
FUNCTION: Habitation
DIMENSIONS: 50.00 m by 5.00 m by 2.00 m

Feature A is a lava tube with three caved-in areas that serve as openings. Oriented in a SW direction, it extends to Site 13458. The width of the cave varies between 3.00-5.00 m and the height varies between 0.60-2.00 m.

A small retaining wall crosses part of the northeast end of the northeast chamber. The retaining wall is oriented at 125 degrees Az. and measures 3.60 m by 0.60 m and 0.45-1.12 m in height. It is constructed with stacked pahoehoe slabs and boulders.

Portable remains consists of Echinoidea and marine shell fgagments.

FEATURE B: Cairn
FUNCTION: Possible agricultural mound
DIMENSIONS: 3.20 m by 2.20 m by 1.10 m

Circular shape in plan, the outer edges are constructed with pahoehoe boulders stacked three to four courses high. Four large upright pahoehoe boulders are built into the cairn exterior wall, extending the full height of the feature and evenly spaced apart. The interior of the cairn consists of pahoehoe cobbles and gravels filled to the top of the feature.

FEATURE C: Steppingstone trail
FUNCTION: Transportation
DIMENSIONS: 18.28 m by 0.55 m

The trail is oriented NW-SE. It consists of 21 pahoehoe slabs of various sizes and shapes placed across an aa flow. From its northwestern end, the runs 7.7 m at 160 degrees Az.. It makes a slight curve and continues 10.34 m at 150 degrees Az. The southeastern end is at a pahoehoe cobble field.

SUBSURFACE FINDINGS

Subsurface testing was conducted at three sites (five features) within the added portion of the project area (Table 2). The testing was conducted January 22-29, 1990, as part of the testing field work for the Queen Liliuokalani Trust lands. Features selected for testing were those which exhibited morphological characteristics of burial monuments. These included a platform, three faced mounds, and a modified outcrop. The sizes and locations of excavation units were designed to locate subsurface skeletal remains, if they were present. One meter square units were used for all features except the modified outcrop, which could be adequately tested with a 0.25 m square unit.

During excavation, the rock fill was removed from the units as a single layer, and underlying soil deposits were excavated in natural layers, or arbitrary 0.1 m levels within natural layers. Depth was measured from the top of the feature, and in most cases, excavation terminated at or just below surrounding ground surface. Portable remains were located in test units at Features E and G, Site 13428. In both cases, single kukui nuts were found. These items were complete, but were fragmented and unburned. The deposits at these features contained other seeds, such as koa-haole, and it is uncertain at this time whether the kukui nuts were purposely placed (planted) in the features, or were introduced by other means. No other portable remains were observed in the five test units.

Samples were collected from soil deposits at three of the features. These were examined in the laboratory and compared with soils collected from a total of sixteen features (Donham 1990b:41-44). All test units were excavated to bedrock. After recordation and photographing was completed, the units were backfilled, and the surface features rebuilt. The excavation findings are summarized here briefly for each feature tested within the added survey area.

Table 2.

SUMMARY OF SUBSURFACE TESTING

SIHP No.	Fea.	Formal Type	Unit Size	Max. Depth	Material Recovered
13424	B	Mod. outcrop	0.25 sq m	0.59 m BS	Soil sample
13428	C	Faced mound	1.00 sq m	0.67 m BS	Soil sample
13428	E	Faced mound	1.00 sq m	1.05 m BS	-
13428	G	Platform	1.00 sq m	0.90 m BS	Soil sample
13434	A	Faced mound	1.00 sq m	1.48 m BS	-

Site 13424, Feature B

The feature consists of a pahoehoe excavation that was filled with chunky pahoehoe blocks and contained three areas that were leveled and paved. The paved areas were defined with boulder perimeters, some of which were set upright. A 0.25 by 0.25 m test unit was placed in the center of the most formal paved area. Rock fill consisted of a 0.28 m thick layer of cobbles directly beneath a single layer of paving pebbles. Beneath the cobbles was a 0.26 m thick deposit of pahoehoe pebbles. A 0.05 m thick deposit of sterile silty loam was present beneath the pebbles, which were partially intermixed with the soil. Bedrock was encountered 0.59 m below the top of the feature. The soil was black (5YR2.5/1), and contained numerous tiny pieces of gravel, and scattered weathered pebbles.

Site 13428, Feature C

This faced mound was constructed with a perimeter of pahoehoe cobbles and was filled with small cobbles and various-sized pebbles. Maximum height of the perimeter was 1.21 m above ground surface. A one m square test unit was located in the center of the mound, and the fill was removed, keeping the perimeter relatively intact. The fill surface was 0.05 m below the datum point along the top of the perimeter. A 0.19 m thick layer of cobbles was present on top of the fill; pebble fill extended 0.28 cm, and overlaid a single layer of cobbles, which was at the base of the surface structure. Beneath the cobble base was a 0.10 m thick layer of sterile silty loam. Bedrock was present beneath the soil. The soil was dark reddish-brown (5YR2.5/2) and contained weathered gravel.

Site 13428, Feature E

Similar in construction to Feature C, this mound had a cobble perimeter and was filled with generally smaller cobbles and pebbles. The feature is larger than Feature C and the fill is more level, giving the appearance of a small platform. Maximum height of the perimeter was 1.28 m. A one m square test unit was excavated in the center of the mound, leaving the perimeter intact. The fill here was found to be generally undifferentiated, with cobbles and pebbles mixed throughout. The fill extended to 0.65 m below mound surface in the eastern portion of the unit, and to 0.76 m below surface in the western portion. The bedrock surface was encountered immediately beneath the core fill in the east side of the unit. In the west side, a soil deposit mixed with pebbles was present between the fill and bedrock. Thickness of the soil varied with slope of the bedrock, and reached a maximum thickness 0.30 in the southwest corner of the unit. A single kukui nut shell was encountered in the rock fill at 0.57 m below mound surface. Soil was dark reddish-brown (5YR3/2) silty loam of duff-like consistence, with organic detritus and land snails.

Site 13428, Feature G

Feature G is a paved rectangular platform with a faced perimeter of boulders and large cobbles. Surface area is 11.40 sq m. A one m square test unit was placed in the center of the platform. The northern portion of the unit consisted of relatively large cobble fill, and the southern half consisted of small, packed and leveled pebble paving. During excavation, it became obvious that the cobble layer was deposited on top of the pebble pavement, which had covered the platform surface at one time but was now only visible in a small area 1.20 m in diameter. The pebble paving was found to be an average of 0.05 m thick, and it overlaid a layer of small cobbles, one to two stones thick. Larger cobble fill was present beneath the small cobbles. This fill varied in thickness, due to the sloping surface of the underlying bedrock. Along the north wall of the unit, fill was 0.7 m thick; along the south wall, it was 0.3 m thick. A soil deposit which varied in thickness from 0.01 to 0.06 m was present at the base of the rock fill. The soil was dark reddish-brown silty loam with small angular gravel, land snails, koa haole seeds, and a single kukui nut (in fragments).

Site 13434, Feature A

This faced mound has a perimeter of boulders and is filled with cobbles and pebbles. The perimeter has a maximum height of 0.80 m above surface, and the core fill was recessed 0.10 m below the top of the perimeter. The mound was located on an aa outcrop that had been artificially leveled and filled. A one m square test unit was excavated into the northern section of the mound, and a portion of the perimeter was removed in order to continue excavation into the underlying aa fill. The core fill was found to be undifferentiated cobbles and pebbles, and directly overlaid the aa pebbles of the modified outcrop beneath the mound. The aa fill continued to a depth of 1.48 m below the top of the mound, where a deposit of soil and pebbles was encountered. This layer was 0.02 m thick and overlaid a sterile layer of decomposing aa bedrock, which could be penetrated to a maximum depth of 1.60 m below the top of the mound. No portable remains were located in the fill or deposits beneath the feature.

The findings of test excavations at these and eleven other similar features in the Queen Liliuokalani Trust lands project area indicate that relatively formalized structures were built for what appear to be agricultural purposes. The features tested are superficially very similar to features known to contain burials in other areas of North Kona, yet no burials, or indications of decomposed skeletal remains, were encountered. The absence of midden remains or artifacts of any kind in or around these features likewise indicates it is unlikely they were used for habitation. Platforms such as Feature G at Site 13428 have been shown in many instances to be habitation features. There is no indication for such use at the tested platforms, which leads to the assumption that they are larger versions of formalized clearance mounds that may have also been used as planting beds.

Evidence of fill layering (larger cobbles placed over paved or pebble-filled surfaces) was observed at the Site 13428 platform, and at other tested platforms in the Queen Liliuokalani Trust lands project area. This layering may indicate that the platforms were built up gradually, rather than as a single construction phase, and that they were used for different specific purposes, depending upon the agricultural activities being conducted at different points in time. More detailed information is obtainable concerning construction phases of the platforms and mounds. This information is best obtained through excavation techniques designed for such a purpose, rather than the techniques used here, which were to determine the presence or absence of burials.

CONCLUSION

DISCUSSION

During the inventory survey conducted within the original Kealakehe project area, 82 sites consisting of 840 component features were identified (Donham 1990a). Within the c. 52 acre area added to the original project area, 24 sites consisting of 279 component features were identified. These additional sites were identified and first reported on during an inventory survey of the Queen Liliuokalani Trust Lands in Keahuolu (Donham 1990b). The resultant total for the revised project area is 106 sites with 1,119 component features. The overall site count for the 800 acre Kealakehe portion of the project area is 53; the overall total for the Keahuolu portion is 52; one site (a wall) is on the boundary between the two ahupua'a. The two Keahuolu parcels account for less than one quarter of the total revised survey area acreage, yet contain 69% (777) of the total number of identified features.

General frequency patterns for various formal feature types have been only slightly altered with the introduction of new data from the added Keahuolu acreage (Table 3). Three feature types occur in the added area

Table 3.

FEATURE COUNTS BY FORMAL CATEGORY

Formal Type	Original Survey Area	Added Survey Area	Total Count	Percent of Total
Alignment	-	3	3	0.2
Cairn	26	12	38	3.4
Cave	3	5	8	0.7
C-shape	1	-	1	0.1
Enclosure	22	9	31	2.8
Filled Crevice	-	1	1	0.1
Hearth	2	-	2	0.2
Kerbst. trail	5	-	5	0.5
Midden scatter	1	-	1	0.1
Modified outcrop	46	29	75	6.7
Overhang	-	1	1	0.1
Phh. excavation	258	84	342	30.6
Pavement	5	5	10	0.9
Platform	16	3	19	1.7
Roadbed	1	2	3	0.2
Rock Mound	350	110	460	41.1
Stpst. trail	11	1	12	1.1
Terrace	73	11	84	7.5
Trail	2	1	3	0.2
Wall	18	2	20	1.8
Total:	840	279	1,119	100.0

that were not represented in the original survey area. These include three alignments, a filled crevice, and an overhang shelter.

Four formal types, each represented by a few features in the original survey area, are not present in the added acreage. These include C-shapes, hearths, midden scatters, and kerbstone trails.

In the original survey area, the predominant feature types were pahoehoe excavations and rock mounds, which together accounted for 72.4% of all identified features. The added feature frequencies result in a combined percentage of 71.7% for pahoehoe excavations and rock mounds, which is a very minor decrease. The added data do, however, enhance the marked difference in occurrences of these two feature types between Keahuolu and Kealakehe. Among the 342 (revised count) identified pahoehoe excavations, 257 (75%) are in Keahuolu; among the 460 rock mounds, 415 (90%) are in Keahuolu.

The clear majority of features identified within the added survey area represent agricultural functions. These include all the rock mounds, pahoehoe excavations, modified outcrops, enclosures, and terraces (244, 87% of total features in added area). Other features that are of likely agricultural function include the filled crevice, some or all of the pavements, and at least one of the three platforms. The overall proportion of agricultural features in the added area is very similar to the proportion derived from the original survey area data, which was 87.6% of the 840 identified features with agricultural functions (Donham 1990a:17).

Habitation features identified in the added area include all of the caves, the overhang shelter, and two of the platforms (eight features; 2.9% of total features in added area. This proportion is over twice as high as the proportion for habitation features within the original survey area (1.4%). The higher proportion of habitation features for the added area is attributable primarily to a higher number of rock shelters (five caves and one overhang). These features all appear to be short-term shelters and contain sparse to very sparse deposits of marine shell midden. Two of the caves (Sites 13425 and 13431) contain additional portable remains, such as kukui nut shell, coral, waterworn basalt, and charcoal.

The only features identified in the added area which possibly represent permanent habitation are platforms at Sites 13430 and 13447. The Site 13430 platform is rectangular with a surface area of 21.07 sq m; no midden remains were observed on this feature, and soil deposits are present on top. The Site 13447 platform has a surface area of 19.80 sq m; it too lacks associated midden deposits on the surface.

Features reflecting transportation account for 1.4% (4) of the total added features. This is about half the relative frequency of transportation features for the original survey area, which was 2.3%. Most of the original survey area transportation features (15 of 19) were in Kealakehe; this pattern is also reflected in the added survey area data. Two of the added transportation features represent sections of the old Palani Roadbed; one is a steppingstone trail section and one is a simple footpath section.

No features indicating ceremonial functions were identified within the added survey area. The revised project area total for this functional category remains at five features--two enclosures, two platforms, and one stepped terrace.

Within the added survey area, five features were initially identified as possibly containing human burials. These included a modified outcrop, three faced mounds, and a platform. Each of these features was tested prior to completion of the Queen Liliuokalani Trust Lands survey. None of the features contained skeletal remains, and their functional interpretations were revised from possible burial to agriculture. Therefore, no burial features or possible burial features are identified within the added acreage at this time. There is, however, always the possibility that burials will be encountered during additional field investigations.

Findings from the subsurface testing of possible burial features in Keahuolu may indicate that some of the faced mounds and small platforms identified in the original survey area as possible burial features may also have alternative functions. Most of the terraces and platforms in the possible burial category for the original survey area are, however, in Kealakehe and are concentrated in two complexes, one of which has been previously identified as a burial site.

Features with indeterminate specific functions identified within the added area include three alignments and 12 cairns. The frequency for cairns in the added area (4.3%) is proportionally greater than the cairn frequency for the original survey area (3.1%), and results in a revised overall frequency of 3.4%.

In summary, the added survey data do not substantially change the general land use patterns indicated for the original survey area. The added data do, however, enhance differences in the archaeological record that signal potential differences in land use between the two ahupua'a of Kealakehe and Keahuolu. The Keahuolu parcels exhibit a greater concentration of features than does the Kealakehe portion of the project area. The Kealakehe portion contains a wider range of functional types than Keahuolu, which has a relatively specialized agricultural pattern. This pattern consists of a large number of rock mounds, pahoehoe excavations, and modified outcrops, with a limited number of terrace and platform features.

The differences between the two ahupua'a as they are represented within the project area appear to be most related to: (a) more intensive use of Kealakehe for cattle ranching, resulting in differential preservation of surface features between the two ahupua'a; (b) more intensive use of Keahuolu for agriculture, due to its more favorable location in relation to rainfall patterns; (c) a possible period of intensive agricultural activities in Keahuolu during the historic period, related to the sisal mill and plantation; and (d) the presence of the Great Wall of Kuakini in Keahuolu, indicating the likely presence of

relatively concentrated and/or politically important residential sites associated with Kailua village. Such features are present in the Queen Liliuokalani Trust lands situated makai of the Keahuolu parcels of the present project.

GENERAL SIGNIFICANCE ASSESSMENTS AND RECOMMENDED GENERAL TREATMENTS

General significance assessments and recommended general treatments for all identified sites are summarized in Table 4. Specific field work tasks for individual sites are summarized in Table 1. Significance categories used in the site evaluation process are based on the National Register criteria for evaluation, as outlined in the Code of Federal Regulations (36 CFR Part 60). DLNR-HSS/SHPO uses these criteria for evaluating cultural resources. Sites determined to be potentially significant for information content fall under Criterion D, which defines significant resources as ones which "...have yielded, or may be likely to yield, information important in prehistory or history." Sites potentially significant as representative examples of site types are evaluated under Criterion C, which defines significant resources as those which "...embody the distinctive characteristics of a type, period, or method of construction...or that represent a significant and distinguishable entity whose components may lack individual distinction."

Sites with potential cultural significance are evaluated under guidelines prepared by the Advisory Council on Historic Preservation (ACHP) entitled "Guidelines for Consideration of Traditional Cultural Values in Historic Preservation Review" (ACHP Draft Report, August 1985). The guidelines define cultural value as "...the contribution made by an historic property to an ongoing society or cultural system. A traditional cultural value is a cultural value that has historical depth." The guidelines further specify that "[a] property need not have been in consistent use since antiquity by a cultural system in order to have traditional cultural value."

To further facilitate management decisions regarding the subsequent treatment of resources, the general significance of the archaeological resources identified during the inventory survey were also evaluated in terms of potential scientific research, interpretive, and/or cultural values (PHRI Cultural Resource Management [CRM] Value Modes; see Appendix C for individual assessments of sites). 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. These three value modes are derived from the above state and federal evaluation criteria.

Table 4.

SUMMARY OF GENERAL SIGNIFICANCE ASSESSMENTS AND RECOMMENDED GENERAL TREATMENTS

SIHP Site Number	Significance Category				Recommended Treatment			
	A	X	B	C	FDC	NFW	PID	PAI
13424	-	+	-	-	-	+	-	-
13426	-	+	-	-	-	+	-	-
13432	-	+	-	-	-	+	-	-
13433	-	+	-	-	-	+	-	-
13434	-	+	-	-	-	+	-	-
13439	-	+	-	-	-	+	-	-
Subtotal:	0	6	0	0	0	6	0	0
13420	+	-	-	-	+	-	-	-
13421	+	-	-	-	+	-	-	-
13422	+	-	-	-	+	-	-	-
13423	+	-	-	-	+	-	-	-
13425	+	-	-	-	+	-	-	-
13427	+	-	-	-	+	-	-	-
13428	+	-	-	-	+	-	-	-
13429	+	-	-	-	+	-	-	-
13430	+	-	-	-	+	-	-	-
13431	+	-	-	-	+	-	-	-
13435	+	-	-	-	+	-	-	-

General Significance Categories:

A=Important for information content, further data collection necessary (PHRI=research value);
X=Important for information content, no further data collection necessary (PHRI=research value, SHPO=not significant)
B=Excellent example of site type at local, region, island, State, or National level (PHRI=interpretive value); and
C=Culturally significant (PHRI=cultural value).

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

Table 4. (Cont.)

SIHP Site Number	Significance Category				Recommended Treatment			
	A	X	B	C	FDC	NFW	PID	PAI
13436	+	-	-	-	+	-	-	-
13437	+	-	-	-	+	-	-	-
13438	+	-	-	-	+	-	-	-
13440	+	-	-	-	+	-	-	-
13447	+	-	-	-	+	-	-	-
13448	+	-	-	-	+	-	-	-
13449	+	-	-	-	+	-	-	-
Subtotal:	18	0	0	0	18	0	0	0
Total:	18	6	0	0	18	6	0	0

Based on the above federal criteria, six of the total 24 sites are assessed as significant solely for information content. No further work is recommended for these sites. They have been measured, mapped, described, photographed, and plotted. Data collected from them during the present survey is considered sufficient; their preservation is not essential, although they could perhaps be considered for inclusion into development landscaping. Further data collection is recommended for the remaining 18 sites.

As an initial step, it is recommended that sites requiring further archaeological work be accurately located and plotted by professional surveyors, with the aid of an archaeologist, on an appropriate scale topographic map of the project area. This would greatly aid development planning by allowing further archaeological work determinations (further data collection, data recovery and/or preservation) to be more accurately considered on a site-by-site basis.

The evaluations and recommendations presented within this addendum report have been based on a 100% aerial, variable-coverage surface, and limited subsurface inventory survey of the project area. There is always the possibility, however remote, that potentially significant, unidentified surface and/or subsurface cultural remains will be encountered in the course of future archaeological investigations or subsequent development activities. In such situations, archaeological consultation should be sought immediately.

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BOTANICAL SURVEY

BOTANICAL SURVEY
KEALAKEHE PLANNED COMMUNITY
NORTH KONA, HAWAI'I

by

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November 1989

Table of Contents

BOTANICAL SURVEY

KEALAKEHE PLANNED COMMUNITY

NORTH KONA, HAWAI'I

The proposed planned community is being undertaken by the State of Hawaii through its Housing Finance and Development Corporation (HFDC) in participation with the County of Hawaii through its Office of Housing and Community Development (OHCD). The primary goal of the project is to provide affordable housing opportunities for the anticipated growth in the West Hawaii area.

The Kealakehe project site consists of approximately 840 acres of land located mauka of the Queen Ka'ahumanu Highway; additionally about 150 acres on the adjacent Queen Lili'uokalani Trust property will also be included within the proposed planned community. The 840-acre parcel extends from about 50 ft. elevation along the Queen Ka'ahumanu Highway to 700 ft. elevation at its upper boundary. Properties near the upper boundary include the Kealakehe Elementary and Intermediate Schools, Public Housing Projects, and single family residences. Adjoining existing land uses near the lower boundary include the County's Kealakehe Landfill, police substation, County Animal Shelter, and power substation. The smaller 150-acre parcel extends from about 500 ft. elevation to roughly 770 ft. elevation; Palani Road runs along its eastern boundary.

Field studies were conducted over a three-day period, 14-16 July 1989, to assess the botanical resources present on the subject property. A total of three botanists were used to gather the technical data contained in this report. The objectives of the survey were to (1) provide a general description of the major

vegetation types; (2) inventory the terrestrial, vascular flora; and (3) search for threatened and endangered plants on the project site.

SURVEY METHODS

Prior to undertaking the field studies, a search was made of the pertinent literature to familiarize the principal investigator with other botanical studies conducted in the general area. Recent aerial photographs and topographic maps were examined to determine vegetation cover patterns, terrain characteristics, access, boundaries and reference points.

Access along the lower boundary of the 840-acre parcel was from the Queen Ka'ahumanu Highway and from a jeep trail behind the quarry and cement batching plant. Along the upper boundary, a number of streets in the residential area dead end adjacent to the property. A number of fencelines, rock walls, dozer walks, and waterline can be found on the property; these were used as reference points during the field studies. The 150-acre parcel was accessed from Palani Road and from the adjacent school property.

A walk-through survey method was employed. Areas most likely to harbor native plant communities or rare species, as the open, mixed shrubland and rougher 'a'a lava flows, were more intensively examined. Notes were made on plant associations and distribution, substrate types, topography, exposure, etc. Species identification was made in the field; plants which could not be positively determined were collected for later identification in the herbarium and for comparison with the taxonomic literature.

The species recorded are indicative of the season ("rainy" vs. "dry") and the environmental conditions at the time of the survey.

A survey taken at a different time and under varying environmental conditions would no doubt yield slight variations in the species list especially of the weedy, annual taxa.

VEGETATION DESCRIPTION

Four major vegetation types are recognized on the project site and are described in detail below. All those vascular plants inventoried during the field studies are presented in the species checklist at the end of the report. One officially listed endangered species, the uhiuhi (Caesalpinia kavaiensis), and one candidate endangered species, Bidens micrantha ssp. ctenophylla, occur on the site. A more detailed discussion on their status is found under the "Threatened and Endangered Plants" section of this report.

The distribution of the four vegetation types corresponds roughly with substrate type, rainfall, and elevation. As one moves upslope, annual rainfall increases from about 20 inches near the Queen Ka'ahumanu Highway to almost 50 inches at the upper boundary. 'A'a lava flows run the length of the property, while more weathered pahoehoe flows are found along the peripheries of the property; one small section along the upper boundary contains Punalu'u extremely rocky peat overlying pahoehoe bedrock (Sato et al. 1973).

1. Open Mixed Shrubland

This vegetation type generally is distributed above the 400 ft. contour interval on 'a'a lava. It may extend to lower elevations on some flows with many of the native elements quickly attenuating.

The physiognomy is of an open scrub with scattered trees,

although in depressions and small gullies shrubs and trees may form dense thickets. Native and introduced shrubs occur in about equal numbers, although among the natives alahe'e (Canthium odoratum) and a'ali'i (Dodonaea viscosa) are locally abundant in places, while among the introduced plants koa-haole (Leucaena leucocephala), klu (Acacia farnesiana), and Christmas berry (Schinus terebinthifolius) are locally abundant. Trees occur as scattered individuals or small, scattered stands. Native shrubs and trees include mamane (Sophora chrysophylla), lama (Diospyros sandwicensis), alahe'e, maiapilo (Capparis sandwichiana), a'ali'i, Bidens micrantha ssp. ctenophylla, kalamona (Senna gaudichaudii), naio (Myoporum sandwicense), uhiuhi (Caesalpinia kavaiensis), wiliwili (Erythrina sandwicensis), and 'ohe (Reynoldsia sandwicensis). The more commonly occurring introduced shrubs include koa-haole, Christmas berry, klu, lantana (Lantana camara), guava (Psidium guajava), senna (Senna septemtrionalis), and pluchea (Pluchea symphytifolia). Introduced trees include kukui (Aleurites moluccana), jacaranda (Jacaranda mimosifolia), silk oak (Grevillea robusta), and monkeypod (Samanea saman).

Ground cover is usually a mixture of grasses, smaller shrubs or subshrubs, and young koa-haole plants less than a foot high. These include Natal redtop (Rhynchelytrum repens), fountain grass (Pennisetum setaceum), Guinea grass (Panicum maximum), love grass (Eragrostis tenella), molassesgrass (Melinis minutiflora), Bermuda grass (Cynodon dactylon), 'uhaloa (Waltheria indica), 'ilima (Sida fallax), coffee senna (Senna occidentalis), false mallow (Malvastrum coromandelianum), nettle-leaved vervain (Stachytarpheta urticifolia), indigo (Indigofera suffruticosa), bur bush (Triumfetta rhomboidea), and air plant (Kalanchoe pinnata).

Cattle grazing on this part of the property tend to keep most of the open mixed shrubland low and there are numerous cattle paths through the shrubland. Where the cattle congregate, usually under

trees and where there is some soil, plants of acute-leaved sida (Sida acuta), bur bush, hairy honohono (Commelina benghalensis), false mallow, amaranth (Amaranthus viridus), and coffee senna are more numerous.

There are minor variants of this shrubland. For example, along the upper boundary, adjacent to the residential area and public housing, the property has been more disturbed as evidenced by the large piles of boulders, a number of dozer walks, and piles of rubbish. In this area, weedy species such as Spanish needle (Bidens pilosa), Florida beggarweed (Desmodium tortuosum), hyptis (Hyptis suaveolens), etc., are abundant, and, California grass (Brachiaria mutica) forms extensive mats. Where the substrate is weathered pahoehoe, fountain grass becomes more numerous.

2. Canthium/Christmas Berry Shrubland

This vegetation type occurs on the ±150-acre parcel which is included in the proposed planned community. The Canthium/Christmas berry shrubland continues across the slope and extends onto the adjacent Queen Lili'uokalani Trust Keahuolu lands where a recent flora survey was conducted (Char 1989).

The substrate is 'a'a with blocky chunks generally 4 to 6 inches in diameter. Both alahe'e (Canthium odoratum) and Christmas berry occur in almost equal numbers, though one or the other may be more abundant in places. The shrubs form dense thickets, 10 to 15 ft. tall. Scattered through the shrubland are clusters of mamane, 18 to 20 ft. tall; other native shrubs and trees include wiliwili, a'ali'i, 'ohe, Bidens micrantha ssp. ctenophylla, lama, and 'ohi'a (Metrosideros polymorpha). Introduced trees and shrubs, which also generally occur as scattered individuals, include jacaranda, silk oak, autograph tree (Clusia rosea), guava, kukui, and monkeypod. Koa-haole forms small clumps in places but is not abundant. Near the school boundary, large plants of sisal (Agave sisalana) are found.

Ground cover varies from 40 to 50% and is composed of seedlings of the tree and shrub species mentioned above plus a mixture of grasses and weedy herbs, though litter and barren 'a'a predominate. Low-lying, open areas are often filled with Natal redtop, molassesgrass, lantana, fountain grass, 'ilima, and air plant. Locally abundant, twining and sprawling over shrubs, are vines of huehue (Cocculus triloba).

3. Koa-haole Shrubland

This vegetation type is generally found associated with pahoehoe substrate. Dense to open koa-haole shrublands are found adjacent to the Kealakehe residential area, the County landfill, and above the quarry and cement batching plant. The koa-haole plants vary in height from 8 to 12 ft. tall, although, in places, they may be somewhat taller. Scattered trees of kiawe (Prosopis pallida) and 'opiuma (Pithecellobium dulce) are usually found associated with this shrubland. Other trees and shrubs occasionally found here include alahe'e, Christmas berry, monkeypod, lantana, maiapilo, and naio. Locally abundant are 'ilima and 'uhaloa.

Lower elevation koa-haole shrubland usually supports a dense ground cover of fountain grass, while upper elevation shrubland has a ground cover composed of Natal redtop, fountain grass, and various weedy species as nettle-leaved vervain (Stachytarpheta urticifolia), beggar's tick (Bidens pilosa, Bidens cynapifolia), hairy abutilon (Abutilon grandifolium), and air plant.

Where this vegetation type occurs on 'a'a substrate, there is very little ground cover and the koa-haole shrubs tend to occur in scattered patches usually in shallow depressions.

4. Fountain Grass Grassland

Along the northern boundary of the subject property, where it abuts Palani Ranch, fountain grass forms a rather extensive and dense grassland. Koa-haole shrubs occur as scattered individuals, although, in low-lying areas they may sometimes form small-sized thickets. Other shrubs and subshrubs occasionally found in the grassland include 'ilima, indigo (Indigofera suffruticosa), alahe'e, 'uhaloa, and maiapilo. A few trees of kiawe and 'ohe can be observed scattered through the grassland; one rather large tree of maua (Xylosma hawaiiense), about 20 ft. tall, is found on a rocky knoll near the jeep trail that begins behind the quarry.

On the 'a'a flow adjacent to Queen Ka'ahumanu Highway, fountain grass occurs in scattered clumps. In these areas, 'uhaloa and 'ilima are abundant.

In general, these grasslands tend to be species poor as the aggressive fountain grass forms a dense cover which crowds out other plants. Fountain grass is considered a serious pest in dry areas of the big island as it outcompetes most native species for establishment. It is also a fire-adapted species. The grass burns swiftly and hot causing extensive damage to native dry forest species. After fires it is able to quickly reestablish itself (Wagner et al. in press).

THREATENED AND ENDANGERED PLANTS

One officially listed endangered species, the uhiuhi (Caesalpinia kavaiensis; formerly known as Mezoneuron kavaiense), and one candidate endangered species, Bidens micrantha subspecies (ssp.) ctenophylla (no common name), occur on the Kealakehe site. An officially listed endangered species is protected by the Federal Endangered Species Act of 1973 (16USC 1531-1543), as amended, and by the State's threatened and endangered wildlife and plants law

(Chapter 124, Title 13, Subtitle 5, Part 2). Bidens micrantha ssp. ctenophylla is considered a Category 1 candidate endangered species by the U. S. Fish and Wildlife Service (1985). Plants considered Category 1 material should be regarded as candidates for addition to the Endangered and Threatened Species List and, as such, consideration should be given them in environmental planning.

The uhiuhi is a large shrub to medium-sized tree (up to 30 ft. tall) with thick, rough, dark gray bark and very dark blackish-brown heartwood. The leaves are twice divided into smaller leaflets with 4 to 8 pairs of pale green leaflets per pinnae. The flowers are borne in clusters at branch tips and are pinkish-purple to brick red. The seed pods are flat and thin; bluish-glaucous when young, pale pinkish-tan to gray when older. From 1 to 4 pale brown, flat seeds are found in each pod. The Hawaiians used the strong, dark, heavy wood for spears and fishing implements called la'au melomelo or la'au makalei (Rock 1913, 1920).

Uhiuhi was first described from the island of Kaua'i in 1867; later specimens were collected on O'ahu and Maui. J. F. Rock, a botanist, discovered uhiuhi plants in the North Kona area in 1909. Today the populations have been greatly reduced. Only a single tree is known from the Kaua'i population, a few plants occur in the Wai'anae Mountains on O'ahu, and about two dozen plants have been recorded on the slopes of Hualalai in the Pu'u-waawaa - Ka'upulehu ahupua'as on the island of Hawai'i. Cattle, goats, and other feral herbivores were probably reponsible for most of the population decline, but in recent years exotic plants, such as fountain grass, have become so abundant as to inhibit regeneration and to increase the chances of wildfire (Lamoureux 1982).

Nineteen uhiuhi plants were located on the Kealakehe project site during our field studies. This find represents a significant increase in the number of known plants and also extends the range

of distribution of the species from Pu'uwaawaa-Ka'upulehu across to the Kailua-Kona area. On the project site, the majority of the plants are found between the 500 and 550 ft. elevation contours in open mixed shrubland. A few plants occur in koa-haole shrubland on 'a'a flows. The plants vary in height from 8 ft. to about 25 ft. tall, with the majority of them 12 to 15 ft. tall. Most are multi-branched and, at the time of the survey, had flowers and many seed pods. Although we made an intensive search around the plants, we did not find any seedlings or saplings of uhiuhi.

Bidens micrantha ssp. ctenophylla occurs in shrubland and dry forests on the leeward slopes of Hualalai, Hawai'i. In addition to being a candidate endangered species, it is also considered vulnerable (Wagner et al in press), that is, it is threatened by extensive habitat destruction or modification or by other environmental disturbances.

It is a rather attractive plant with its dense clusters of yellow, daisy-like flowers. Bidens is an erect, much-branched, perennial herb from 2 to 5 ft. tall. Under optimum growing conditions, it may reach 7 to 8 ft. in height. The dense inflorescences may contain 15 to 75 or more flowers per cluster.

On the Kealakehe project site, Bidens is found scattered throughout the open mixed shrubland and Canthium/Christmas berry shrubland in fairly large numbers.

DISCUSSION AND RECOMMENDATIONS

A total of 145 plant species were inventoried on the project site during the course of the field studies. Of these, 110 (76%) are introduced or alien species, 31 (21%) are native, and 4 (3%) are originally of Polynesian origin. Among the natives, 16 are indigenous (native to the Hawaiian islands and also elsewhere)

while 15 are endemic (native only to the islands). Native species are the dominant components in two of the four major vegetation types recognized on the project site; these are the open mixed shrubland and the Canthium/Christmas berry shrubland. One officially listed endangered species, the uhiuhi, and one candidate endangered species, Bidens micrantha ssp. ctenophylla, occur on the site. The uhiuhi is protected by both Federal and State endangered species laws.

A 20-acre nature study park or preserve sited around the largest concentration of uhiuhi would be the most biologically sound and practical solution. This larger nature park would preserve not only the uhiuhi but also other natives in the area such as the Bidens, 'ohe, mamane, naio, kalomona, lama, alahe'e, and maiapilo. Attempts would be made to transplant the smaller uhiuhi outside the preserve onto the site. Seedlings started from seeds collected from all the uhiuhi plants outside the park would also be planted here, thus preserving the gene pool, even if the original plants were lost.

However, it is the legal opinion of the State's Department of the Attorney General that "... because it does not seem the uhiuhi trees can be successfully transplanted, and because it cannot be said that destruction of any of the species would help propagate the species as a whole, under existing statutes the uhiuhi trees must be preserved in place." (letter to Wm. W. Paty, Chairperson, Board of Land and Natural Resources, 20 December 1989). With the above in mind, the following mitigation measures are recommended. An 5-acre preserve should be set up around the cluster of six trees and two outlying trees. This would also preserve a number of other native species in the area including the candidate Bidens species. Propagation material from other natives not found within the 5-acre park, such as maua, wiliwili, halapepe (Pleomele hawaiiensis), olopua (Nestegis sandwicensis),

and pua-kala (Argemone glauca) as well as from the separate uhiuhi plants, should be collected for inclusion onto the site. This should be an actively used nature study park with trails, jogging paths, picnic shelters, etc. Descriptive signs should be provided for the plants. Pamphlets for a self-guided tour could be provided at a kiosk; the pamphlets would highlight the native species, describe how the Hawaiians used the plants, present ways these natives could be used in landscaping to conserve water, etc. One-half acre plots should be established around each of the remaining eleven plants outside the preserve. Long-term management of these separate, small one-half acre plots and the 5-acre preserve should include an active management plan for the eradication of introduced plants, especially fountain grass, koa-haole, and Christmas berry.

All mitigating actions should be undertaken in cooperation with and reviewed by the U. S. Fish and Wildlife Service and the State's Department of Land and Natural Resources. These are the agencies which oversee the protection of endangered species.

The use of native plant material for landscaping should also be considered. Recently, attention has been focused on using native species already adapted to the local climatic and soil conditions of a site. The Honolulu Board of Water Supply has installed a "xeriscape" garden -- a garden with plants which use less water -- on its property in the Halawa Industrial Park. A number of native, dryland species are incorporated into the landscape design. Native plants adapted to the low rainfall and lava substrates on the Kealakehe site would require less water, maintenance, and almost no soil if used for landscaping. The plants could be propagated and used for landscaping common areas such as schoolgrounds, parks, golf courses, entrance ways, etc. In addition, homeowners may also be interested in planting natives if these were made available to them. Many of the natives are attractive and of ornamental value; these include the uhiuhi, wiliwili, 'ohe, naio, alahe'e, maiapilo, mamane, kalomona, and Bidens micrantha ssp. ctenophylla.

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PLANT SPECIES LIST -- Kealakehe Planned Community

Following is a checklist of all those vascular plant species inventoried during the field studies. Plant families are arranged alphabetically within each of three groups: Ferns and Fern Allies, Monocots, and Dicots. Taxonomy and nomenclature of the Ferns and Fern Allies follow Lamoureux (1984); the flowering plants (Monocots and Dicots) are in accordance with Wagner et al. (in press). In most cases, common English and/or Hawaiian names given follow St. John (1973) or Porter (1972).

For each species, the following information is provided:

1. Scientific name with author citation.
2. Common English and/or Hawaiian name, when known.
3. Biogeographic status. The following symbols are used:
   E = endemic = native only to the Hawaiian Islands
   I = indigenous = native to the islands and also to one or more other geographic area(s)
   P = Polynesian = plants of Polynesian introduction prior to Western contact (1778); not native
   X = introduced or alien = all those plants brought to the islands intentionally or accidentally after Western contact; not native.
4. Presence (+) or absence (-) of a particular species within each of four vegetation types recognized on the project site (see text for discussion):
   o = Open mixed shrubland
   c = Canthium/Christmas berry shrubland
   k = Koa-haole scrub
   f = Fountain grass grassland

Scientific Name	Common Name	Status	Vegetation Type o	c	k	f
FERNS AND FERN ALLIES						
NEPHROLEPIDACEAE (Sword Fern Family)						
Nephrolepis multiflora (Roxb.) Jarrett ex Morton	hairy sword fern, kupukupu	X	+	+	+	+
POLYPODIACEAE (Common Fern Family)						
Phlebodium aureum (L.) J. Sm.	laua'e-haole	X	+	+	-	-
Phymatosorus scolopendria (Burm.) Pic-Ser.	laua'e, lauwa'e	X	+	+	-	-
PSILOTACEAE (Psilotum Family)						
Psilotum nudum (L.) Beauv.	moa	I	-	+	-	+
SINOPTERIDACEAE (Cliffbrake Fern Family)						
Doryopteris decora Brack.	kumu niu, 'iwa 'iwa	E	-	-	+	-
MONOCOTS						
AGAVACEAE (Agave Family)						
Agave sisalana Perrine	sisal	X	-	+	-	-
Pleomele hawaiiensis Degener & I. Degener	halapepe	E	+	-	-	-
COMMELINACEAE (Spiderwort Family)						
Commelina benghalensis L.	hairy honohono	X	+	-	+	-
Rhoeo spathacea (Sw.) Stern	tradescantia	X	-	+	-	-
CYPERACEAE (Sedge Family)						
Cyperus compressus L.	cyperus	X	+	-	-	-
DIOSCOREACEAE (Yam Family)						
Dioscorea bulbifera L.	bitter yam, pi'oi	P	+	+	-	-

Scientific Name	Common Name	Status	Vegetation Type			
			o	m	k	f
POACEAE (Grass Family)						
Brachiaria mutica (Forssk.) Stapf	California grass	X	+	–	–	–
Cenchrus echinatus L.	common sandbur, 'ume 'alu	X	–	–	+	–
Chloris barbata (L.) Sw.	swollen finger grass, mau'ulei	X	+	+	+	+
Cynodon dactylon (L.) Pers.	Bermuda grass, manienie	X	+	–	–	–
Dactyloctenium aegyptium (L.) Willd.	beach wiregrass	X	+	–	–	–
Digitaria ciliaris (Retz.) Koeler	crabgrass	X	+	–	–	–
Digitaria radicosa (Presl) Miq.		X	–	+	–	–
Eleusine indica (L.) Gaertn.	wiregrass	X	+	+	–	–
Eragrostis tenella (L.) P. Beauv. ex Roem. & Schult.	lovegrass	X	+	+	+	+
Melinis minutiflora P. Beauv.	molassesgrass	X	+	+	+	–
Panicum maximum Jacq.	Guinea grass	X	+	+	–	–
Pennisetum setaceum (Forssk.) Chiov.	fountain grass	X	+	+	+	+
Rhynchelytrum repens (Willd.) Hubb.	Natal redtop	X	+	+	+	+
Setaria gracilis Kunth	yellow foxtail, mau'u Kaleponi	X	+	–	–	–
DICOTS						
ACANTHACEAE (Acanthus Family)						
Barleria cristata L.	barleria	X	–	+	+	–
Justicia betonica L.	white shrimp plant	X	–	+	–	–
AMARANTHACEAE (Amaranth Family)						
Amaranthus spinosus L.	spiny amaranth, pakai kuku	X	+	–	–	–
Amaranthus viridus L.	amaranth, pakai	X	+	–	–	–
ANACARDIACEAE (Mango Family)						
Mangifera indica L.	mango	X	+	–	+	–
Schinus terebinthifolius Raddi	Christmas berry, wilelaiki	X	+	+	+	+

Scientific Name	Common Name	Status	Vegetation Type o	c	k	f
APOCYNACEAE (Dogbane Family)						
Catharanthus roseus (L.) G. Don	Madagascar periwinkle	X	+	+	+	+
ARALIACEAE (Ginseng Family)						
Reynoldsia sandwicensis A. Gray	'ohe	E	+	+	+	+
Schefflera actinophylla (Endl.) Harms	octopus tree	X	–	+	+	–
ARISTOLOCHIACEAE (Birthwort Family)						
Aristolochia littoralis Parodi	Dutchman's pipe	X	+	–	–	–
ASTERACEAE (Sunflower Family)						
Ageratum conyzoides L.	maile hohono	X	+	–	–	–
Bidens cynapiifolia Kunth	West Indian beggar's tick	X	+	+	+	–
Bidens micrantha ssp. ctenophylla (Sherff) Nagata and Ganders		E	+	+	–	–
Bidens pilosa L.	Spanish needle, beggar's tick	X	+	+	+	+
Crassocephalum crepidioides (Benth.) S. Moore	crassocephalum	X	+	+	–	–
Emilia coccinea (Sims) G. Don	Flora's paintbrush	X	+	–	–	–
Emilia fosbergii Nicolson	pualele	X	+	+	–	–
Pluchea symphytifolia (Mill.) Gillis	pluchea, sourbush	X	+	+	+	+
Sonchus oleraceus L.	sow thistle	X	+	+	+	–
Tridax procumbens L.	coat buttons	X	+	+	+	+
Vernonia cinerea var. parviflora (Reinw.) DC	little ironweed	X	+	–	–	–
BIGNONIACEAE (Bignonia Family)						
Jacaranda mimosifolia D. Don	jacaranda	X	+	+	–	–
Spathodea campanulata P. Beauv.	African tulip	X	+	+	–	–
BRASSICACEAE (Mustard Family)						
Lepidium virginicum L.	wild peppergrass	X	+	–	–	–

Scientific Name	Common Name	Status	Vegetation Type o	c	k	f
BUDDLEJACEAE (Butterfly Bush Family)						
Buddleia asiatica Lour.	dog tail, huelo 'ilio	X	+	+	–	+
CACTACEAE (Cactus Family)						
Opuntia ficus-indica (L.) Mill.	panini, papipi	X	+	–	–	+
CAPPARACEAE (Caper Family)						
Capparis sandwichiana DC	maiapilo, pilo	E	+	+	+	+
Cleome gynandra L.	wild spider flower	X	+	–	–	–
CARICACEAE (Papaya Family)						
Carica papaya L.	papaya, mikana	X	+	+	–	–
CLUSIACEAE (Mangosteen Family)						
Clusia rosea Jacq.	autograph tree, copey	X	–	+	–	–
CONVOLVULACEAE (Morning-glory Family)						
Ipomoea indica (J. Burm.) Merr.	koali-'awania	I	+	+	+	+
Ipomoea obscura (L.) Ker-Gawl.	field bindweed	X	–	+	–	–
Ipomoea triloba L.	little bell, pink bindweed	X	+	+	–	–
CRASSULACEAE (Orpine Family)						
Kalanchoë pinnata (Lam.) Poir.	air plant	X	+	+	+	–
CUCURBITACEAE (Gourd Family)						
Coccinia grandis (L.) Voigt	scarlet-fruited gourd, coccinia	X	+	–	+	–
Cucumis dipsaceus Ehrenb. ex Spach	wild cucumber	X	+	–	–	+
Cucurbita pepo L.	pumpkin	X	–	–	+	–
Momordica charantia L.	wild bittermelon	X	+	+	+	+
CUSCUTACEAE (Dodder Family)						
Cuscuta sandwichiana Choisy	kauna'oa	E	–	+	–	–
EBENACEAE (Ebony Family)						
Diospyros sandwicensis (A. DC) Fosb.	lama	E	+	+	+	–

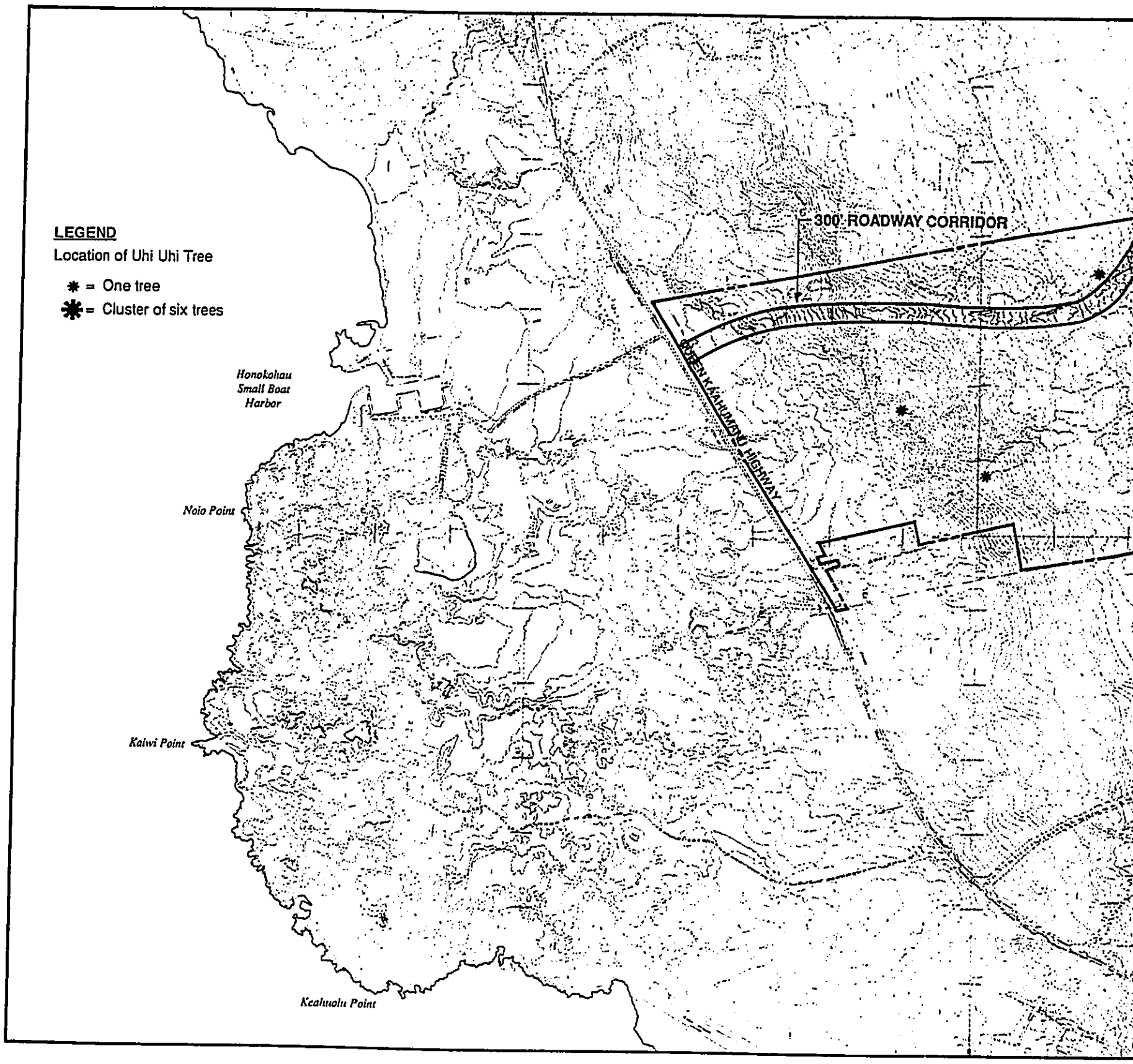
Scientific Name	Common Name	Status	Vegetation Type			
			o	c	k	f
EUPHORBIACEAE (Spurge Family)						
Aleurites moluccana (L.) Willd.	kukui, tutui	P	+	+	+	–
Chamaesyce hirta (L.) Millsp.	hairy spurge, garden spurge	X	+	+	+	+
Chamaesyce hypericifolia (L.) Millsp.	graceful spurge	X	+	–	+	+
Chamaesyce hyssopifolia (L.) Sm.	spurge	X	–	–	+	–
Chamaesyce prostrata (Aiton) Sm.	prostrate spurge	X	–	–	–	+
Euphorbia heterophylla L.	fire plant	X	+	–	–	–
Phyllanthus debilis Klein ex Willd.	phyllanthus weed	X	+	+	+	–
Ricinus communis L.	castor bean	X	+	+	–	+
FABACEAE (Pea Family)						
Abrus precatorius L.	rosary pea	X	–	+	–	–
Acacia farnesiana (L.) Willd.	klu	X	+	+	+	+
Albizia lebbeck (L.) Benth.	Siris tree	X	–	+	–	–
Caesalpinia bonduc (L.) Roxb.	kakalaioa, hihikolo	I	+	+	–	–
Caesalpinia kavaiensis H. Mann.	uhiuhi	E	+	–	+	–
Chamaecrista nictitans (L.) Moench	partridge pea, lauki	X	+	+	+	–
Crotalaria incana L.	fuzzy rattlepod	X	+	+	–	–
Crotalaria pallida Aiton	rattlepod	X	+	+	–	–
Desmodium incanum DC	Spanish clover, ka'imi	X	+	+	–	–
Desmodium tortuosum (Sw.) DC	Florida beggarweed	X	+	+	–	+
Erythrina sandwicensis Degener	wiliwili	E	+	+	–	–
Erythrina variegata Stckm.	haole wiliwili	X	–	+	–	–
Indigofera suffruticosa Mill.	indigo, iniko	X	+	+	+	+
Leucaena leucocephala (Lam.) de Wit	koa-haole	X	+	+	+	+
Macroptilium lathyroides (L.) Urb.	wild bean, cow pea	X	+	–	–	–
Medicago lupulina L.	black medic	X	+	–	–	–
Pithecellobium dulce (Roxb.) Benth.	'opiuma	X	+	+	+	+
Prosopis pallida (Humb. & Bonpl. ex Willd.) Kunth	kiawe	X	+	+	+	+
Samanea saman (Jacq.) Merr.	monkeypod	X	+	+	+	–

Scientific Name	Common Name	Status	Vegetation Type o	c	k	f
Senna gaudichaudii (Hook. & Arnott) H. Irwin & Barneby	kalamona, uhuiuhi	I	+	+	+	–
Senna occidentalis (L.) Link	coffee senna, 'auko'i	X	+	+	–	+
Senna septemtrionalis (Viv.) H. Irwin & Barneby	senna, kolomona	X	+	+	–	–
Sophora chrysophylla (Salisb.) Seem.	mamane	E	+	+	–	–
Tephrosia purpurea (L.) Pers.	'ahuhu, 'auhuhu	P	+	–	–	–
FLACOURTIACEAE (Flacourtia Family)						
Xylosma hawaiiense Seem.	maua, a'e	E	–	–	–	+
GOODENIACEAE (Goodenia Family)						
Scaevola sericea Vahl	naupaka kahakai	I	+	–	–	–
LAMIACEAE (Mint Family)						
Hyptis suaveolens (L.) Poit.	hyptis	X	+	–	–	–
Plectranthus parviflorus Willd.	spurflower	I	+	+	–	–
Salvia coccinea Juss. ex J. A. Murray	scarlet sage	X	+	+	–	–
Salvia occidentalis Sw.	West Indian sage	X	–	–	–	+
MALVACEAE (Mallow Family)						
Abutilon grandifolium (Willd.) Sweet	abutilon, mao	X	+	+	+	+
Malvastrum coromandelianum (L.) Garcke	false mallow, hauuoi	X	+	+	+	+
Sida acuta ssp. carpinifolia (L. f.) Borssum Waalkes	acute-leaved sida	X	+	–	–	–
Sida fallax Walp.	'ilima	I	+	+	+	+
Sida rhombifolia L.	Cuba jute	X	+	–	–	–
Sida spinosa L.	prickly sida	X	+	–	+	–
MENISPERMACEAE (Moonseed Family)						
Cocculus trilobus (Thunb.) DC	huehue	I	+	+	+	–

Scientific Name	Common Name	Status	Vegetation Type o	c	k	f
MYOPORACEAE (Myoporum Family)						
Myoporum sandwicense A. Gray	naio	I	+	-	+	-
MYRTACEAE (Myrtle Family)						
Metrosideros polymorpha Gaud.	'ohi'a, 'ohi'a-lehua	E	-	+	-	-
Psidium cattleianum Sabine	strawberry guava, waiawi 'ula'ula	X	+	+	-	-
Psidium guajava L.	guava, kuawa	X	+	+	-	-
NYCTAGINACEAE (Four-o'clock Family)						
Boerhavia coccinea Mill.	red-flowered boerhavia	X	+	-	+	+
OLEACEAE (Olive Family)						
Nestegis sandwicensis (A. Gray) Degener, I. Degener, & L. Johnson	olopua, pua	E	+	-	-	-
OXALIDACEAE (Wood Sorrel Family)						
Oxalis corymbosa DC	pink wood sorrel, 'ihi pehu	X	+	-	-	-
PAPAVERACEAE (Poppy Family)						
Argemone glauca (Nutt. ex Prain) Pope	native poppy, pua-kala	E	+	-	-	-
PASSIFLORACEAE (Passion Flower Family)						
Passiflora edulis Sims	passion fruit, liliko'i	X	+	-	-	-
Passiflora foetida L.	pohapoha	X	+	+	+	+
PHYTOLACCACEAE (Pokeweed Family)						
Rivinia humilis L.	rouge plant	X	+	+	-	-
PIPERACEAE (Pepper Family)						
Peperomia leptostachya Hook. & Arnott	'ala'ala-wai-nui	I	+	+	+	-
PLANTAGINACEAE (Plantain Family)						
Plantago lanceolata L.	narrow-leaved plantain	X	+	+	-	-

Scientific Name	Common Name	Status	Vegetation Type o	c	k	f
PLUMBAGINACEAE (Leadwort Family)						
Plumbago zeylanica L.	'ilie'e, hilie'e	I	+	+	+	–
PORTULACACEAE (Purslane Family)						
Portulaca oleracea L.	pigweed, portulaca	X	+	+	+	+
Portulaca pilosa L.	'ihi	X	+	+	–	+
Talinum triangulare (Jacq.) Willd.	talinum	X	+	+	+	–
PROTEACEAE (Protea Family)						
Grevillea robusta A. Cunn. ex R. Br.	silk oak, 'oka kalika	X	+	+	–	–
ROSACEAE (Rose Family)						
Osteomeles anthyllidifolia (Sm.) Lindl.	'ulei	I	+	+	–	–
RUBIACEAE (Coffee Family)						
Canthium odoratum (G. Forster) Seem.	alahe'e, walahe'e	I	+	+	+	+
Morinda citrifolia L.	noni	P	+	+	+	+
SANTALACEAE (Sandalwood Family)						
Santalum paniculatum Hook. & Arnott	'iliahi	E	+	–	+	–
SAPINDACEAE (Soapberry Family)						
Dodonaea viscosa Jacq.	a'ali'i	I	+	+	+	+
SCROPHULARIACEAE (Figwort Family)						
Lophospermum erubescens D. Don	larger roving sailor, creeping gloxinia	X	+	–	–	–
SOLANACEAE (Nightshade Family)						
Lycopersicon esculentum Mill.	cherry tomato, ohi'a lomi	X	+	–	–	–
Lycopersicon pimpinellifolium (Jusl.) Mill.	currant tomato, wild tomato	X	+	–	–	+

Scientific Name	Common Name	Status	Vegetation Type			
			o	c	k	f
Solanum americanum Mill.	popolo	I?	+	–	–	–
Solanum aff. elaeagnifolium Cav.		X	+	–	–	–
STERCULIACEAE (Cacao Family)						
Waltheria indica L.	'uhaloa, hi'aloa	I?	+	+	+	+
TILIACEAE (Linden Family)						
Triumfetta rhomboidea Jacq.	bur bush	X	+	–	–	–
VERBENACEAE (Verbena Family)						
Lantana camara L.	lantana, lakana	X	+	+	+	+
Stachytarpheta dichotoma (Ruiz & Pav.) Vahl	vervain	X	+	+	–	–
Stachytarpheta jamaicensis (L.) Vahl	Jamaica vervain, oi, owi	X	–	+	–	–
Stachytarpheta urticifolia (Salisb.) Sims	nettle-leaved vervain	X	+	+	+	–
Verbena litoralis Kunth	verbena, oi, owi	X	+	–	–	–



KEALAKEHE PROPOSED ROADWAY CORRIDOR

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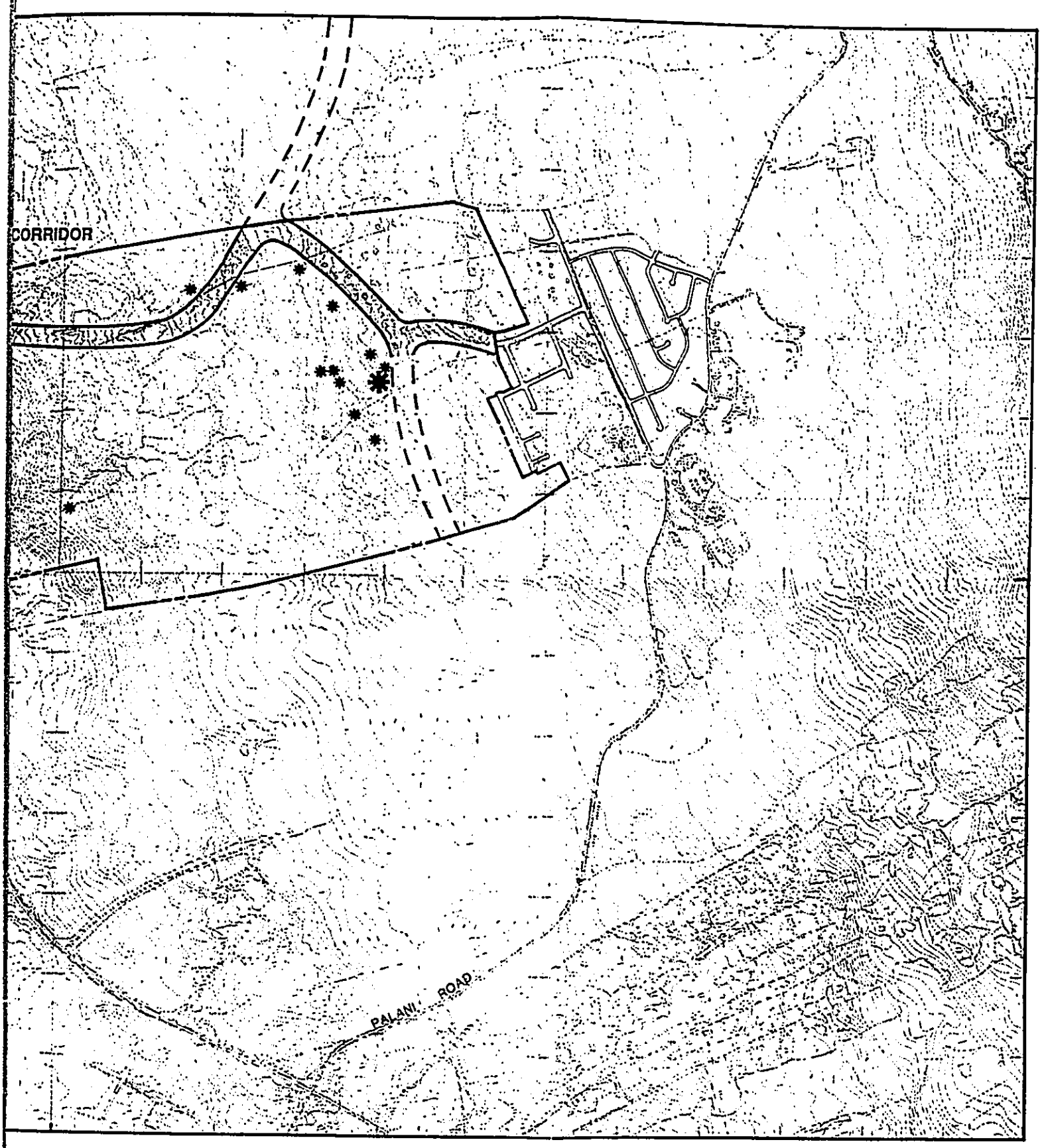

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SCALE IN FEET

NORTH

Prepared by: BELT COLLINS & ASSOCIATES

EXHIBIT 2

ENDANGERED FLORA SPECIES LOCATION

FAUNA SURVEY

SURVEY OF THE AVIFAUNA AND FERAL MAMMALS AT KEALAKEHE PROPERTY, NORTH KONA, HAWAII

Prepared for

Belt Collins & Associates

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7 August 1989

SURVEY OF THE AVIFAUNA AND FERAL MAMMALS AT KEALAKEHE PROPERTY, NORTH KONA, HAWAII

INTRODUCTION

The purpose of this report is to summarize the findings of a four day (1-4 August 1989) bird and mammal field survey of Kealakehe Property, North Kona, Hawaii (see Fig.1). Also included are references to pertinent literature as well as unpublished reports.

The objectives of the field survey were to:

1- Document what bird and mammal species occur on the property or may likely occur given the type of habitats available.

2- Provide some baseline data on the relative abundance of each species as well as general habitat preferences.

3- Determine the presence or likely occurrence of any native fauna particularly any that are considered "Endangered" or "Threatened". If such occur or may likely be found on the property identify what features of the habitat may be essential for these species and suggest how those resources may best be protected.

4- Determine if the property contains any special habitats that if lost or altered by development might result in a significant impact on the fauna in this region of the island.

GENERAL SITE DESCRIPTION

The project site is located on approximately 840 acres at Kealakehe, North Kona, Hawaii (see Fig.1). The makai section is parkland habitat with scattered low trees, Kiawe (Prosopis pallida) Koa Haoli (Leucaena latisiliqua) and Fountain Grass (Pennisetum setaceum) are the common plants in this area. The mauka portions of the property are covered by a dense second growth forest of Christmas Berry (Schinus terebinthifolius) Kukui (Aleurites moluccana) and a host of other exotic trees. Some native trees are also scattered throughout the area.

Weather during the field survey was variable with clear mornings and cloudy afternoons. All days of the survey had light easterly winds.

STUDY METHODS

Field observations were made with the aid of binoculars and by listening for vocalizations. These observations were concentrated during the peak bird activity periods of early morning and late afternoon. Attention was also paid to the presence of tracks and

scats as indicators of bird and mammal activity.

A trail was cut and marked in the dense upper section of the property. At various locations along this trail as well as in all types of habitat elsewhere on the property (see Fig. 1) eight minute counts were made of all birds seen or heard. Between these count stations observations of birds seen or heard were also noted. These data provide the basis for the relative abundance estimates given in this report. Published and unpublished reports of birds known from similar habitat on lands adjacent to this site and elsewhere in West Hawaii were also consulted in order to acquire a more complete picture of the possible species that might occur in the area (Bruner 1979, 1980, 1984a, 1984b, 1984c, 1985a, 1985b, 1985c, 1988a, 1988b, 1989a, 1989b; Pratt et al. 1987). Observations of feral mammals were limited to visual sightings and evidence in the form of skeletal remains, scats and tracks. No attempts were made to trap mammals in order to obtain data on their relative abundance and distribution. Three evenings were devoted to searching for the presence of owls and the Hawaiian Hoary Bat (Lasiurus cinerus semotus).

Scientific names used herein follow those given in the most recent American Ornithologist's Union Checklist (A.O.U. 1983), Hawaii's Birds (Hawaii Audubon Society 1984), A Field Guide to the Birds of Hawaii and the Tropical Pacific (Pratt et al. 1987), Mammal Species of the World (Honacki et al. 1982), Hawaiian Coastal Plants and Hawaiian Forest Plants (Merlin 1977a, 1977b).

RESULTS AND DISCUSSION

Resident Endemic (Native) Land and Water Birds:

No endemic species were recorded during the course of the field survey. The Short-eared Owl or Pueo (Asio flammeus sandwichensis) is the only species which might occur at this site. This species is relatively common on Hawaii particularly at higher elevations (Berger 1972, Hawaii Audubon Society 1984, Pratt et al. 1987). No other endemic birds would be expected at this site given the elevation and location of the site and the nature of the habitats available to the birds.

Migratory Indigenous (Native) Birds:

Migratory shorebirds winter in Hawaii between the months of August through May. Some juveniles will stay through the summer months as well (Johnson and Johnson 1983). Of all the shorebirds species which winter in Hawaii the Pacific Golden Plover (Pluvialis fulva) is the most abundant. Plover prefer open areas such as mud flats, lawns, pastures and plowed fields. They arrive in Hawaii in early August and depart to their arctic breeding grounds during the last week of April (Johnson et al. 1981). Bruner (1983) and Johnson et al. (1989) have also shown plover are extremely site-faithful on their wintering grounds and many establish foraging territories which they defend vigorously. Such behavior makes it possible to acquire a fairly good estimate of the abundance of plover in any one area. These populations likewise remain relatively stable over many years (Johnson et al. 1989). No plover were recorded during this field survey. This result was

not unexpected due to the time of year of the survey and the type of habitats present on the site. It is likely that during the time of year when plover are in Hawaii that very few if any actually utilize this property. In its present state this property is unsuitable for migrating shorebirds.

Resident Indigenous (Native) Birds:

No indigenous species were recorded nor would any be expected at this site.

Resident Indigenous (Native) Seabirds:

No seabirds were observed on the property. Some seabirds nest and roost on barren lava flows in Hawaii but at much higher elevation (Pratt et al. 1987).

Exotic (Introduced) Birds:

A total of 18 species of exotic birds were recorded during the field survey. Table One shows the relative abundance of each species as well as general habitat preferences. The list of exotic species found on the adjacent Queen Liliuokalani property was similar. The most abundant species at Kealakehe were Japanese White-eye (Zosterops japonicus), Common Myna (Acridotheres tristis), House Finch (Carpodacus mexicanus) and Zebra Dove (Geopelia striata). Given the range of habitats found on the property as well as data from surveys elsewhere in West Hawaii (Bruner 1979, 1980, 1984a, 1984b, 1984c, 1985a, 1985b, 1985, 1988a, 1988b, 1989a, 1989b) and information provided in Berger (1972),

Hawaii Audubon Society (1984) and Pratt et al. (1987) the following exotic bird species might also be expected to occur on or near the property: Erckel's Francolin (Francolinus erkelii), California Quail (Callipepla californica), and Japanese Quail (Coturnix japonica). The most unexpected sightings were: Lavender Waxbill (Estrilda caerulescens), Yellow-fronted Canary (Serinus mozambicus), and Saffron Finch (Sicalis flaveola). These popular cage birds have become increasingly more common in this region over the past few years. The Yellow-billed Cardinal (Paroaria capitata) has likewise expanded its range along the Kona Coast. This species does not at present occur elsewhere in the State. A close relative the Red-crested Cardinal (Paroaria coronata) is common on Oahu. Like its relative the Yellow-billed Cardinal prefers coastal habitat and does not range into dense middle or upper elevation forests.

Feral Mammals:

A total of 7 Small Indian Mongoose (Herpestes auropunctatus) were seen or heard during the survey. Three feral cats were observed as well as the skeletal remains of pigs and cows. Cattle were also heard along the north boundary of the property. Evidence of rats and mice were also found in the area of the sanitary landfill (County of Hawaii Kealakehe Rubbish Dump). No trapping was done in order to assess the relative abundance of mammals on this property. The presence of the sanitary

landfill provides a concentrated food resource for birds as well as rats, mice, mongooses and cats.

Records of the endemic and endangered Hawaiian Hoary Bat (Lasiurus cinerus semotus) are sketchy but the species has been reported from Hawaii (Tomich 1986). None were observed on this field survey despite three nights of observations. This species roosts solitarily in trees. Much remains to be known about the natural history of this bat and its ecological requirements here in Hawaii. Bruner (1984d) found bats on the Sheraton Waikoloa Beach Resort property located to the NW of this site.

CONCLUSION

A brief field survey can at best provide only a limited perspective of the wildlife present in any given area. Not all species will necessarily be observed and information on their use of the site must be sketched together from brief observations and the available literature. The number of species and the relative abundance of each species may vary throughout the year due to available resources and reproductive success. Species which are migratory will quite obviously be a part of the faunal picture only at certain times during the year. Exotic species sometimes prosper for a time only to later disappear or become a less significant part of the ecosystem (Williams 1987). Thus only long term studies can provide a comprehensive view of the

bird and mammal populations in a partieular area. However, when brief field studies are coupled with data gathered from other similar habitats the value of the conclusions drawn are significantly increased.

The following are some general conclusions related to bird and mammal activity on the property.

1- The dense tangle of vegetation in the upper portions of the site make access on foot extremely difficult. A trail was cut through this area and thus provided a means of censusing the fauna. All representative types of habitat found on the property were censused. The dense forested mauka section contained many more species of birds than the open habitat located on the lower slope.

2- The present habitats provide a limited range of living spaces which are utilized by the typical array of exotic species of birds one would expect at this elevation and in this type of environment in Hawaii. However, some species typically found in this habitat were not recorded. This could have been due to the fact that the survey was too brief or that their numbers are so low that they went undetected or a combination of these and other factors. No endemic birds or seabirds were recorded nor would they be expected to occur on this property. The creation of open habitat, as a result of development, will increase the usuable space for birds like Pacific Golden Plover.

3- The proposed development will create an urban environment. Some species are presently concentrated around the sanitary landfill these include: Common Myna (Acridotheres tristis) and the ubiquitous House Sparrow (Passer domesticus). Census data taken on three separate occasions at the sanitary landfill site found approximately 1000 Common Myna as well as large numbers of House Sparrows ! These large concentrations are typical of urban birds where concentrated food resources are available. Following development these two species will likely be more widespread on the property. Other species such as Japanese White-eye (Zosterops japonicus), House Finch (Carpodacus mexicanus) and game birds like Black Francolin (Francolinus francolinus) will decline in abundance once the forested area is eliminated.

4- In order to obtain more definitive data on mammals, a trapping program would be required. No endangered species were observed. The sanitary landfill provides an unatural concentration of food resources for mammals as well as birds. Census data obtained by trapping would likely show a greater than normal numbers of rats, mice, mongooses and cats than would be expected without this resource.

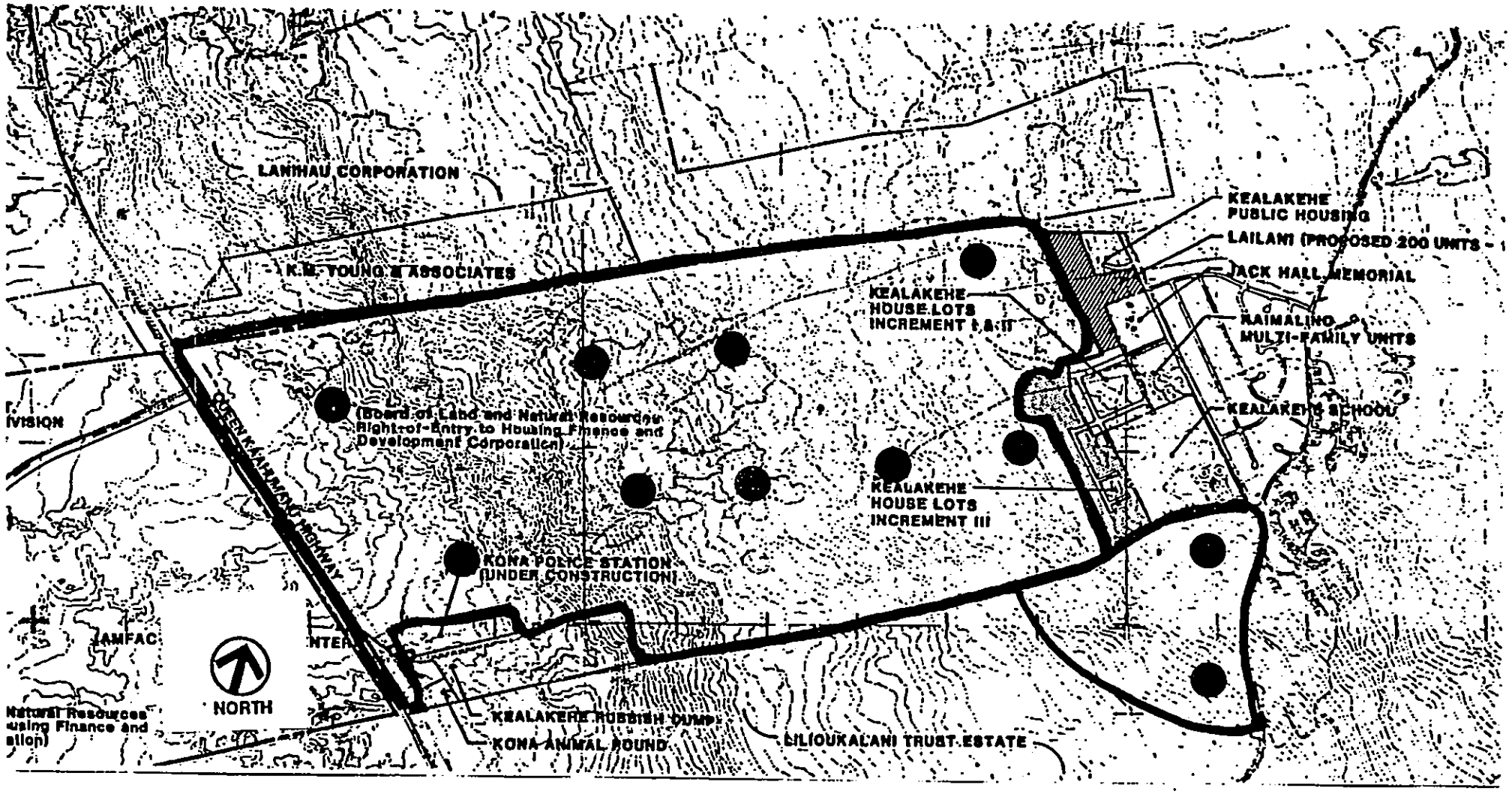

Fig. 1. Kealakehe property with eight minute count stations marked by a ●.

TABLE 1

Exotic species of birds recorded on Kealakehe Property, North Kona, Hawaii

COMMON NAME	SCIENTIFIC NAME	RELATIVE ABUNDANCE*	HABITAT PREFERENCES*
Ring-necked Pheasant	Phasianus colchicus	R = 1	G,E
Black Francolin	Francolinus francolinus	U = 2	G,E
Gray Francolin	Francolinus pondicerianus	R = 9	E,T
Spotted Dove	Streptopelia chinensis	U = 3	E
Zebra Dove	Geopelia striata	A = 16	E
Common Barn Owl	Tyto alba	R = 1	G,E
Northern Mockingbird	Mimus polyglottos	R = 3	E,U
Common Myna	Acridotheres tristis	A = 12	U,E
Yellow-billed Cardinal	Paroaria capitata	U = 3	T
Northern Cardinal	Cardinalis cardinalis	C = 6	T
Japanese White-eye	Zosterops japonicus	A = 21	T,E
Nutmeg Mannikin	Lonchura punctulata	U = 9	G,E
Warbling Silverbill	Lonchura malabarica	U = 5	E,G
Lavender Waxbill	Estrilda caerulescens	R = 10	E,G
House Finch	Carpodacus mexicanus	A = 13	T,E
House Sparrow	Passer domesticus	C = 10	U
Saffron Finch	Sicalis flaveola	R = 4	G,E
Yellow-fronted Canary	Serinus mozambicus	C = 6	E

* (see page 12 fro key to symbols)

KEY TO TABLE 1

RELATIVE ABUNDANCE = Number of times observed during survey or average number on eight minute counts in appropriate habitat.

A = abundant (ave. 10+) Number which follows is average of data from all survey days

C = common (ave. 5-10) Number which follows is average of data from all survey days

U = uncommon (ave. less than 5) Number which follows is average of data from all survey days

R = recorded (seen or heard at times other than on 8 min. counts. Number which follows is the total number seen or heard over the duration of the survey).

HABITAT PREFENCE = habitat type most frequently recorded in during survey. If more than one then listed in descending order of usage.

G = grassland, open lava and scattered vegetation

T = thickets of brush and trees

E = edge habitat: roadsides, forest edge

U = urban: houses, rubbish dumps, livestock pens

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NOISE IMPACTS

NOISE STUDY
FOR THE PROPOSED
KEALAKEHE PLANNED COMMUNITY PROJECT
KONA, HAWAII

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JUNE 1990

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER I. SUMMARY

The existing and future traffic noise levels in the vicinity of the proposed Kealakehe Planned Community Project in Kona, Hawaii were evaluated for their potential impact on present and future noise sensitive areas. Evaluations were performed for the CY 1992 period following completion of the Kealakehe House Lots III increment, as well as for the CY 2010 period following complete project build-out. The future traffic noise levels along the primary access roadways to the project were calculated with and without the proposed development. The noise analysis assumed that the necessary roadway improvements would be implemented to accommodate the increases in future project and non-project traffic.

Along the Queen Ka'ahumanu Highway and Palani Road, traffic noise levels are expected to increase significantly by 3 to 5 Ldn between CY 1990 and CY 2010. Worsening traffic conditions may require improvements to the existing highway and other roadways in the project area. Project traffic are predicted to cause a 0.2 to 0.8 Ldn increase in traffic noise levels along the existing Queen Ka'ahumanu Highway from the present to CY 2010. Along Palani Road, project traffic are predicted to cause a 0 to 0.3 Ldn increase in traffic noise levels. These increases in traffic noise levels over a 20 year period are not considered to be significant.

Large traffic noise increases are expected to occur as a result of non-project traffic growth in the Kona area by CY 2010. The projected increases are in the order of 3 to 5 Ldn, and are the result of a three-fold increase in project and non-project traffic volumes in the Kona area. Residents along Palani Road may be impacted by future increases in traffic noise if adequate setback distances are not provided from the roadway. Noise mitigation measures should be incorporated into those roadway improvement projects which are necessary to accommodate the increased traffic volumes along Palani Road.

The Preferred Master Plan for the project locates a golf course and Community Center at 200+ FT setback distance along Queen Ka'ahumanu Highway. These uses are not normally considered to be noise sensitive. For this reason, and the relatively small increases in traffic noise associated with project traffic, the plan should not cause severe or adverse noise impacts on future noise sensitive developments along Queen Ka'ahumanu Highway.

Proposed residential developments in the mauka (or east) sections of the project may be impacted by the relatively high traffic noise levels along the north section of Palani Road and along the proposed mauka extension of Kealekehe Parkway. Noise mitigation measures, such as adequate setback distances, berms, or sound attenuation walls, may be employed to minimize traffic noise impacts on these future residences.

Unavoidable, but temporary, noise impacts may occur during the construction of the proposed project. Because construction activities are predicted to be audible at adjoining properties, the quality of the acoustic environment may be degraded to unacceptable levels during periods of construction. Mitigation measures to reduce construction noise to inaudible levels will not be practical in all cases. For this reason, the use of quiet equipment and construction curfew periods as required under the State Department of Health noise regulations are recommended to minimize construction noise impacts.

CHAPTER II. PURPOSE

One objective of this study was to describe the existing and future noise environment in the environs of the proposed Kealakehe Planned Community Project in Kona on the island of Hawaii. Traffic noise level increases and impacts associated with the proposed development were to be determined within the project site as well as along the public roadways expected to service the project traffic. Another objective was to determine future traffic noise level increases associated with both project and non-project traffic, and the potential noise impacts associated with these increases. Recommendations for minimizing these noise impacts were also to be provided as required. Assessments of possible future impacts from short term construction noise at the project site were also included in the noise study objectives.

CHAPTER III. NOISE DESCRIPTORS AND THEIR RELATIONSHIP TO LAND USE COMPATIBILITY

The noise descriptor currently used by federal agencies to assess environmental noise is the Day-Night Average Sound Level (Ldn). This descriptor incorporates a 24-hour average of instantaneous A-Weighted Sound Levels as read on a standard Sound Level Meter. By definition, the minimum averaging period for the Ldn descriptor is 24 hours. Additionally, sound levels which occur during the nighttime hours of 10:00 PM to 7:00 AM are increased by 10 decibels (dB) before computing the 24-hour average by the Ldn descriptor. A more complete list of noise descriptors is provided in **APPENDIX B** to this report.

TABLE 1, derived from **Reference 1**, presents current federal noise standards and acceptability criteria for residential land uses. Land use compatibility guidelines for various levels of environmental noise as measured by the Ldn descriptor system are shown in **FIGURE 1.** Noise levels of 55 Ldn or less occur in rural areas, or in areas which are removed from high volume roadways. In urbanized areas which are shielded from high volume streets, Ldn levels generally range from 55 to 65 Ldn, and are usually controlled by motor vehicle traffic noise. Residences which front major roadways are generally exposed to levels of 65 Ldn, and as high as 75 Ldn when the roadway is a high speed freeway. In the Kona area, noise levels at lots which front Queen Ka'ahumanu Highway and Palani Road are typically above 60 Ldn. Due to noise shielding effects from intervening structures, interior lots are usually exposed to 3 to 10 Ldn lower noise levels than the front lots which are not shielded from the traffic noise.

For determining noise acceptability for funding assistance from federal agencies (FHA/HUD and VA), an exterior noise level of 65 Ldn or lower is considered acceptable. This standard is applied nationally (**Reference 2**), including Hawaii. Because of our open-living conditions, the predominant use of naturally ventila-

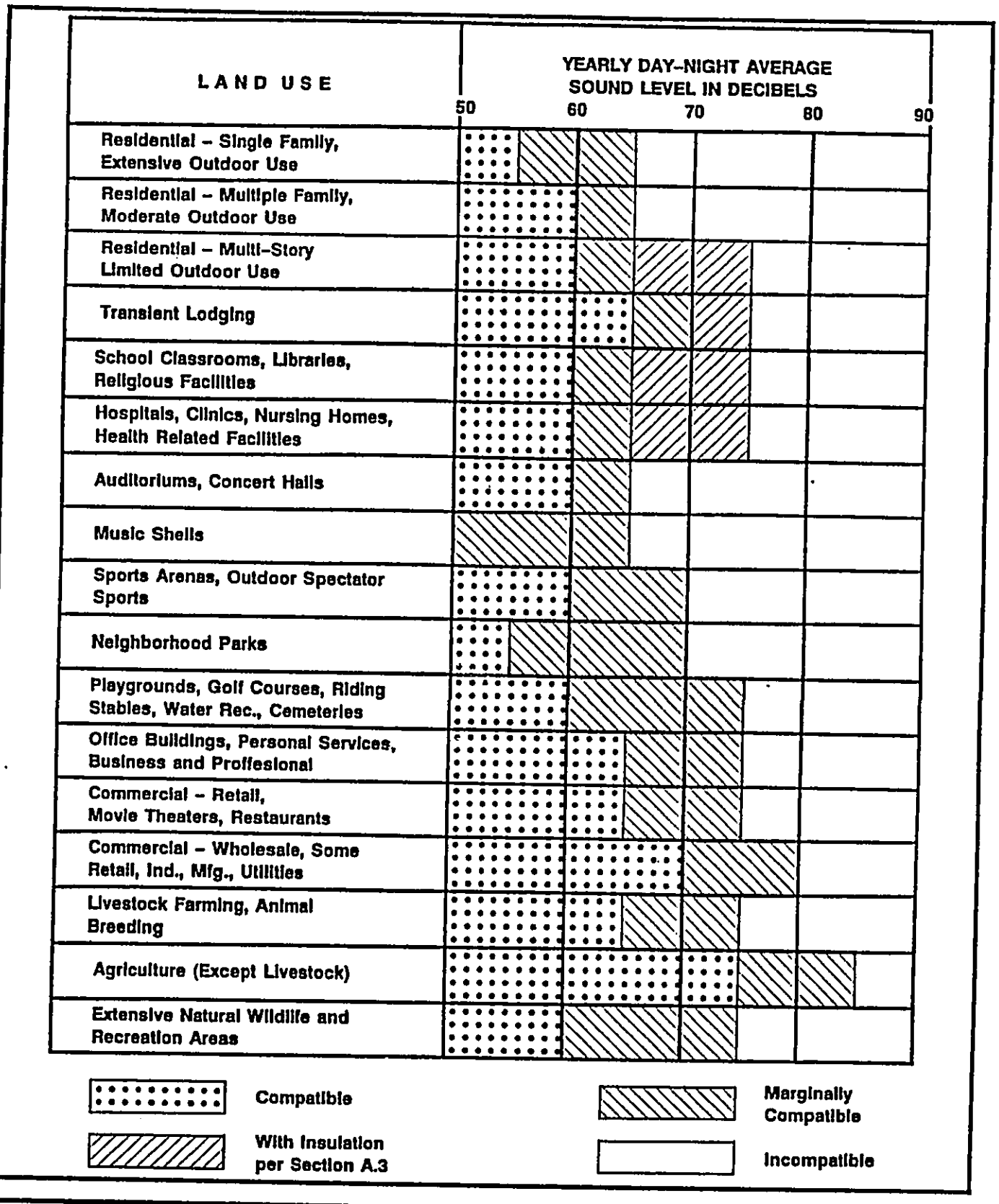
TABLE 1

EXTERIOR NOISE EXPOSURE CLASSIFICATION (RESIDENTIAL LAND USE)

NOISE EXPOSURE CLASS	DAY-NIGHT SOUND LEVEL	EQUIVALENT SOUND LEVEL	FEDERAL[1] STANDARD
Minimal Exposure	Not Exceeding 55 L_{dn}	Not Exceeding 55 L_{eq}	Unconditionally Acceptable
Moderate Exposure	Above 55 L_{dn} But Not Above 65 L_{dn}	Above 55 L_{eq} But Not Above 65 L_{eq}	Acceptable[2]
Significant Exposure	Above 65 L_{dn} But Not Above 75 L_{dn}	Above 65 L_{eq} But Not Above 75 L_{eq}	Normally Unacceptable
Severe Exposure	Above 75 L_{dn}	Above 75 L_{eq}	Unacceptable

Notes: (1) Federal Housing Administration, Veterans Administration, Department of Defense, and Department of Transportation.

(2) FHWA uses the L_{eq} instead of the L_{dn} descriptor. For planning purposes, both are equivalent if: (a) heavy trucks do not exceed 10 percent of total traffic flow in vehicles per 24 hours, and (b) traffic between 10:00 PM and 7:00 AM does not exceed 15 percent of average daily traffic flow in vehicles per 24 hours. The noise mitigation threshold used by FHWA for residences is 67 L_{eq}.



LAND USE COMPATIBILITY
WITH YEARLY DAY-NIGHT AVERAGE SOUND LEVEL
AT A SITE FOR BUILDINGS AS COMMONLY CONSTRUCTED
(Source: American National Standards Institute S3.23-1980)

FIGURE
1

ted dwellings, and the relatively low exterior-to-interior sound attenuation afforded by these naturally ventilated structures, an exterior noise level of 65 Ldn does not eliminate all risks of noise impacts. Because of these factors, and as recommended in **Reference 3**, a lower level of 55 Ldn is considered as the "Unconditionally Acceptable" (or "Near-Zero Risk") level of exterior noise. However, after considering the cost and feasibility of applying the lower level of 55 Ldn, government agencies such as FHA/HUD and VA have selected 65 Ldn as a more appropriate regulatory standard.

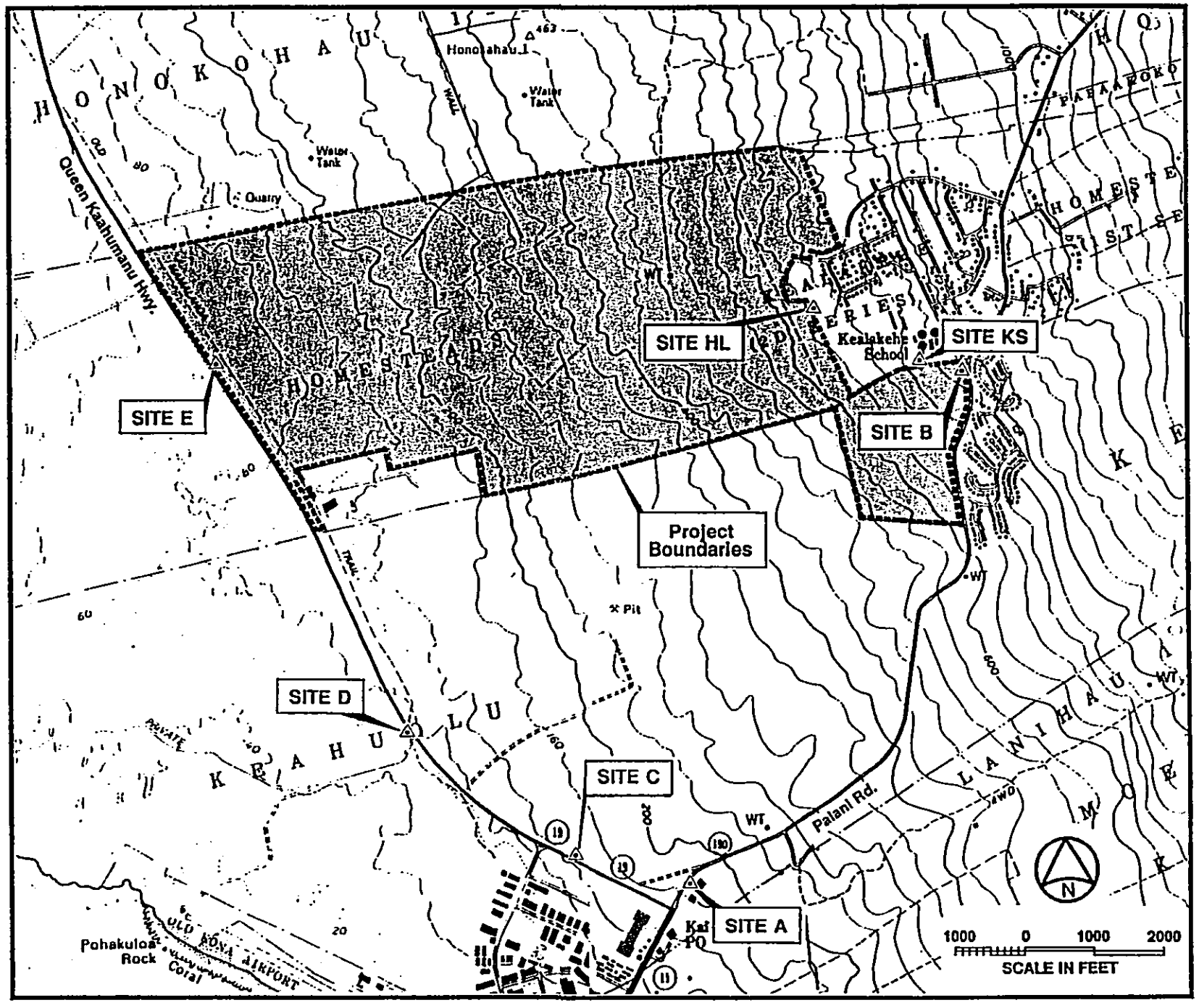
As indicated in **FIGURE 1**, exterior noise levels as high as 60 to 75 Ldn are considered to be "Compatible" or "Marginally Compatible" for those existing and planned land uses within the Civic Center area adjacent to Queen Ka'ahumanu Highway. These compatible noise levels should be achievable at the planned 200+ FT setback of the Civic Center from the highway centerline.

CHAPTER IV. GENERAL STUDY METHODOLOGY

Existing traffic noise levels were measured at seven locations in the project environs to provide a basis for developing the project's traffic noise contributions along the roadways which will service the proposed development: Queen Ka'ahumanu Highway, Palani Road, the proposed Kealekehe Parkway (Honokohau Boat Harbor Road), and the proposed Main Project Access Road. The locations of the measurement sites are shown in **FIGURE 2.** Noise measurements were performed during the latter part of June 1989. The traffic noise measurement results, and their comparisons with computer model predictions of existing traffic noise levels are summarized in **TABLE 2.** The results of the traffic noise measurements were compared with calculations of existing traffic noise levels to validate the computer model used.

Traffic noise calculations for the existing conditions as well as noise predictions for the Years 1992 and 2010 were performed using the Federal Highway Administration (FHWA) Noise Prediction Model (**Reference 4**). Traffic data entered into the noise prediction model were: hourly traffic volumes, average vehicle speeds, estimates of traffic mix, and soft ground propagation loss factor. The traffic studies for the project (**References 5 and 6**) and Hawaii State Department of Transportation counts on Queen Ka'ahumanu Highway and Palani Road (**Reference 7**), were the primary sources of data inputs to the model. For existing and future traffic, it was assumed that the average noise levels, or Leq(h), during the PM peak hour were equal to the 24-hour Ldn along each roadway segment. This assumption was based on computations of both the hourly Leq and the 24-hour Ldn of traffic noise on Queen Ka'ahumanu Highway and Palani Road (see **FIGURES 3 and 4**).

Traffic noise calculations for both the existing and future conditions in the project environs were developed for ground level receptors without the benefit of shielding effects. **FIGURE 5** identifies the major access roadways to the project for which



LOCATIONS OF NOISE MEASUREMENT SITES

FIGURE 2

TABLE 2

TRAFFIC NOISE MEASUREMENTS
(June 27, 1989)

	Location	Time of Day (HRS)	Ave.Speed (MPH)	---Hourly Traffic Volume--- Auto	Med.Truck	Heavy Truck	Measured Leq (dB)	Predicted Leq(dB)
A.	50 FT from the center-line of Palani Road at Fire Station.	0715 TO 0750	45	1,129	21	21	67.6	67.7
B.	50 FT from the center-line of Palani Road at Kealakaa St.	1525 TO 1539	45	986	21	4	64.3	64.2
C.	50 FT from the center-line of Queen Kaahumanu Hwy. at Industrial Park.	0925 TO 0954	46	1,232	29	29	68.7	68.9
D.	50 FT from the center-line of Queen Kaahumanu Hwy. at Road to Children's Center.	1012 TO 1042	48	1,009	49	34	68.1	68.4
E.	50 FT from the center-line of Queen Kaahumanu Hwy. North of Police Station.	1148 TO 1224	49	1,014	53	43	68.7	69.2
HL.	Makai Boundary of Existing Residential Area.	1841 TO 1843	N/A	N/A	N/A	N/A	43.8	N/A
KS.	Makai Boundary of Kealakehe School.	1820 TO 1829	N/A	N/A	N/A	N/A	46.3	N/A

FIGURE 3

HOURLY VARIATIONS OF TRAFFIC NOISE AT 50 FT SETBACK DISTANCE FROM THE CENTERLINE OF QUEEN KA'AHUMANU HIGHWAY AT PALANI ROAD

(TOWARD KEAHOLE AIRPORT: 5/3-5/88)

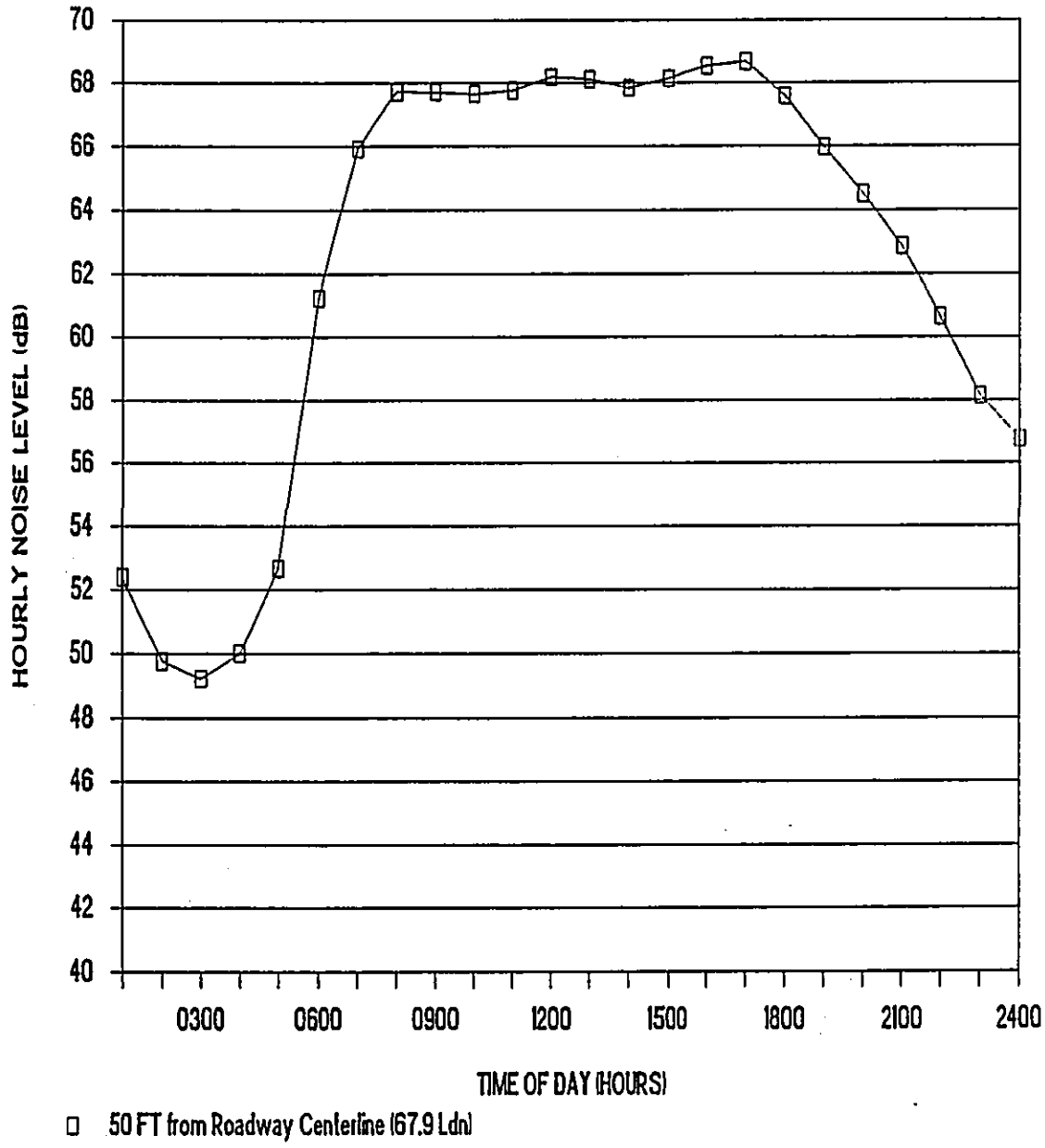
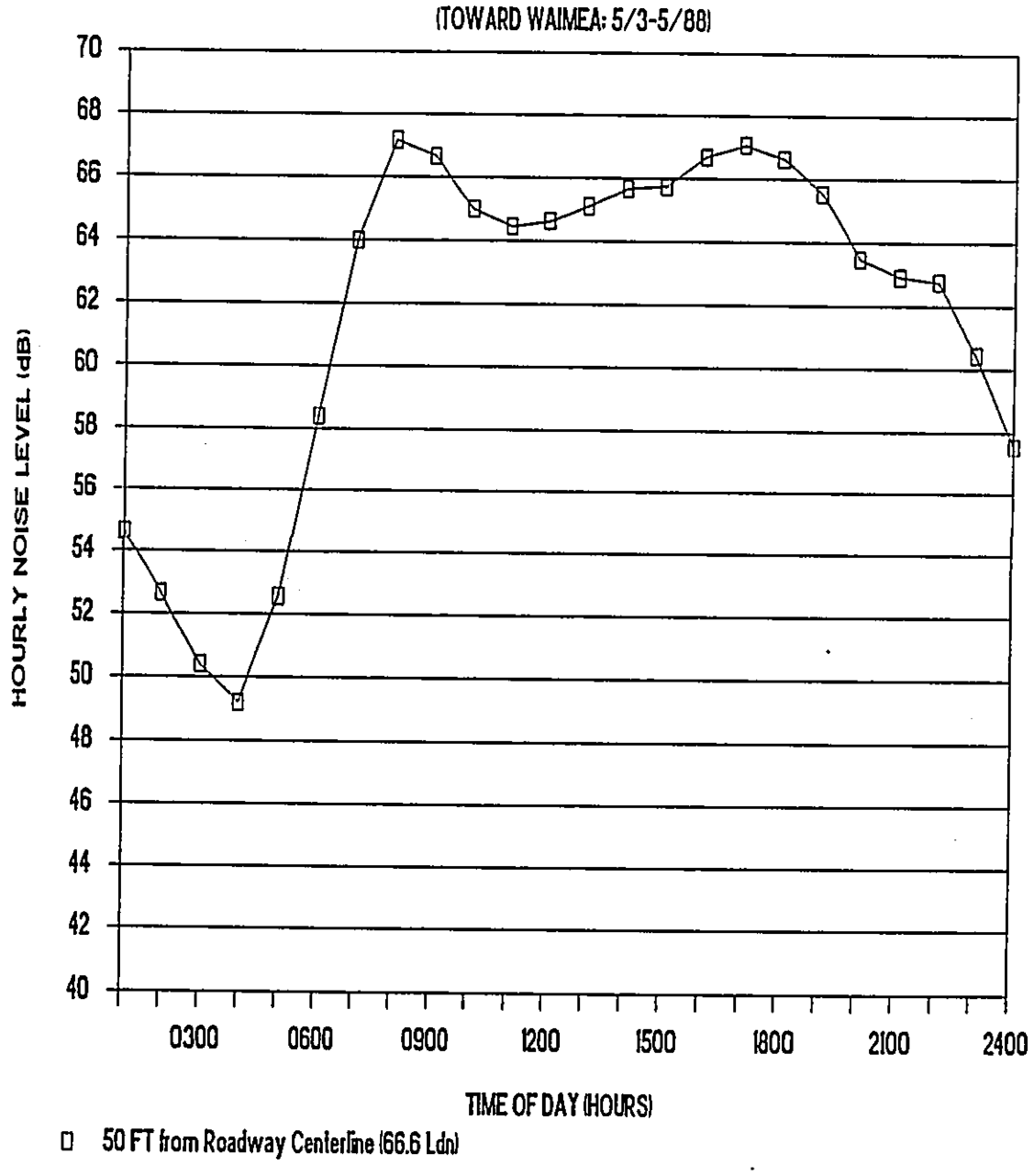
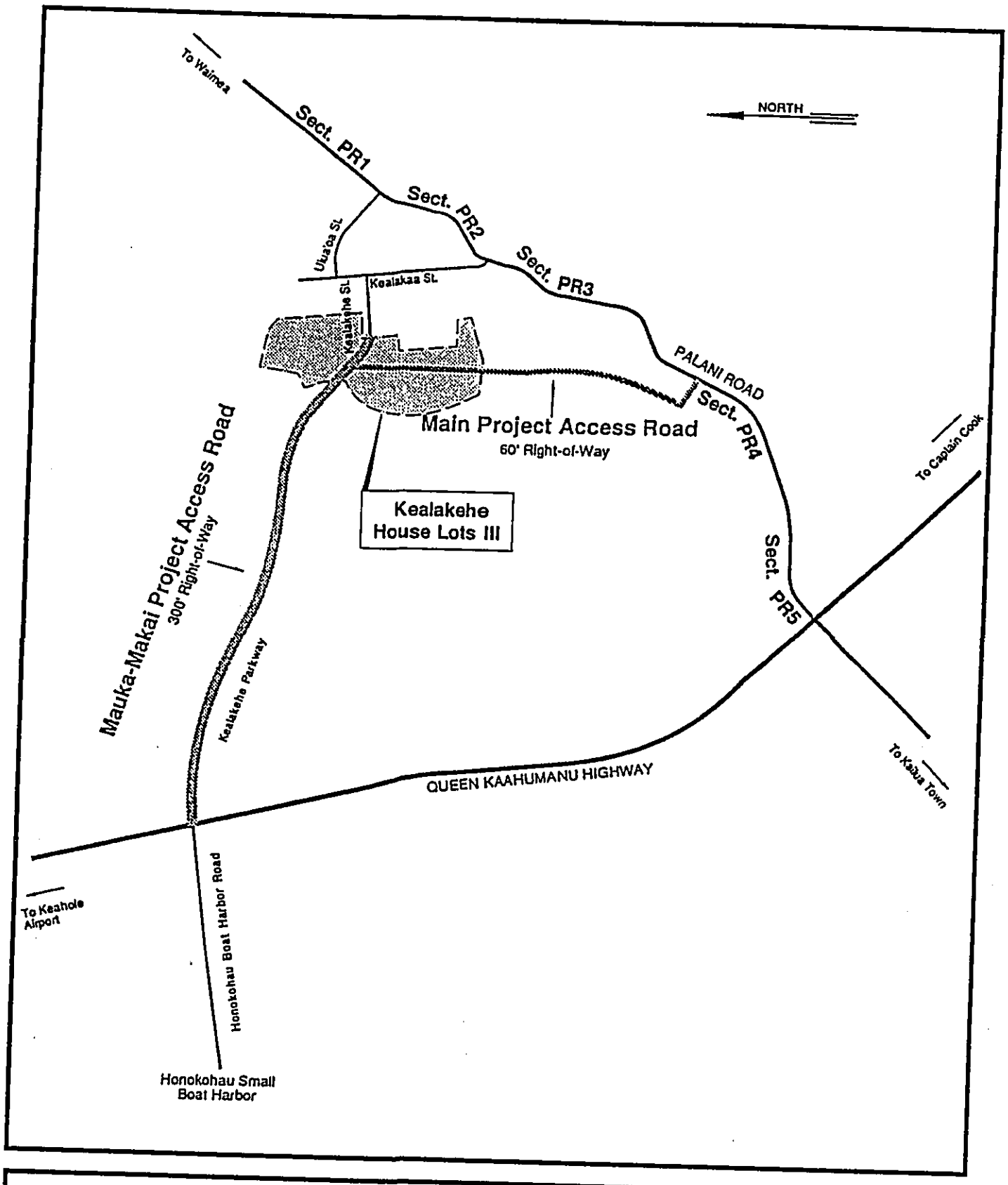


FIGURE 4

HOURLY VARIATIONS OF TRAFFIC NOISE AT 50 FT SETBACK DISTANCE FROM THE CENTERLINE OF PALANI ROAD AT QUEEN KA'AHUMANU HIGHWAY

(TOWARD WAIMEA: 5/3-5/88)





ULTIMATE ACCESS ROADWAYS TO PROJECT SITE

FIGURE 5

traffic noise levels were calculated. The forecasted increases in traffic noise levels over existing levels were calculated for conditions with and without the project. The relative contributions of non-project and project related traffic to the total noise levels were also calculated. Evaluations of possible traffic noise impacts were performed for periods following completion of the Kealakehe House Lots III increment and following total project build-out by CY 2010.

CHAPTER V. EXISTING NOISE ENVIRONMENT

The existing traffic noise levels in the project environs (see **FIGURE 2**) are in the "Significant Exposure, Normally Unacceptable" category at 50 FT distance from the centerlines of Queen Ka'ahumanu Highway and Palani Road. Traffic noise levels along the Right-of-Way of a roadway generally represent the worst case (or highest) levels due to the proximity of the Right-of-Way to the noise sources. At greater setback distances of approximately 92 to 96 FT, traffic noise along Queen Ka'ahumanu Highway decrease to the "Moderate Exposure, Acceptable" category. Setback distances of approximately 49 to 86 FT are required from the centerline of Palani Road to be in the "Moderate Exposure, Acceptable" noise exposure category.

Calculations of existing traffic noise levels during the PM peak traffic hour are presented in **TABLES 3A and 3B**. The hourly Leq (or Equivalent Sound Level) contributions from each roadway section in the project environs were calculated for comparison with forecasted traffic noise levels with and without the project. The existing setback distances from the roadways' centerlines to their associated 60, 65, and 70 Ldn contours were also calculated as shown in **TABLES 4A and 4B**. The contour line setback distances do not consider noise shielding effects or the additive contributions of traffic noise from intersecting street sections. The existing setback distances to the 65 Ldn contour lines are relatively large along Queen Ka'ahumanu Highway and the makai (or west) section of Palani Road. Along the mauka (or east) section of Palani Road, the setback distances to the 65 Ldn contour are relatively small and in the order of 50 FT. Along Ulua'oa and Kealakaa Streets, existing traffic noise levels are very low, and in the order of 50 to 60 Ldn at 50 FT setback distance from the roadways' centerlines.

Existing traffic noise levels at the mauka (inland) portions of the project site are very low (less than 60 Ldn) due to their

TABLE 3A

COMPARISONS OF EXISTING AND CY 1992 TRAFFIC NOISE LEVELS
ALONG ACCESS ROADS TO PROJECT SITE
(PM PEAK HOUR AND 50 FT FROM ROADWAY CENTERLINES)

LOCATION	SPEED (MPH)	VPH	***** HOURLY LEQ IN dB **** AUTO	MT	HT	ALL VEH
EXISTING (CY 1990) PM PEAK HR. TRAFFIC:						
Q. Ka'ahumanu Hwy. (North)	49	1,429	65.4	60.7	65.1	69.0
Q. Ka'ahumanu Hwy. (Front)	49	1,509	65.7	60.9	65.4	69.2
Q. Ka'ahumanu Hwy. (South)	48	1,509	65.3	60.6	65.1	68.9
Palani Rd. (Section PR1)	45	903	62.1	56.0	60.8	65.1
Palani Rd. (Section PR2)	45	860	61.9	55.8	60.6	64.9
Palani Rd. (Section PR3)	45	1,296	63.7	57.6	62.4	66.7
Palani Rd. (Section PR4)	45	1,412	64.1	57.9	62.7	67.0
Palani Rd. (Section PR5)	45	1,412	65.6	59.4	64.2	68.5
Ulua'oa Street	30	149	47.6	40.8	47.2	50.9
Kealakaa Street	35	481	55.3	48.2	54.0	58.1
CY 1992 PM PEAK HR. TRAFFIC WITH HOUSE LOTS III:						
Q. Ka'ahumanu Hwy. (North)	49	1,997	66.9	62.1	66.6	70.4
Q. Ka'ahumanu Hwy. (Front)	49	1,813	66.5	61.7	66.2	70.0
Q. Ka'ahumanu Hwy. (South)	48	1,813	66.1	61.4	65.9	69.7
Palani Rd. (Section PR1)	45	1,153	63.2	57.1	61.9	66.1
Palani Rd. (Section PR2)	45	1,059	62.8	56.7	61.5	65.8
Palani Rd. (Section PR3)	45	1,474	64.2	58.1	62.9	67.2
Palani Rd. (Section PR4)	45	1,681	64.8	58.7	63.5	67.8
Palani Rd. (Section PR5)	45	1,688	66.3	60.2	65.0	69.3
Ulua'oa Street	30	189	48.7	41.8	48.3	51.9
Kealakaa Street	35	430	54.8	47.7	53.5	57.7
Kealakehe Parkway	47	315	60.3	54.1	58.7	63.1
Main Project Access Road	37	179	51.9	46.1	51.7	55.3

Notes:

The following assumed traffic mixes of autos, medium trucks, and heavy trucks were used for existing and future conditions:

(a) Queen Ka'ahumanu Highway: 95.0% autos, 2.5% medium trucks, and 2.5% heavy trucks or buses.

(b) Palani Road: 96.4% autos, 1.8% medium trucks, and 1.8% heavy trucks or buses.

(c) Ulua'oa and Kealakaa Streets: 97.4% autos, 1.3% medium trucks, and 1.3% heavy trucks or buses.

(d) Kealakehe Parkway and Main Project Access Road: 96.4% autos, 1.8% medium trucks, and 1.8% heavy trucks or buses.

TABLE 3B

COMPARISONS OF EXISTING AND CY 2010 TRAFFIC NOISE LEVELS
ALONG ACCESS ROADS TO PROJECT SITE
(PM PEAK HOUR AND 50 FT FROM ROADWAY CENTERLINES)

LOCATION	SPEED (MPH)	VPH	***** HOURLY LEQ IN dB **** AUTO	MT	HT	ALL VEH
EXISTING (CY 1990) PM PEAK HR. TRAFFIC:						
Q. Ka'ahumanu Hwy. (North)	49	1,429	65.4	60.7	65.1	69.0
Q. Ka'ahumanu Hwy. (Front)	49	1,509	65.7	60.9	65.4	69.2
Q. Ka'ahumanu Hwy. (South)	48	1,509	65.3	60.6	65.1	68.9
Palani Rd. (Section PR1)	45	903	62.1	56.0	60.8	65.1
Palani Rd. (Section PR2)	45	860	61.9	55.8	60.6	64.9
Palani Rd. (Section PR3)	45	1,296	63.7	57.6	62.4	66.7
Palani Rd. (Section PR4)	45	1,412	64.1	57.9	62.7	67.0
Palani Rd. (Section PR5)	45	1,412	65.6	59.4	64.2	68.5
Ulua'oa Street	30	149	47.6	40.8	47.2	50.9
Kealakaa Street	35	481	55.3	48.2	54.0	58.1
CY 2010 PM PEAK HR. TRAFFIC WITH FULL PROJECT DEVELOPMENT:						
Q. Ka'ahumanu Hwy. (North)	49	4,590	70.5	65.7	70.2	74.1
Q. Ka'ahumanu Hwy. (Front)	49	4,020	69.9	65.2	69.6	73.5
Q. Ka'ahumanu Hwy. (South)	48	4,020	69.6	64.9	69.4	73.2
Palani Rd. (Section PR5)	45	3,050	68.9	62.8	67.6	71.9
Kealakehe Parkway	47	3,080	70.2	64.0	68.6	73.0

Notes:

The following assumed traffic mixes of autos, medium trucks, and heavy trucks were used for existing and future conditions:

(a) Queen Ka'ahumanu Highway: 95.0% autos, 2.5% medium trucks, and 2.5% heavy trucks or buses.

(b) Palani Road: 96.4% autos, 1.8% medium trucks, and 1.8% heavy trucks or buses.

(c) Ulua'oa and Kealakaa Streets: 97.4% autos, 1.3% medium trucks, and 1.3% heavy trucks or buses.

(d) Kealakehe Parkway and Main Project Access Road: 96.4% autos, 1.8% medium trucks, and 1.8% heavy trucks or buses.

TABLE 4A

EXISTING AND CY 1992 DISTANCES TO 60, 65, AND 70 Ldn CONTOURS

STREET SECTION	60 Ldn SETBACK (FT) EXISTING	60 Ldn SETBACK (FT) CY 1992	65 Ldn SETBACK (FT) EXISTING	65 Ldn SETBACK (FT) CY 1992	70 Ldn SETBACK(FT) EXISTING	70 Ldn SETBACK(FT) CY 1992
Q. Ka'ahumanu Hwy. (North)	199	249	92	115	43	54
Q. Ka'ahumanu Hwy. (Front)	206	233	96	108	44	50
Q. Ka'ahumanu Hwy. (South)	197	223	92	104	43	48
Palani Rd. (Section PR1)	109	129	51	60	24	28
Palani Rd. (Section PR2)	106	121	49	56	23	26
Palani Rd. (Section PR3)	139	151	64	70	30	33
Palani Rd. (Section PR4)	147	165	68	77	32	36
Palani Rd. (Section PR5)	185	209	86	97	40	45
Ulua'oa Street	12	14	6	7	3	3
Kealakaa Street	38	35	17	16	8	8
Kealakehe Parkway	N/A	81	N/A	38	N/A	17
Main Project Access Road	N/A	24	N/A	11	N/A	5

Notes:

(1) All setback distances are from the roadways' centerlines.
(2) See TABLE 3A for traffic volume, speed, and mix assumptions.
(3) Ldn assumed to be equal to PM Peak Hour Leq along all roadways.
(4) Setback distances are for unobstructed line-of-sight conditions.
(5) Soft ground conditions assumed along all roadways.

TABLE 4B

EXISTING AND CY 2010 DISTANCES TO 60, 65, AND 70 Ldn CONTOURS

STREET SECTION	60 Ldn SETBACK (FT) EXISTING	60 Ldn SETBACK (FT) CY 2010	65 Ldn SETBACK (FT) EXISTING	65 Ldn SETBACK (FT) CY 2010	70 Ldn SETBACK(FT) EXISTING	70 Ldn SETBACK(FT) CY 2010
Q. Ka'ahumanu Hwy. (North)	199	433	92	201	43	93
Q. Ka'ahumanu Hwy. (Front)	206	396	96	184	44	85
Q. Ka'ahumanu Hwy. (South)	197	379	92	176	43	82
Palani Rd. (Section PR5)	185	309	86	144	40	67
Kealakehe Parkway	N/A	370	N/A	172	N/A	80

Notes:

(1) All setback distances are from the roadways' centerlines.
(2) See TABLE 3B for traffic volume, speed, and mix assumptions.
(3) Ldn assumed to be equal to PM Peak Hour Leq along all roadways.
(4) Setback distances are for unobstructed line-of-sight conditions.
(5) Soft ground conditions assumed along all roadways.

large setback distances from Queen Ka'ahumanu Highway. The proposed residential areas of the project are located beyond a quarter mile from the highway. At 49 FT or greater setback distance from the centerline of the mauka sections of Palani Road, traffic noise levels from this lower volume roadway are less than 65 Ldn. Existing background ambient noise measurements obtained at Sites "HL" and "KS" confirm that noise levels in the mauka portions of the project are very low, and in the order of 45 to 50 Ldn. Based on the above information, it was concluded that the existing noise levels at the proposed residential portions of the project are not expected to exceed current FHA/HUD noise standards or cause adverse noise impacts on future project residents.

CHAPTER VI. FUTURE TRAFFIC NOISE ENVIRONMENT

Following Completion of Housing Lots III. Predictions of future traffic noise levels following completion of the proposed Kealakehe House Lots II residential subdivision were made using the traffic volume assignments of Reference 5 for CY 1992 with and without the project. The future projections of project plus non-project traffic on the roadways which would service the project are shown in **TABLE 3A** for the PM peak hour of traffic. As indicated in **TABLE 3A**, by CY 1992, traffic noise levels on existing roadways will increase moderately by 0.6 to 1.5 dB.

TABLE 4A summarizes the predicted setback distances to the 60, 65, and 70 Ldn traffic noise contour lines along the roadways servicing the House Lots III increment and attributable to both project plus non-project traffic. The setback distances in **TABLE 4A** do not include the beneficial effects of noise shielding from terrain features and highway cuts, or the detrimental effects of additive contributions of noise from intersecting streets. As indicated in **TABLE 4A**, moderately large setback distances to the 65 Ldn contour of 104 to 115 FT from the centerline of Queen Ka'ahumanu Highway are predicted in CY 1992. Along Palani Road, shorter setback distances of 56 to 97 FT to the 65 Ldn contour line are predicted.

TABLE 5A presents the predicted increases in traffic noise levels associated with non-project and project traffic by CY 1992, and as measured by the Ldn descriptor system. As indicated in **TABLE 5A**, the increases in traffic noise along Queen Ka'ahumanu Highway due to House Lots III project traffic are very small or insignificant when compared to those increases expected from non-project traffic. Similar conclusions apply along Palani Road. Project traffic noise increases are expected to be greatest relative to non-project traffic along Ulua'oa and Kealakehe Streets. However, current traffic volumes and noise levels along these two streets are very low, and the additional project traffic on these

TABLE 5A

CALCULATIONS OF PROJECT AND NON-PROJECT
TRAFFIC NOISE CONTRIBUTIONS (CY 1992)

STREET SECTION	NOISE LEVEL INCREASES (Ldn) DUE TO NON-PROJECT TRAFFIC	PROJECT TRAFFIC
Q. Ka'ahumanu Hwy. (North)	1.0	0.5
Q. Ka'ahumanu Hwy. (Front)	0.9	-0.1
Q. Ka'ahumanu Hwy. (South)	0.9	-0.1
Palani Rd. (Section PR1)	0.7	0.3
Palani Rd. (Section PR2)	0.8	0.1
Palani Rd. (Section PR3)	0.5	0.0
Palani Rd. (Section PR4)	0.5	0.2
Palani Rd. (Section PR5)	0.5	0.3
Ulua'oa Street	0.0	1.0
Kealakaa Street	0.0	-0.5
Kealakehe Parkway	N/A	63.1
Main Project Access Road	N/A	55.3

two streets will not increase noise levels to unacceptable levels.

As a result of the construction of the Main Project Access Road, traffic noise levels are expected to increase at the inland areas mauka of Queen Ka'ahumanu Highway. By CY 1992, following the construction of this new roadway, background ambient noise levels at the future House Lots III residential area (see **FIGURE 5**) are expected to increase significantly from existing low levels. However, in the planned residential areas fronting these two roadways, setback distances to the 65 Ldn contour lines are expected to be less than 20 FT from the centerline of the Main Project Access Road. For this reason, traffic noise impacts along this roadway are not expected following completion of the House Lots III increment in CY 1992.

Following Complete Project Build-Out. The CY 2010 projections of project plus non-project traffic on the roadways which would service the project are shown in **TABLE 3B** for the PM peak hour of traffic. As indicated in **TABLE 3B**, by CY 2010, traffic noise levels on existing roadways will increase significantly by 3 to 5 dB.

TABLE 4B summarizes the predicted setback distances to the 60, 65, and 70 Ldn traffic noise contour lines along the roadways in CY 2010 and attributable to both project plus non-project traffic. The setback distances in **TABLE 4B** do not include the beneficial effects of noise shielding from terrain features and highway cuts, or the detrimental effects of additive contributions of noise from intersecting streets. As indicated in **TABLE 4B**, relatively large setback distances to the 65 Ldn contour of 176 to 201 FT from the centerline of Queen Ka'ahumanu Highway are predicted in CY 2010. Along Palani Road, moderately large setback distances of 100 to 144 FT to the 65 Ldn contour line are predicted.

TABLE 5B presents the predicted increases in traffic noise levels associated with non-project and project traffic by CY 2010, and as measured by the Ldn descriptor system. As indicated in **TABLE 5B**, the increases in traffic noise along Queen Ka'ahumanu

TABLE 5B

CALCULATIONS OF PROJECT AND NON-PROJECT
TRAFFIC NOISE CONTRIBUTIONS (CY 2010)

STREET SECTION	NOISE LEVEL INCREASES (Ldn) DUE TO NON-PROJECT TRAFFIC	PROJECT TRAFFIC
Q. Ka'ahumanu Hwy. (North)	4.3	0.8
Q. Ka'ahumanu Hwy. (Front)	4.1	0.2
Q. Ka'ahumanu Hwy. (South)	4.1	0.2
Palani Rd. (Section PR5)	3.4	-0.1
Kealakehe Parkway	N/A	73.0

Highway due to project traffic are very small or insignificant when compared to those increases expected from non-project traffic. Similar conclusions apply along Palani Road. Project traffic noise increases are expected to be greatest relative to non-project traffic along Ulua'oa and Kealakehe Streets, and the two new access roadways to the project site.

As a result of the construction of the mauka portions of the Kealakehe Parkway, traffic noise levels are expected to increase at the inland areas mauka of Queen Ka'ahumanu Highway and along the north boundary of the project. By CY 2010, following the construction of the parkway, background ambient noise levels at planned residential areas along the parkways are expected to increase significantly from existing low levels. Future traffic noise levels along the Right-of-Way and at intersection with Queen Ka'ahumanu Highway are expected to be slightly above 65 Ldn following complete project build-out. Although commercial and golf course uses are planned at the intersection, traffic noise mitigation measures may be required along the planned residential areas fronting this roadway.

CHAPTER VII. DISCUSSION OF PROJECT RELATED TRAFFIC NOISE IMPACTS AND POSSIBLE NOISE MITIGATION MEASURES

The increases in traffic noise levels attributable to the project from the present to CY 2010 are predicted to range from 0.2 to 0.8 Ldn along Queen Ka'ahumanu Highway, where traffic noise levels are expected to remain above 65 Ldn along the highway Right-of-Way. This degree of increase in traffic noise levels attributable to the project will be difficult to perceive over a 20-year period from CY 1990 to CY 2010, and is not considered to be significant. Existing and planned land uses along the highway are primarily commercial and light industrial. For these reasons, traffic noise impacts along Queen Ka'ahumanu Highway and resulting from project traffic are not considered to be serious.

Relatively large increases in traffic noise levels along the improved Palani Road are expected to occur as a result of project plus non-project traffic. By CY 2010, traffic noise levels are expected to increase along Palani Road by 3.4 Ldn, primarily as a result of non-project traffic. Setback distances of 100 to 144 FT from Palani Road's centerline will be required to meet FHA/HUD noise standards under unobstructed line-of-sight conditions between the roadway and noise sensitive receptors. Under conditions of noise shielding by terrain features or man-made obstructions, setback distances required to meet the FHA/HUD standard would be significantly less, and be probably less than 100 FT from the roadway centerline.

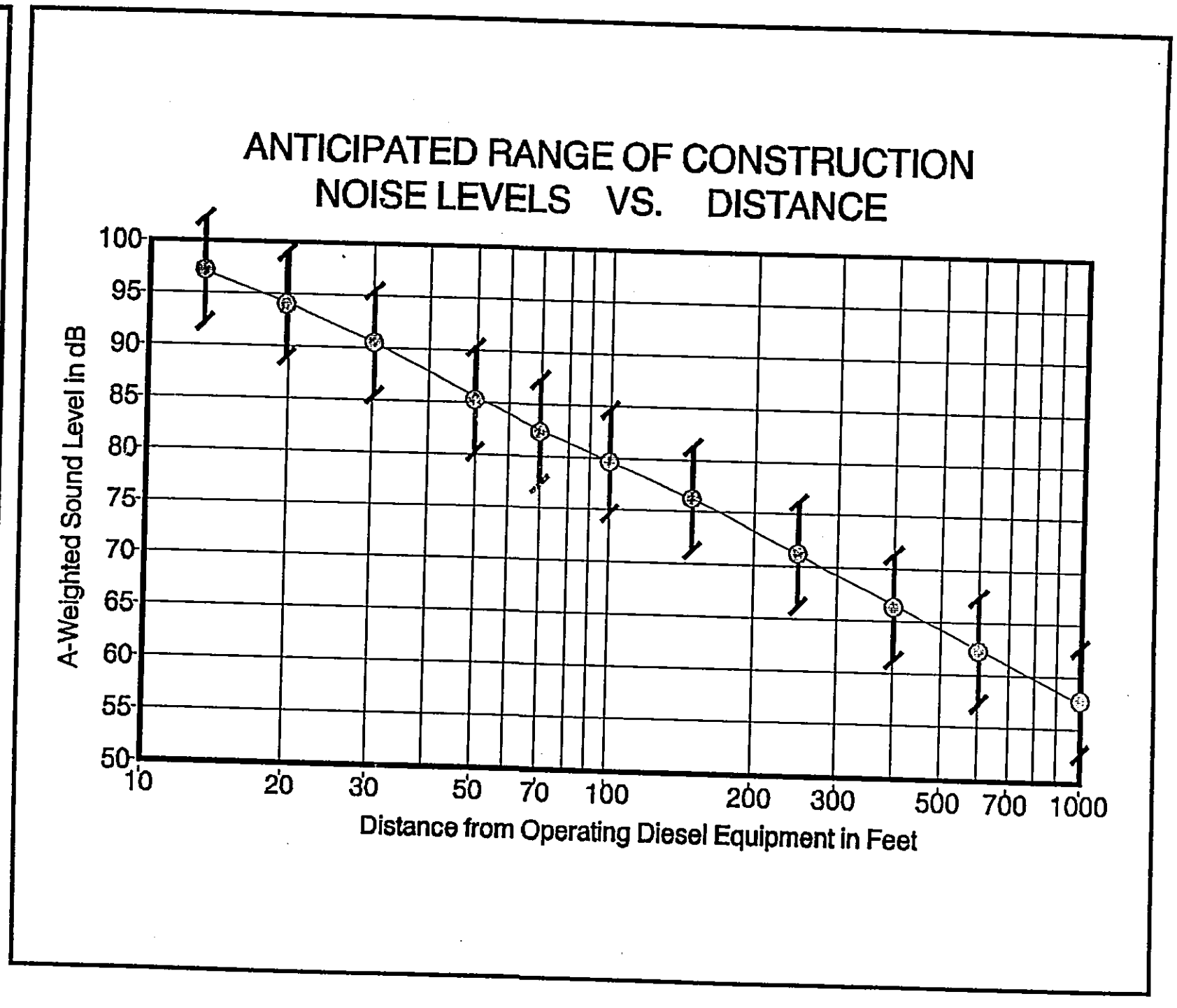
Potential noise impacts along the improved Palani Road are possible, both in respect to existing and planned noise sensitive receptors along the roadway. Existing residences located along the roadway may be impacted by the added traffic noise as well as by the future roadway improvements if noise mitigation measures are not included with the construction of the roadway improvements. Mitigation of off-site traffic noise impacts are generally performed by individual property owners fronting the roadways'

Right-of-Way or by public agencies during roadway improvement projects. These mitigation measures generally take the form of increased setbacks, sound attenuating walls, total closure and air conditioning, or the use of sound attenuating windows. Severe noise impacts should not occur as a result of the proposed project as long as noise mitigation measures are incorporated into any improvement projects along Palani Road.

CHAPTER VIII. OTHER NON-TRAFFIC NOISE CONSIDERATIONS

Construction Noise. Audible construction noise will probably be unavoidable during the entire project construction period. The total period of construction is unknown, but it is anticipated that the actual work will be moving from one location on the project site to another during that period. Actual length of exposure to construction noise at any receptor location will probably be less than the total construction period for the entire project. Typical levels of noise from construction activity (excluding pile driving activity) are shown in **FIGURE 6**. The impulsive noise levels of impact pile drivers are approximately 15 dB higher than the levels shown in **FIGURE 6**, while the intermittent noise levels of vibratory pile drivers are at the upper end of the noise level ranges depicted in the figure. Adverse impacts from construction noise are not expected to be in the "public health and welfare" category due to the temporary nature of the work and due to the administrative controls available for its regulation. Instead, these impacts will probably be limited to the temporary degradation of the quality of the acoustic environment near the project site.

Mitigation of construction noise to inaudible levels will not be practical in all cases due to the intensity of construction noise sources (80 to 90+ dB at 50 FT distance), and due to the exterior nature of the work (pile driving, grading and earth moving, trenching, concrete pouring, hammering, etc.). The use of properly muffled construction equipment should be required on the job site. In addition, if soil conditions allow, the use of vibratory pile driving equipment is also recommended for minimizing construction noise impacts. The incorporation of State Department of Health construction noise limits and curfew times, which are applicable on the island of Oahu (**Reference 8**), is another noise mitigation measure which can be applied to this project. **TABLE 6** depicts the allowed hours of construction for normal construction



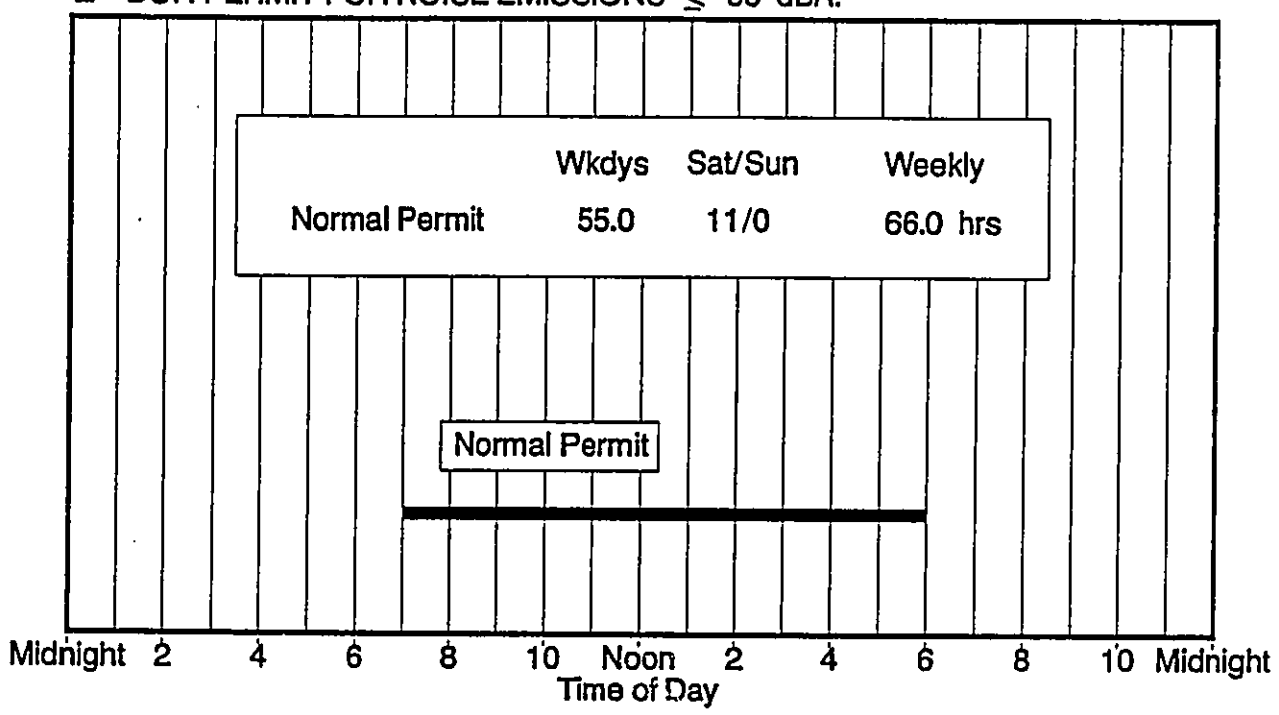
CONSTRUCTION NOISE LEVELS VS. DISTANCE

FIGURE 6

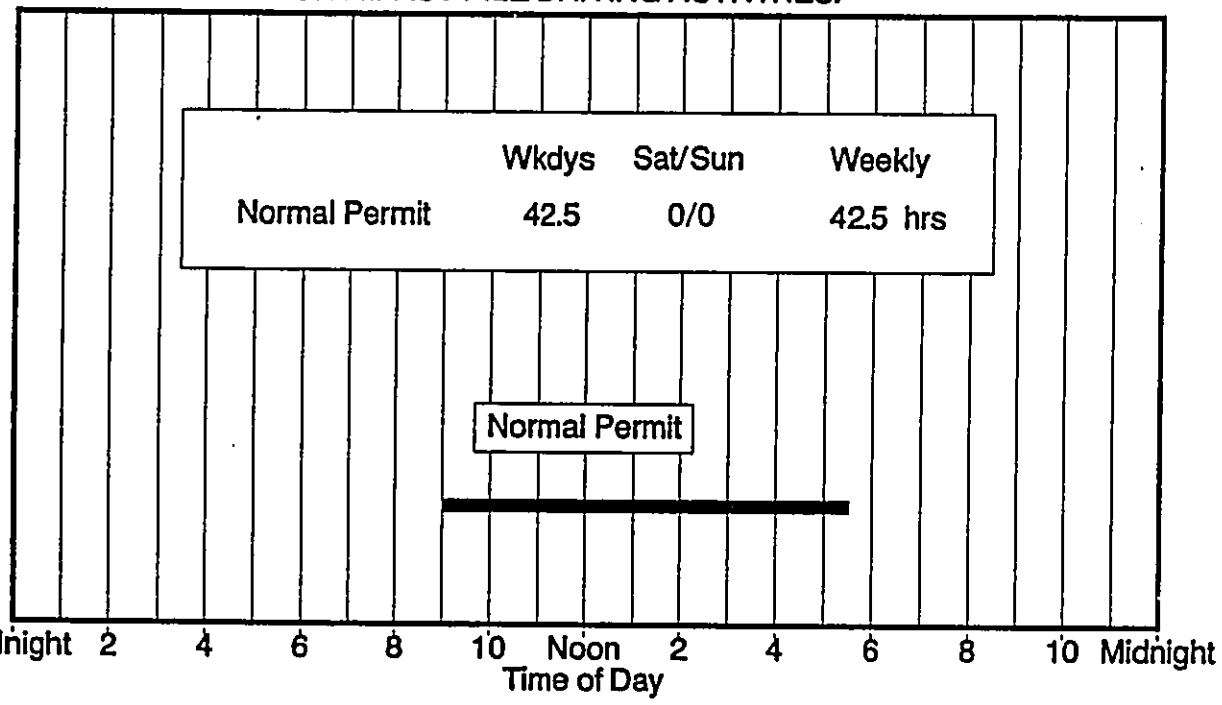
TABLE 6

AVAILABLE WORK HOURS UNDER DOH PERMIT PROCEDURES FOR CONSTRUCTION NOISE

a. DOH PERMIT FOR NOISE EMISSIONS ≤ 95 dBA.



b. DOH PERMIT FOR IMPACT PILE DRIVING ACTIVITIES.



noise (levels which do not exceed 95 dB at the project's property line) and for construction noise which exceed 95 dB at the project's property line. Noisy construction activities are not allowed on holidays under the DOH permit procedures.

APPENDIX A. REFERENCES

(1) "Guidelines for Considering Noise in Land Use Planning and Control"; Federal Interagency Committee on Urban Noise; June 1980.

(2) "Environmental Criteria and Standards, Noise Abatement and Control, 24 CFR, Part 51, Subpart B"; U.S. Department of Housing and Urban Development; July 12, 1979.

(3) "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety"; Environmental Protection Agency (EPA 550/9-74-004); March 1974.

(4) Barry, T. and J. Reagan, "FHWA Highway Traffic Noise Prediction Model"; FHWA-RD-77-108, Federal Highway Administration; Washington, D.C.; December 1978.

(5) "Traffic Impact Assessment Report for the Kealakehe House Lots III;" Pacific Planning & Engineering, Inc.; February 1990.

(6) Transmittal from Pacific Planning & Engineering, Inc. containing CY 2010 traffic projections; June 21, 1990.

(7) May 3-5, 1988 24-Hour Traffic Counts; Queen Ka'ahumanu Highway at Palani Road; Hawaii State Department of Transportation.

(8) "Title 11, Administrative Rules, Chapter 43, Community Noise Control for Oahu"; Hawaii State Department of Health; November 6, 1981.

APPENDIX B

EXCERPTS FROM EPA'S ACOUSTIC TERMINOLOGY GUIDE

Descriptor Symbol Usage

The recommended symbols for the commonly used acoustic descriptors based on A-weighting are contained in Table I. As most acoustic criteria and standards used by EPA are derived from the A-weighted sound level, almost all descriptor symbol usage guidance is contained in Table I.

Since acoustic nomenclature includes weighting networks other than "A" and measurements other than pressure, an expansion of Table I was developed (Table II). The group adopted the ANSI descriptor-symbol scheme which is structured into three stages. The first stage indicates that the descriptor is a level (i.e., based upon the logarithm of a ratio), the second stage indicates the type of quantity (power, pressure, or sound exposure), and the third stage indicates the weighting network (A, B, C, D, E.....). If no weighting network is specified, "A" weighting is understood. Exceptions are the A-weighted sound level and the A-weighted peak sound level which require that the "A" be specified. For convenience in those situations in which an A-weighted descriptor is being compared to that of another weighting, the alternative column in Table II permits the inclusion of the "A". For example, a report on blast noise might wish to contrast the LCdn with the LAdn.

Although not included in the tables, it is also recommended that "Lpn" and "LepN" be used as symbols for perceived noise levels and effective perceived noise levels, respectively.

It is recommended that in their initial use within a report, such terms be written in full, rather than abbreviated. An example of preferred usage is as follows:

The A-weighted sound level (LA) was measured before and after the installation of acoustical treatment. The measured LA values were 85 and 75 dB respectively.

Descriptor Nomenclature

With regard to energy averaging over time, the term "average" should be discouraged in favor of the term "equivalent". Hence, Leq, is designated the "equivalent sound level". For Ld, Ln, and Ldn, "equivalent" need not be stated since the concept of day, night, or day-night averaging is by definition understood. Therefore, the designations are "day sound level", "night sound level", and "day-night sound level", respectively.

The peak sound level is the logarithmic ratio of peak sound pressure to a reference pressure and not the maximum root mean square pressure. While the latter is the maximum sound pressure level, it is often incorrectly labelled peak. In that sound level meters have "peak" settings, this distinction is most important.

"Background ambient" should be used in lieu of "background", "ambient", "residual", or "indigenous" to describe the level characteristics of the general background noise due to the contribution of many unidentifiable noise sources near and far.

With regard to units, it is recommended that the unit decibel (abbreviated dB) be used without modification. Hence, DBA, PNdB, and EPNdB are not to be used. Examples of this preferred usage are: the Perceived Noise Level (Lpn was found to be 75 dB. Lpn = 75 dB). This decision was based upon the recommendation of the National Bureau of Standards, and the policies of ANSI and the Acoustical Society of America, all of which disallow any modification of bel except for prefixes indicating its multiples or submultiples (e.g., deci).

Noise Impact

In discussing noise impact, it is recommended that "Level Weighted Population" (LWP) replace "Equivalent Noise Impact" (ENI). The term "Relative Change of Impact" (RCI) shall be used for comparing the relative differences in LWP between two alternatives.

Further, when appropriate, "Noise Impact Index" (NII) and "Population Weighed Loss of Hearing" (PHL) shall be used consistent with CHABA Working Group 69 Report Guidelines for Preparing Environmental Impact Statements (1977).

APPENDIX B (CONTINUED)

TABLE I

A-WEIGHTED RECOMMENDED DESCRIPTOR LIST

TERM	SYMBOL
1. A-Weighted Sound Level	L_A
2. A-Weighted Sound Power Level	L_{WA}
3. Maximum A-Weighted Sound Level	L_{max}
4. Peak A-Weighted Sound Level	L_{Apk}
5. Level Exceeded x% of the Time	L_x
6. Equivalent Sound Level	L_{eq}
7. Equivalent Sound Level over Time (T) (1)	$L_{eq(T)}$
8. Day Sound Level	L_d
9. Night Sound Level	L_n
10. Day-Night Sound Level	L_{dn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$
12. Sound Exposure Level	L_{SE}

(1) Unless otherwise specified, time is in hours (e.g. the hourly equivalent level is $L_{eq(1)}$). Time may be specified in non-quantitative terms (e.g., could be specified a $L_{eq(WASH)}$ to mean the washing cycle noise for a washing machine).

SOURCE: EPA ACOUSTIC TERMINOLOGY GUIDE, BNA 8-14-78, NOISE REGULATION REPORTER.

APPENDIX B (CONTINUED)

TABLE II

RECOMMENDED DESCRIPTOR LIST

TERM	A-WEIGHTING	ALTERNATIVE[1] A-WEIGHTING	OTHER[2] WEIGHTING	UNWEIGHTED
1. Sound (Pressure)[3] Level	L_A	L_{pA}	L_B, L_{pB}	L_p
2. Sound Power Level	L_{WA}		L_{WB}	L_W
3. Max. Sound Level	L_{max}	L_{Amax}	L_{Bmax}	L_{pmax}
4. Peak Sound (Pressure) Level	L_{Apk}		L_{Bpk}	L_{pk}
5. Level Exceeded x% of the time	L_x	L_{Ax}	L_{Bx}	L_{px}
6. Equivalent Sound Level	L_{eq}	L_{Aeq}	L_{Beq}	L_{peq}
7. Equivalent Sound Level[4] Over Time(T)	$L_{eq(T)}$	$L_{Aeq(T)}$	$L_{Beq(T)}$	$L_{peq(T)}$
8. Day Sound Level	L_d	L_{Ad}	L_d	L_{pd}
9. Night Sound Level	L_n	L_{An}	L_{Bn}	L_{pn}
10. Day-Night Sound Level	L_{dn}	L_{Adn}	L_{Bdn}	L_{pdn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$	$L_{Adn(Y)}$	$L_{Bdn(Y)}$	$L_{pdn(Y)}$
12. Sound Exposure Level	L_S	L_{SA}	L_{SB}	L_{Sp}
13. Energy Average value over (non-time domain) set of observations	$L_{eq(e)}$	$L_{Aeq(e)}$	$L_{Beq(e)}$	$L_{peq(e)}$
14. Level exceeded x% of the total set of (non-time domain) observations	$L_{x(e)}$	$L_{Ax(e)}$	$L_{Bx(e)}$	$L_{px(e)}$
15. Average L_x value	L_x	L_{Ax}	L_{Bx}	L_{px}

(1) "Alternative" symbols may be used to assure clarity or consistency.

(2) Only B-weighting shown. Applies also to C,D,E,.....weighting.

(3) The term "pressure" is used only for the unweighted level.

(4) Unless otherwise specified, time is in hours (e.g., the hourly equivalent level is Leq(1). Time may be specified in non-quantitative terms (e.g., could be specified as Leq(WASH) to mean the washing cycle noise for a washing machine.

SOCIAL IMPACTS

COMMUNITY RESOURCES, INC.

==========

SOCIO-ECONOMIC IMPACT ASSESSMENT OF

PROPOSED KEALAKEHE RESIDENTIAL DEVELOPMENT,

NORTH KONA, HAWAII

==========

Prepared for:

Belt Collins & Associates

and

Housing Finance Development Corporation, State of Hawaii

Prepared by:

Community Resources, Inc.

Date:

Original Draft, January 1990,
With Selected Factual Updates, July 1990

Personnel involved in CRI's work on this project: John M. Knox, Ph.D., Principal, CRI staff (John Kirkpatrick, Heidi Meeker, Bob Stanfield, and Paula Yanagisako), and CRI associate William H. Dendle, III.

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EXECUTIVE SUMMARY

The Hawaii State Housing Finance Development Corporation has proposed development of a residential community at Kealakehe, North Kona, Hawaii County. The project will eventually include about 3,900 residential units, a public golf course, a neighborhood commercial area, roadways, and sites for schools and other public facilities.

The primary aim of the project is to provide affordable housing in a rapidly growing region. About 60% of the homes in the project will be priced to rent or sell to families with low, or moderate income(individuals and families earning below 120% of the County's median income) or special needs groups. The project responds to an existing shortage of housing for these groups and to expected growth in the resident population over the next 20 years.

Community Issues and Concerns: When West Hawaii residents were interviewed for this study, most viewed the project in the light of perceived problems in the area:

- They supported the project as the first serious effort to alleviate the shortage of available housing, and as making homeownership possible for many in the area;
- They were concerned that the project could aggravate existing infrastructure problems -- notably, traffic congestion -- and hoped that project infrastructure would be put in place quickly, in order not to strain existing systems; and
- They saw the Kealakehe project as potentially a model community. Its design, financing, and governance could avoid problems perceived in some existing neighborhoods.

West Hawaii residents were uncertain about working families' ability to afford homes in the project. Some thought that resort workers and other residents would economize to afford homes, while others expected that more affluent people would end up owning the bulk of the homes.

Several interviewees were concerned about impacts on nearby residential areas. More raised questions about the State's makai land, which is not included in the project. They sought assurances that the land will remain open.

Socio-Economic Impacts: Economic and demographic growth in West Hawaii are expected to occur with or without the project. The project's major impacts are functions of locating many homes in one place, organizing a planned community, and providing affordable housing.

At buildout, the project will house about 7,500 to 11,200 people. (Population and employment estimates are given in the form of a range, to allow for decisions still to be made about the number of units in the project.) Some of the owners of market homes are expected to be part-time residents of West Hawaii, but these will amount to 7% or less of the on-site population.

Project construction will generate about 190 to 280 direct jobs per year if the entire development is built out over twenty years. Operational employment created at the project will total 370 to 470 jobs.

Project impacts include:

- A better balance between the West Hawaii housing supply and demand, leading to some improvements in social life (less crowding in existing neighborhoods; reduced stress, less transiency among in-migrants);
- Potentially, design and subdivision organization choices which will serve as models for other West Hawaii developments, encouraging community pride and the provision of needed services, notably child care;
- For nearby residential areas, improved access to public facilities, but also an increase in nearby population, changing community character slightly and increasing use of public facilities and infrastructure (which is to be expanded in response to demand);
- For nearby commercial areas and the proposed regional center, an increase in the number of potential customers and workers nearby, increasing the chance of success;
- Increased demand for nearby recreational resources; and
- Provision of a public golf course -- a less expensive alternative to golf at resort courses.

CONTENTS

CONTENTS (Cont.)

FIGURES

TABLES

1.0 INTRODUCTION

1.1 THE KEALAKEHE PLANNED COMMUNITY

The Housing Finance Development Corporation (HFDC) of the State of Hawaii proposes to develop land in Kealakehe division and part of the adjacent Keahuolu division, North Kona district, County of Hawaii, as a planned residential community. The project is intended to provided affordable housing for Hawaii's citizens and to help alleviate the current housing shortage.

The project's location is shown in Figure 1. Figure 2 shows the major elements of the project.

In Kealakehe, an area of some 90 acres makai of the existing Kealakehe community would be developed first. An additional 500 acres of State land would be devoted to housing and built out in increments after the initial section is completed. In Keahuolu, to the south, some 150 acres, makai of Palani Road, now owned by the Queen Liliuokalani Trust (QLT) would be developed as part of the Kealakehe project.

The Kealakehe residential community would include, when fully built, some 3,000 to 4,000 housing units. At least 60% of these would be "affordable" -- priced to be affordable to families making from 80% to 120% of the median income in the County of Hawaii.

Additional elements of the project are:

- An 18-hole public golf course, located between the proposed Kealakehe residential community and the Queen Kaahumanu Highway;
- Roadways, including a mauka-makai connector and a road parallel to (and mauka of) the Queen Kaahumanu Highway;
- Sites for public facilities -- a new Kona high school, an elementary school, and a civic center near the Police Station; and
- A neighborhood shopping area.

Project construction is scheduled to begin in late 1990 with the construction of the mauka-makai road. Construction of the first phase of housing will begin in 1991. The project would be built out over about 20 years -- depending in part on demand for affordable housing.

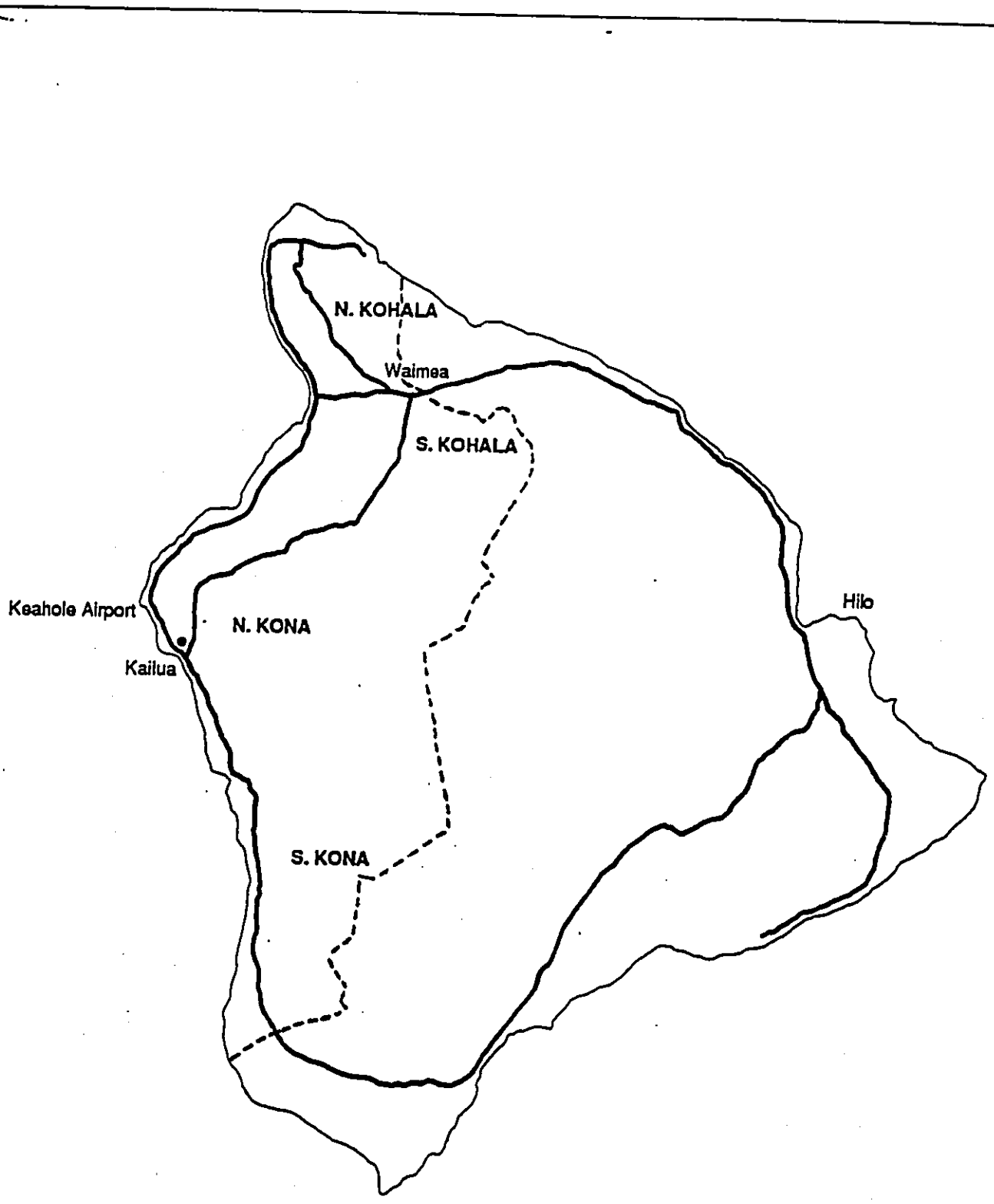


Figure 1: **ISLAND OF HAWAII**

• Kealakehe Project Site

- - - Boundary of West Hawaii Study Area

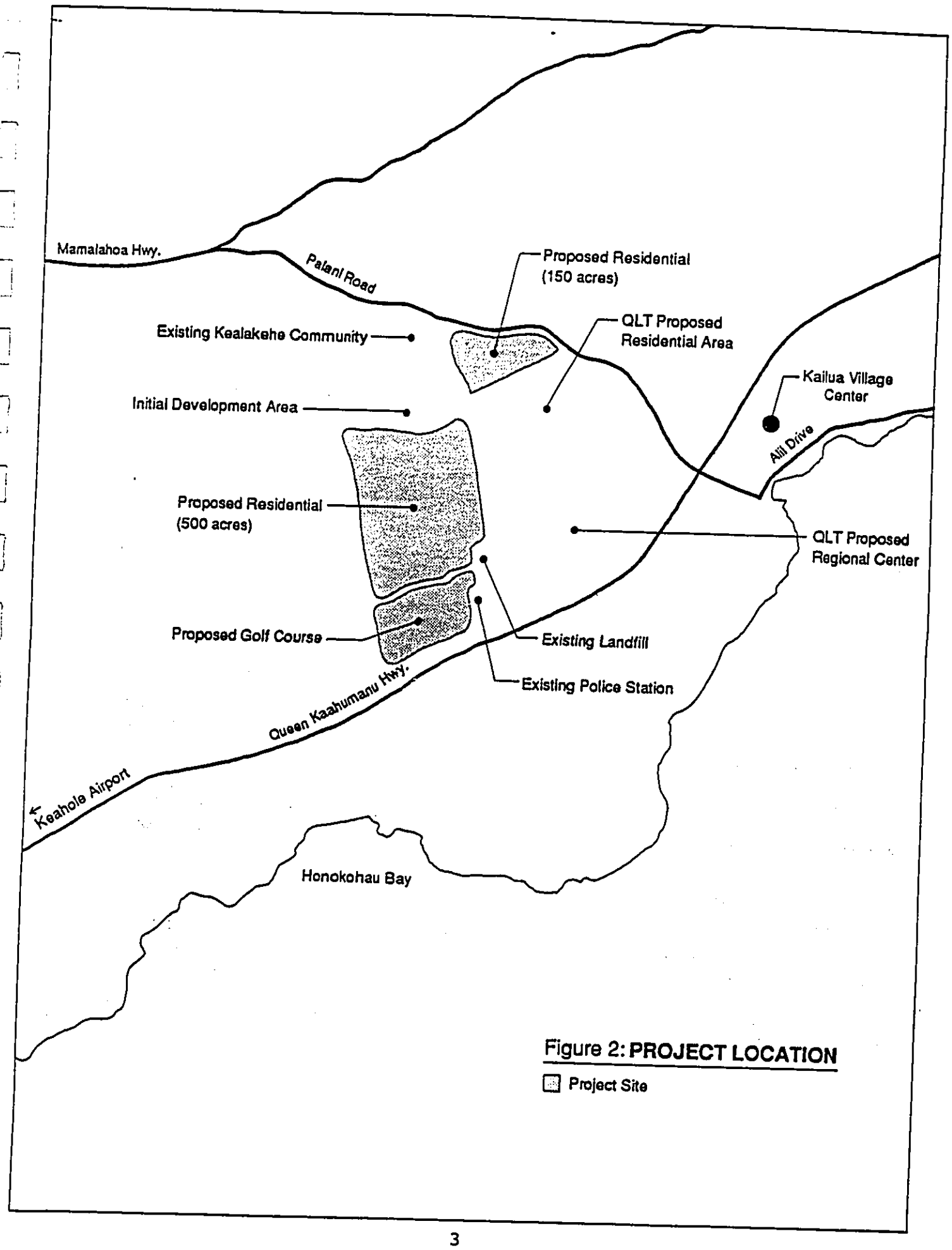


Figure 2: **PROJECT LOCATION**

Project Site

Currently, the project site is occupied only by a landfill, about four acres in size, the Hawaii Humane Society's animal shelter, and the Kealakehe Police Station. The police station will remain in operation on the site. The landfill is to be replaced by a new landfill proposed for Puuanahulu, which could open in 1991. The Humane Society's lease is reviewed annually.

The Queen Liliuokalani Trust is currently proposing its own development in Keahuolu. Its plans for a new regional center include commercial space, offices, a hospital, a hotel for business travelers, and residential land.

The QLT project and the Kealakehe project are separate, but related. The Trust is applying for a change in State Land Use designation to Urban. The area covered by the application includes about 60 acres of land that are part of the Keahuolu land used for the HFDC Kealakehe project. (The remaining 90 acres of land slated for HFDC development is already designated Urban.)

The State's land in Kealakehe includes an additional parcel of about 700 acres between Queen Kaahumanu Highway and the ocean. However, that area is outside the present project. Current plans call for a sewage treatment plant on that site and expansion of Honokohau Harbor at the northern side of that site. Use of most of the area in the makai parcel has not been planned. (The concept of eventually developing the makai land to finance affordable housing is considered a possible long range strategy.)

1.2 PURPOSE AND SCOPE OF THIS REPORT

This report provides an assessment of the socio-economic impacts of the proposed Kealakehe Planned Community project. It has been prepared for Belt Collins & Associates, for eventual inclusion in the Environmental Impact Statement being written for the State Housing Finance Development Corporation.

Social impact assessments are made in order to identify and disclose information of use to decision-makers and members of the general public, as they evaluate the implications of proposed developments.

The impacts of a project will occur in relation to the conditions existing at the time the project is built. Hence those impacts must be judged in relation to probable future conditions in the surrounding area, not just the situation existing at the time of writing the report. Construction of the present project could extend over a 20-year period, so major growth trends in West Hawaii form an important part of the context for assessing the project.

This report has four main sections:

- This section includes introductory material;
- The second section summarizes trends which form the socio-economic context for the project;
- The third section identifies community issues and concerns, including both general concerns and issues raised specifically with regard to the project; and
- The fourth section identifies socio-economic impacts of the project. Where appropriate, possible mitigating measures are noted.

While Community Resources, Inc.(CRI) was assessing the social impacts of the Kealakehe project, a separate assessment was being prepared by CRI for the QLT Keahuolu project. During the community interviews outlined in Section 3 of this report, both projects were discussed. Different issues and concerns arose with regard to the two projects and were separated for each report.

1.3 DEFINITION OF STUDY AREA

The project can be considered both in relation to a broad area affected by ongoing and anticipated economic growth, and in relation to its immediate area.

For the purposes of market analysis, a study area including the judicial districts of South Kona, North Kona, South Kohala, North Kohala, and Hamakua was identified (KPMG Peat Marwick, 1990). That area includes current and future visitor destination areas and the larger area in which persons who work at such resorts are likely to reside. By providing housing in a planned community, the project is expected to affect housing conditions and residents' housing choices throughout this region.

Other social impacts are expected to be largely felt in the North Kona district, notably at the project site and in nearby residential and urban areas.

In this report, attention will focus on the West Hawaii region, or the North Kona district, as appropriate with regard to particular citizen concerns and social impacts. Also, some economic trends and impacts can be quantified fairly rigorously at the state and/or county level, and with less certainty for the regional level. Accordingly, these are discussed with regard to the County of Hawaii as well as the West Hawaii region.

("West Hawaii is defined as the four judicial districts of North Kona, South Kona, South Kohala, and North Kohala. Hamakua is not discussed in this report, as it is not part of the area traditionally viewed as West Hawaii. Occasionally, reference is made to Kona, meaning the two judicial districts of North and South Kona, or to the Kona area. The latter phrase refers to interviewees' notion of an area centering on Kailua-Kona.)

2.0 CURRENT AND ANTICIPATED REGIONAL TRENDS

2.1 ONGOING TRENDS

Economic and Labor Force Trends: West Hawaii's economy is based on the visitor industry, construction, diversified agriculture and ranching, and high technology initiatives (in ocean science and astronomy). The visitor industry has emerged as the leading industry both in terms of size and potential growth.

Construction activity has continued to increase in Hawaii County -- construction put in place in 1988 was valued at $162,750,000, an increase of 26.6% over 1987. Currently, three major luxury hotels are under construction in West Hawaii.

Currently, West Hawaii employers report a labor shortage, particularly among skilled construction workers and entry level service workers for restaurant, retail, and resort operations.

Recent available unemployment and workforce estimates from the Department of Labor and Industrial Relations (DLIR) (personal communication, Manuel Fragrante, Researcher, Research and Statistics Office, Hawaii State DLIR, December 15, 1989) show:

	1988 Annual Average		August 1989	
	Civilian Labor Force	Unemp. Rate	Civilian Labor Force	Unemp. Rate
North Kona	9,776	3.7%	10,645	2.1%
South Kona	3,778	4.0%	4,108	2.4%
North Kohala	1,795	6.6%	1,929	3.9%
South Kohala	2,819	4.4%	3,060	2.6%
West Hawaii	18,168	4.3%	19,742	2.4%
Hawaii County	54,676	5.0%	59,206	2.9%

(NOTE: DLIR estimates for sub-county areas are based on 1980 census shares, hence usually under-estimate numbers for high-growth areas like West Hawaii. Based on actual population and labor force participation rates, CRI would estimate West Hawaii's 1988 civilian labor force as about 19,100 -- a figure to be used later in this section for forecasting purposes.)

The most recent detailed analysis of occupational patterns is provided by the 1980 Census. Table 1 shows selected data from the 1980 and 1970 Censuses. Some conclusions from this table:

TABLE 1: LABOR FORCE SIZE AND CHARACTERISTICS -- STATE AND COUNTY OF HAWAII, AND WEST HAWAII DISTRICTS, 1970 AND 1980

	STATE OF HAWAII		COUNTY OF HAWAII		NORTH KONA		SOUTH KONA		SOUTH KOHALA		NORTH KOHALA	
	1970	1980	1970	1980	1970	1980	1970	1980	1970	1980	1970	1980
POTENTIAL LABOR FORCE (aged 16+)	522,018	723,479	43,075	67,205	3,632	10,115	2,629	4,265	1,446	3,290	2,240	2,286
not in labor force	34.1%	31.7%	39.5%	38.7%	44.3%	27.8%	41.6%	33.8%	34.2%	35.9%	38.4%	39.8%
armed forces	9.5	8.1	0.4	0.3	0.0	0.1	0.0	0.0	0.0	0.0	1.1	1.0
civil. labor force	56.4	60.2	60.1	61.0	55.7	72.1	58.4	66.2	65.8	64.1	60.5	59.3
CIVILIAN LABOR FORCE(CLF)	294,484	435,780	25,889	41,006	2,022	7,293	1,535	2,823	951	2,110	1,355	1,355
unemployed	3.0%	4.7%	2.7%	7.0%	4.8%	5.2%	2.3%	5.7%	4.1%	6.3%	1.9%	9.2%
EMPLOYED CLF	285,556	415,181	25,180	38,150	1,925	6,913	1,500	2,662	912	1,978	1,330	1,230
OCCUPATION	%	%	%	%	%	%	%	%	%	%	%	%
service	15.4	17.9	16.3	16.5	19.3	21.5	16.0	17.3	15.9	18.0	25.9	34.2
manager./profes.	NC	23.5	NC	20.0	NC	21.2	NC	13.6	NC	20.6	NC	15.2
technical, sales & adminis.	NC	32.0	NC	26.1	NC	28.2	NC	24.8	NC	19.2	NC	13.7
farm/fish/forest	NC	3.4	NC	10.3	NC	7.1	NC	19.5	NC	14.0	NC	14.2
precision, craft, repair	NC	11.6	NC	12.7	NC	12.1	NC	14.8	NC	16.5	NC	9.7
operators, fabricators, laborers	NC	11.7	NC	14.4	NC	9.9	NC	10.0	NC	11.8	NC	12.9
INDUSTRY (selected)												
agric., mining	4.7	3.6	12.5	11.2	N/A	6.2	N/A	19.4	N/A	16.8	N/A	8.1
construction	9.3	7.2	10.6	9.1	23.6	11.2	20.4	14.3	13.6	12.3	2.6	5.0
manufacturing	10.9	7.9	15.0	8.3	1.0	1.9	3.2	1.2	2.3	5.1	29.3	8.1
retail trade	17.4	19.9	14.8	17.5	13.1	23.6	8.9	18.4	15.9	13.8	2.9	7.0
financ., real estate	5.0	7.6	2.8	5.7	4.0	8.6	3.5	4.5	3.5	7.6	1.1	2.3
personal, entertain. & recreat. services	8.5	9.2	11.2	10.9	N/A	20.7	N/A	15.2	N/A	16.0	N/A	31.4
health, educ, & professional	17.2	17.7	14.1	16.7	7.8	11.4	18.3	13.1	13.9	14.8	14.7	20.5
public adminis.	11.4	10.0	6.5	7.3	4.2	2.7	3.7	4.8	3.1	2.1	5.5	8.1
COMMUTE TO WORK												
45 minutes or more	N/A	13.5	N/A	6.0	N/A	4.8	N/A	6.8	N/A	13.9	N/A	22.6
mean travel (min.)	N/A	21.5	N/A	16.5	N/A	16.4	N/A	20.6	N/A	21.7	N/A	24.1

Notes: All figures based on 15 sample; hence, numbers represent estimates.
"N/A" = "Not Available" in published form. "NC" = 1970 categories or bases "Not Comparable" to 1980 Census.

Sources: U.S. Bureau of the Census, 1970 Census of Population and Housing--Census Tracts--Honolulu, Hawaii, PHC(1)-88; 1980 Summary Tape File 3-A; State of Hawaii, 1973, Community Profiles for Hawaii. .pr or=l

- Compared to workers countywide or statewide, employed residents of North Kona, North Kohala, and South Kohala were much more likely to be in tourism-related occupations or industries in 1980.

- In North Kohala, there was a dramatic 1970-80 shift from agriculture to tourism-related work, due to the sugar phaseout. Many such tourism jobs were located outside North Kohala, as indicated by high average commute times.

- South Kona's workforce was more involved in agricultural occupations and industries than was the case elsewhere in West Hawaii or the rest of the county, on average.

- South Kona and North Kohala had relatively low proportions of managerial/professional workers.

Continuing West Hawaii resort development would suggest even more concentration in tourism today, as well as more intensive use of available workers. Preliminary results of the 1988 "Tourism Impact Management System" survey by the Department of Business and Economic Development (1989) indicate:

- The percentage of employed workers who consider themselves "in the visitor industry" was around 40% in Kona and 35% in Kohala, compared to an islandwide figure of just 25%.

- North Kona's civilian labor force participation rate is *now close to 80% -- i.e., four out of every five* potential workers aged 15 or above now holds a job or is actively seeking one.

Population Levels and Composition: West Hawaii has been one of the fastest growing areas in the State of Hawaii. Its population nearly tripled from 1970 to 1988 (from 14,500 to 40,700). (See Table 2.) The growth rates have been particularly high in North Kona and South Kohala, sites of major resort development in the 1970's and 1980's. Growth in South Kona has essentially just matched the islandwide rate. In North Kohala, there was no growth from 1970 to 1980 and only modest estimated population increases since 1980.

As of 1980, North Kona was the only district in Hawaii County where a majority of the population consisted of Caucasians. (See Census data in Table 3.) Nearly a quarter of North Kona's population at that time had been living on the Mainland five years previously, and 40% had been Mainland-born -- much larger percentages than for the county as a whole.

TABLE 2: POPULATION TRENDS, STATE OF HAWAII, COUNTY OF HAWAII, AND STUDY AREA, 1970 - 1988

	April 1, 1970	April 1, 1980	Est. July 1, 1988
North Kona District	4,832	13,748	21,600
South Kona District	4,004	5,914	7,500
South Kohala District	2,310	4,607	7,900
North Kohala District	3,326	3,249	3,700
Total West Hawaii Study Area	14,472	27,518	40,700
County of Hawaii	63,468	92,053	117,500
State of Hawaii	769,913	964,691	1,098,200

	AVERAGE ANNUAL RATE OF GROWTH		
	1970-1980	1980-1988	1970-1988
North Kona District	11.0%	5.6%	8.6%
South Kona District	4.0%	2.9%	3.5%
South Kohala District	7.1%	6.8%	7.0%
North Kohala District	-0.2%	1.6%	0.6%
Total West Hawaii Study Area	6.6%	4.9%	5.8%
County of Hawaii	3.8%	3.0%	3.4%
State of Hawaii	2.3%	1.6%	2.0%

Source: Hawaii State Department of Business and Economic Development, 1988, and unpublished tables for the 1989 Data Book.

TABLE 3: TOTAL POPULATION AND DEMOGRAPHIC BREAKDOWNS -- STATE AND COUNTY OF HAWAII, AND WEST HAWAII DISTRICTS, 1970 AND 1980

	STATE OF HAWAII		COUNTY OF HAWAII		NORTH KONA		SOUTH KONA		SOUTH KOHALA		NORTH KOHALA	
	1970	1980	1970	1980	1970	1980	1970	1980	1970	1980	1970	1980
TOTAL POPULATION	769,913	964,691	63,468	92,053	4,832	13,748	4,004	5,914	2,310	4,607	3,326	3,249
	%	%	%	%	%	%	%	%	%	%	%	%
ETHNICITY*												
Caucasian	38.8	34.4	28.8	35.0	44.0	53.8	17.7	30.0	39.2	46.5	25.6	27.8
Japanese	28.3	24.9	37.5	26.6	23.1	11.8	39.6	27.5	24.4	14.6	23.8	16.1
Chinese	6.8	5.8	2.9	1.7	3.7	1.6	0.8	0.8	1.3	1.4	4.3	1.0
Filipino	12.2	13.7	16.5	13.9	8.4	7.2	26.2	13.0	6.6	5.6	29.2	24.0
Hawaiian	9.3	12.3	12.3	18.8	19.3	22.1	14.7	23.5	26.4	28.5	15.3	24.7
Other	4.6	9.0	2.0	4.1	1.5	3.5	1.0	5.2	2.0	3.4	1.7	6.4
AGE												
Less than 5 yr.	9.2	8.1	8.6	9.1	9.1	9.1	9.0	9.8	9.3	10.2	10.0	9.2
5 - 17 yr.	26.6	20.5	27.8	21.5	27.0	20.3	29.8	20.7	28.3	23.6	29.4	22.9
18 - 64 yr.	58.5	63.5	54.4	59.2	55.7	63.9	48.9	58.8	56.1	58.6	51.1	54.4
65 or more yr.	5.8	7.9	9.2	10.2	8.2	6.7	12.4	10.6	6.4	7.7	9.5	13.6
Median age (yr.)	25.0	28.4	28.9	29.4	28.6	28.9	29.7	29.7	28.1	29.3	27.3	31.9
PLACE OF BIRTH*												
Hawaii	NC	57.8	NC	70.5	NC	54.4	NC	71.2	NC	64.9	NC	75.6
Other U.S.**	NC	28.0	NC	20.0	NC	39.9	NC	20.8	NC	30.4	NC	13.6
Foreign country	NC	14.2	NC	9.4	NC	5.7	NC	7.8	NC	4.7	NC	10.8
RESIDENCE 5 YRS. PREVIOUS* (people aged 5+)												
Same house	46.0	49.3	62.5	52.9	51.1	38.8	56.1	57.4	45.6	50.7	49.9	68.9
Same island	NC	25.2	NC	24.9	NC	28.1	NC	22.9	NC	17.3	NC	12.1
Different island	NC	2.8	NC	8.1	NC	7.0	NC	6.5	NC	14.9	NC	4.4
Different state	NC	16.9	NC	11.1	NC	23.1	NC	10.7	NC	16.4	NC	11.6
Different country	NC	5.9	NC	3.1	NC	3.0	NC	1.2	NC	0.7	NC	3.1
EDUCATION* (people aged 25+)												
0-8 years only	24.8	16.2	37.2	20.1	28.9	8.0	26.1	23.6	24.1	8.6	44.2	29.0
Hi school only	35.9	35.1	31.6	35.5	66.0	40.9	21.9	33.8	34.2	37.0	30.0	39.0
College, 4+ yr.	14.0	20.3	7.5	15.2	8.8	18.8	6.4	12.4	13.1	20.7	5.9	8.1

Notes: *Figures based on 15% sample; hence, numbers represent estimate.
**Including persons born in U.S. territories, and persons born abroad or at sea to American parent/s.
"NC" = 1970 categories or bases "Not Comparable" to 1980.

Sources: U.S. Bureau of the Census, 1970 Census of Population and Housing--Census Tracts--Honolulu, Hawaii, PHC(1)-88; 1980 Summary Tape Files 1-A and 3-A; State of Hawaii, 1973, Community Profiles for Hawaii.

Substantial in-migration from the Mainland is also apparent in the 1980 Census data for South Kohala. By contrast, South Kona and North Kohala had a more ethnically mixed population, including more people born in Hawaii (more than 70% each).

Housing Stock: Housing in West Hawaii (with the possible exception of North Kohala) is now considered to be in very short supply, leading to crowding and to high rentals and sales costs. The housing situation is discussed further in Section 4.3.

Family Life: With Hawaii County labor force participation is lower than elsewhere in the State, the proportion of families with full-time homemakers is likely to be higher than elsewhere. However, resort work, which is increasingly important in West Hawaii, is criticized by some as leading parents to give their children little supervision, or as creating stress in family life (Section 3.2). Available data on family conditions do include some indications of possible strain, but no clear proof:

- o West Hawaii workers (particularly those in North Kona) are more likely than those in East Hawaii to work more than 48 hours a week and to work evening and/or weekend hours often (Hawaii State Department of Business and Economic Development, Tourism Branch, 1989);
- o The proportion of students applying for the State's "A+" afterschool care -- presumably latchkey children or children depending on afterschool care from persons other than their parents -- was higher for elementary schools between Kealakehe and Kealakekua than for more rural areas of West Hawaii and for the County as a whole (personal communication, Ethel Yoshimasu, Hawaii District Superintendent's Office, Hawaii State Department of Education, January 1990);
- o Staff and teachers at Kealakehe Elementary and Intermediate Schools estimate that about half their students live in families headed by women -- a figure far higher than 1980 Census figures for the district and the County.

2.2 LIKELY FUTURE TRENDS

Following is a review of future changes expected to occur <u>with or without</u> the proposed Kealakehe project.

Countywide Quantitative Trends: The State of Hawaii's official "M-K Series" forecast for the period through year 2010 (as shown in Table 4 and Figure 3) indicate substantial economic and population growth for Hawaii County:

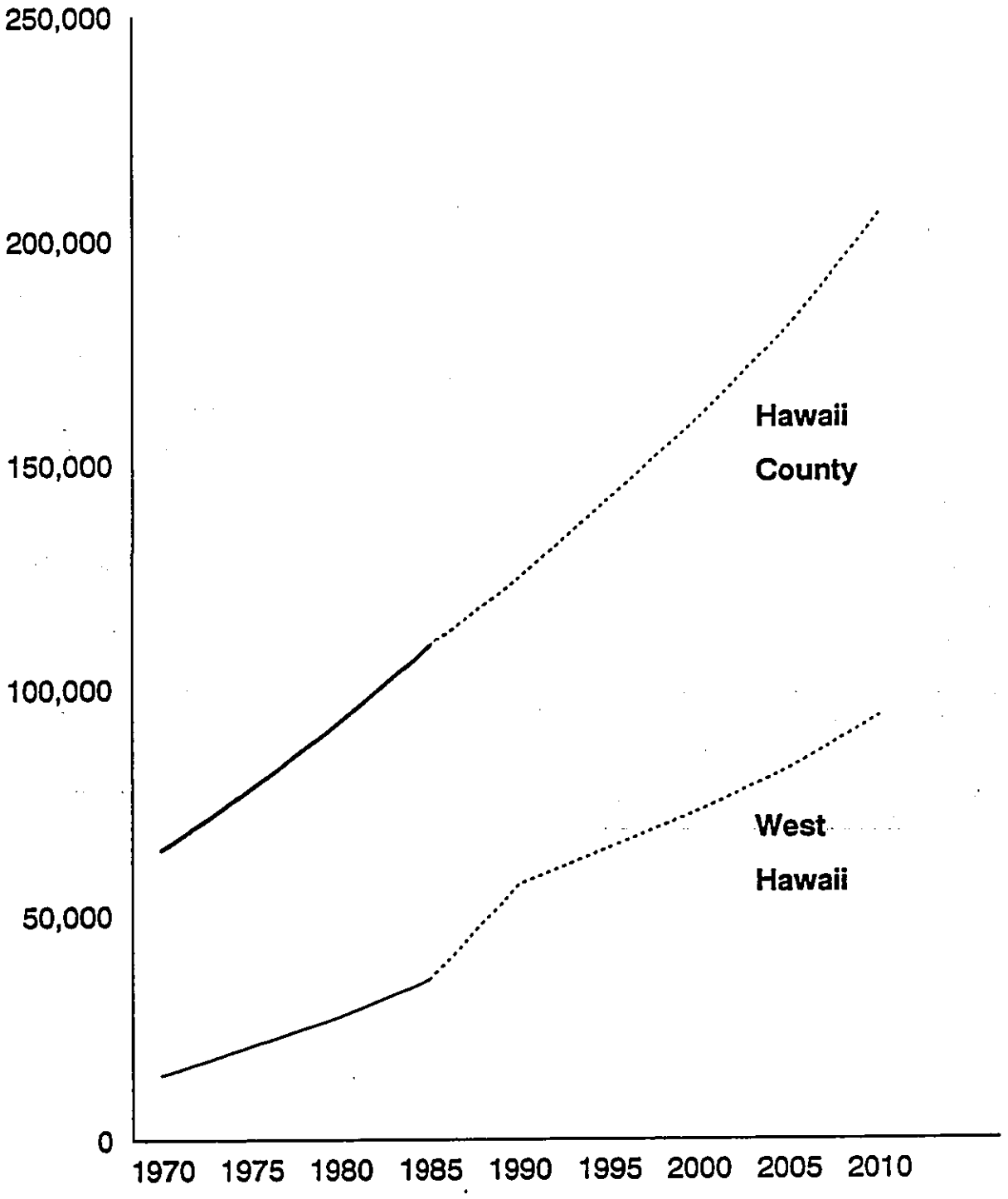
TABLE 4: OFFICIAL STATE POPULATION AND ECONOMIC PROJECTIONS FOR HAWAII COUNTY, 1990 - 2010

	1990	1995	2000	2005	2010
Resident Population	124,600	142,500	160,400	180,800	206,100
Average Daily Visitor Population	11,400	17,900	24,700	32,600	39,600
Civilian Jobs:	50,800	59,300	68,200	78,300	89,800
Jobs in Selected Industries: *	%	%	%	%	%
Agriculture	8.6%	7.5%	6.6%	5.8%	5.2%
Construction	3.7%	3.7%	3.7%	3.6%	3.6%
Trade (excluding eating/drinking)	16.9%	16.7%	16.8%	16.8%	16.7%
Eating and Drinking	8.8%	9.8%	10.7%	11.7%	12.5%
Banking, Finance	3.9%	3.7%	3.7%	3.8%	3.8%
Services	26.9%	28.7%	30.0%	30.9%	31.8%
-- Hotels	--12.1%	--12.4%	--12.5%	--12.7%	--12.8%
Government	18.8%	18.3%	18.0%	17.5%	17.1%
Personal Income (millions of 1982 dollars)	1,328	1,643	1,965	2,342	2,812
Per Capita Income (1982 dollars)	10,700	11,500	12,300	13,000	13,600

NOTE: * Percentages of wage and salary workforce (excluding tne self-employed).

SOURCE: Hawaii State Department of Business and Economic Development, 1988b.

FIGURE 3: HISTORICAL AND ANTICIPATED POPULATION TRENDS, HAWAII COUNTY, 1970 - 2010



SOURCES: Hawaii Department of Business and Economic Development, 1989; KPMG Peat Marwick, 1990.

- Resident population increasing by 75% over the estimated 1988 figure of 117,500, to reach 180,800 persons by the year 2005 and 206,100 by year 2010;

- The visitor count growing threefold, to reach 36,900 in 2010;

- An ongoing shift in the distribution of jobs, with fewer people working in agriculture and more in tourism (hotels, eating and drinking);

- Per capita personal income increasing by 40% from 1990 to 2010, to an average of $13,600 (1982 dollars).

West Hawaii Quantitative Trends: Projected massive growth in West Hawaii's visitor industry is expected to produce major increases in employment and population.

For example, the West Hawaii Regional Plan (Office of State Planning, 1989) estimated current West Hawaii "resort units" (hotel plus condominiums) at 7,429 -- a figure which would increase to 39,009 if all planned and proposed resort developments were to build out. (The report assumes the actual build-out figure by the year 2005 would be just 25,279 units, which is still nearly three and a half times the existing inventory.)

Unpublished projections made by the Hawaii County Planning Department in April 1989 assumed only slightly slower growth -- a total of about 26,000 visitor units (13,600 hotel rooms plus 12,400 resort condominiums) by the year 2010. More than 60% of these are assumed to be located in North Kona; most of the rest in South Kohala; and only a handful in South Kona or North Kohala.

In terms of population and employment, the State's M-K projections apply only to the county level. However, several other documents (all roughly compatible with the M-K projections at the countywide level) do give forecasts for West Hawaii in particular. These include:

(1) The Hawaii County Planning Department's General Plan contains three series of population and visitor industry projections. The lowest of these ("Series A," the current basis for County infrastructure planning) indicates a year 2005 countywide population of 173,000, slightly lower than the M-K figure of 180,800. Projected distribution of this total population is:

North Kona	43,250	25%
South Kona	10,899	6%
South Kohala	19,203	11%
North Kohala	5,363	3%
(West Hawaii Subtotal)	(78,715)	(46%)
South Hilo	44,115	26%
Puna	39,790	23%
Rest of East Hawaii	10,380	6%
COUNTY TOTAL	173,000	100%

Additionally, the County Planning Department's unpublished April 1989 projections anticipate that about 53% of the island's employment will be located in West Hawaii (primarily North Kona and South Kohala) by the year 2010.

(2) The Office of State Planning's West Hawaii Regional Plan also extends only to the year 2005. It projects a year 2005 countywide population of 170,400 and a West Hawaii population of 79,000 -- figures highly compatible with the General Plan "Series A" and preliminary draft M-K forecasts. The plan also assumes 25,900 new countywide jobs resulting from West Hawaii resort development, but does not attempt to predict what portion of these jobs will be in West Hawaii.

(3) The market assessment for the Kealakehe project (KPMG Peat Marwick, 1990) is based on the final M-K projections, with additional assumptions and projections for West Hawaii. It projects a slightly higher year 2005 West Hawaii resident population (82,300) than do the West Hawaii Regional Plan or the County Series A projections, but is otherwise consistent with them. That is, all three assume the West Hawaii population will, roughly, double by 2005.

Table 5 contains a summary of key assumptions and results from this market assessment.

Based on the M-K projections, current employment estimates, and the market assessment discussed above, Community Resources, Inc. (CRI) has developed some additional projections of future West Hawaii jobs and labor supply, for the years 2005 and 2020. These are shown in Table 6..

The CRI analysis results in a total projected West Hawaii jobcount of 37,700 for the year 2005 and 45,000 for 2010. New labor supply resulting from natural increase (excess of births over deaths) in the existing West Hawaii population -- as measured by two separate methods producing highly similar results -- would be able to fill only about 13% of the new jobs from now until 2005 and about 14% of the projected new jobs for the entire period until 2010. If there is no increase in commuting from

TABLE 5: PROJECTED WEST HAWAII SOCIAL AND ECONOMIC TRENDS

	1990	1995	2000	2005	2010
Resident Population					
North Kona	31,200	35,600	40,100	45,200	51,500
South Kona	7,800	9,000	10,100	11,400	13,000
North Kohala	3,900	4,400	5,000	5,600	6,400
South Kohala	13,800	15,800	17,800	20,100	22,900
West Hawaii Total	56,700	64,800	73,000	82,300	93,800
West Hawaii Share of County Resid. Population	45.5%	45.5%	45.5%	45.5%	45.5%
Projected New Visitor Units (Cumulative)					
Hotel	0	5,700	9,085	9,085	9,785
Condo	230	2,010	4,110	5,990	6,470
New Direct Jobs From Visitor Unit Development in Hawaii County (Cumulative) (1)	50	7,470	12,050	16,130	17,080
New Indirect and Induced Jobs From Visitor Unit Development in Hawaii County (Cumulative) (2)	20	2,800	4,520	6,050	6,410
Total New Hawaii County Jobs Attributable to Visitor Unit Development	70	10,270	16,570	22,180	23,490
Persons per Housing Unit, Hawaii County	2.8	2.8	2.75	2.75	2.7
Cumulative Housing Demand (3)					
North Kona	800	2,920	5,800	9,130	13,680
South Kona	840	1,210	1,720	2,210	2,870
North Kohala	190	370	630	850	1,160
South Kohala	500	1,540	3,020	4,830	7,440
West Hawaii Total	2,330	6,040	11,170	17,020	25,150

NOTES:

(1) Approximately 90% of all direct jobs estimated to be located in Hawaii County.

(2) Approximately 40% of indirect/induced jobs estimated to be located in Hawaii County.

(3) Baseline for estimation is 1987 County Planning Department inventory (14,094 units in West Hawaii).

SOURCE: KPMG Peat Marwick, 1990.

CORRECTION

THE PRECEDING DOCUMENT(S) HAS BEEN REPHOTOGRAPHED TO ASSURE LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

TABLE 5: PROJECTED WEST HAWAII SOCIAL AND ECONOMIC TRENDS

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North Kohala	3,900	4,400	5,000	5,600	6,400
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SOURCE: KPMG Peat Marwick, 1990.

TABLE 6: NATURAL GROWTH AND IN-MIGRATION OF LABOR FOR WEST HAWAII, 1988-2010

		Projected				
				1988-2005	2006-2010	1988-2010
	1988	2005	2010	Change	Change	Change
Natural Increase in West Hawaii Population Projected by:						
Growth Rate Trend Model (1)	40,700	48,201	50,660	7,500	2,500	10,000
Age-Cohort Model (2)	40,700	50,055	51,657	9,400	1,600	11,000
Average of Methods	40,700	49,100	51,200	8,400	2,100	10,500
Hawaii County Civilian Jobs (3)	54,600	78,300	89,800	23,700	11,500	35,200
Civilian Jobs Located in West Hawaii (4)	20,000	37,700	45,000	17,700	7,300	25,000
Required Labor Force (at 0.9525 workers/job, 5% unemployment, as per M-K assumptions)	20,100	37,800	45,100	17,700	7,300	25,000
Natural Increase in Labor Force in West Hawaii (5)	19,100	21,400	22,500	2,300	1,100	3,400
Assumed Net In-Commuters	1,000	1,000	1,000	0	0	0
Required Net In-Migrant Labor	0	15,400	21,600	15,400	6,200	21,600
Percentage of Total New West Hawaii Jobs Filled by:						
-- Natural Increase, 1988 Population				13.0%	15.1%	13.6%
-- Net In-Migration				87.0%	84.9%	86.4%

NOTES:

(1) Natural growth rate of 10 per 1000 persons characteristic of West Hawaii trends, 1980-88.

(2) CRI Age-Cohort Model, December 1989.

(3) 2005 and 2010 figures from M-K Series projections; 1988 figure estimated from DLIR data on employed workforce.

(4) Figure for 1988 is CRI estimate, adjusting DLIR figures for actual growth. Future years based on projected West Hawaii share of county population: 48% for 2005; 50% for 2010 (KPMG Peat Marwick, 1990).

(5) Based on natural increase in population and using a labor force per 1,000 population rate of 43.5% for 2005 and 44% for 2010 (from M-K projections).

These figures may somewhat overestimate the amount of net in-migrant labor required. The M-K County projections assume much lower labor force participation rates for Hawaii County than for other counties. If the 2005 participation rate for the Big Island matches that projected by the M-K model for Maui, the proportion of new jobs to be filled by net in-migrants would drop from 87% to 60%.

East Hawaii, the remaining 86% of new jobs would have to be filled by net in-migration (that is, more people moving into West Hawaii than moving away) and by children born to in-migrants.

As the table notes, however, the actual proportion of jobs going to net in-migrants may be somewhat lower, perhaps only 60% by 2005. That is because the analysis is based primarily on M-K assumptions for Hawaii County, and these assumptions include very low rates of labor force participation compared to other counties. If existing residents and their children absorb more jobs, fewer in-migrants will be needed.

The analysis deals with a long period, and does not distinguish recent in-migrants from ones who have lived in the area for decades. If in-migrants come to take West Hawaii jobs at a constant pace, recent in-migrants, who have lived 5 years or less in West Hawaii, could account for only about 12% of the 2005 workforce, and 11% of the 2010 workforce -- a lower percentage of in-migrants to West Hawaii than 1980 Census figures (for all people aged 5 and older) and 1983 West Hawaii survey responses (Hawaii Opinion, 1983) indicate for recent years. (See Table 5.)

Qualitative Changes in West Hawaii: The social impacts of the preceding quantitative changes will depend in large part on (1) geographical distribution of growth; (2) location and timeliness of development of infrastructure (including housing); and (3) characteristics of in-migrant workers.

Geographical Distribution of Growth: This is still being determined through the government land use process, but several documents provide indications of broad policies. First, both the County and market assessment projected distributions of population indicate that West Hawaii growth will be concentrated primarily in North Kona and secondarily in South Kohala. Second, the West Hawaii Regional Plan calls for development of a major new support community in Kealakehe -- for the present project, in effect -- as well as South Kohala development at Waikoloa, Lalamilo, and Kawaihae. Third, the Hawaii County Planning Department's Draft Keahole to Kailua Development Plan (focusing only on North Kona from Palani Road to the airport) envisions four new "residential villages," separated by greenbelts, at Kealakehe and points north, substantially mauka of the Queen Kaahumanu Highway. An open space greenbelt would separate the new residential areas from Kailua Village.

The foregoing addresses distribution of residential growth only. The West Hawaii Regional Plan calls for resort development to be distributed among various coastal "nodes" -- two in North Kona (Keahole-Keauhou and Kaupulehu-Kukio) and two in South Kohala (Mauna Kea and Waikoloa-Mauna Lani). This is roughly consistent with County General Plan designations.

The Draft Keahole to Kailua Development Plan suggests that a 100 acre Regional Center could be sited makai of the Queen Kaahumanu Highway, on the State's Kealakehe lands. The Queen Liliuokalani Trust is proposing its Keahuolu lands as a location for a Regional Center, including a 30 acre civic center. HFDC includes a 30 acre civic center on County owned land adjacent to the Kealakehe landfill and encompassing the existing police sub station.

Infrastructure Development (location and timeliness) is the second major qualitative determinant of West Hawaii's future. As discussed above in the section on resident issues and concerns, congested highways are already major sources of unhappiness in the Kona area, contributing to a sense of declining quality of life despite economic advances. The magnitude of growth now being planned for West Hawaii could intensify these social impacts, unless solutions are found.

Both the State and County governments are currently in the process of exploring various mechanisms (impact fees, taxing authority, etc.) to assure that physical and social infrastructure development no longer lags far behind population growth in the future. For purposes of this impact assessment, it must be assumed that some solution to the timeliness problems will be found; otherwise, the projected growth is unlikely to occur.

State and County planners are currently debating new North Kona road alignments. One aspect of the Draft Keahole to Kailua Development Plan is a new shoreline road from Honokohau Harbor to Kailua Village. The plan also calls for a new mid-level roadway mauka of the Queen Kaahumanu Highway. road, each to loop mauka of the present roads.

Both State and County agencies are drilling for water at present, and the County plans to develop three new wells in 1990. A new reservoir is planned at the 325 foot elevation on the Kealakehe property, near the northern property boundary.

Bids for a new County landfill were opened in April, 1990, and use of the landfill could begin after about a year's construction work. However, a lawsuit challenging the project's EIS could affect scheduling drastically.

The County's Kealakehe Sewage Treatment Plant is expected to be completed by February 1992. Connections to the plant could be finished in another year. That facility is expected to serve Kailua Village and areas to the south. Plans are under discussions for expansion of the Kealakehe Sewage Treatment Plant to serve major new residential populations.

Characteristics of New In-Migrant Population comprise the third major determinant of social impacts from future West Hawaii growth. Two components may be identified:

- Relatively affluent retirees and second-home owners could widen the gap between "have's" and "have-not's" in West Hawaii, although they may also contribute to local charities and cultural facilities (as has recently occurred in Maui).

  The West Hawaii Regional Plan estimates that under ten percent of resort-induced population growth will be on-site resort residents, whose isolation from the general community would probably reduce any impacts, positive or negative. Undetermined, however, is the likely future number or geographic distribution of off-resort wealthy in-migrants, who would have more direct impacts on residential real estate values and the fabric of community life.

- In-migrant workers and their children (who may be West Hawaii-born), as earlier noted, will be required to fill anywhere from 60% to 90% of new West Hawaii jobs. The question remains as to where these in-migrant workers will come from. Two deliberately extreme scenarios illustrate the range of possible futures:

  -- All future in-migrants are from the Mainland. The ethnic distribution in West Hawaii would probably be concentrated even more heavily among Caucasians. Since previously discussed projections assume that West Hawaii residents will comprise a majority of the Big Island population in about 20 years, the socio-political impacts could be islandwide. As noted below, the M-K forecasts also imply some eventual net in-migration to East Hawaii, but a much lower level. Thus, it may be expected that differences in values and lifestyles between East and West Hawaii residents would grow even greater.

  -- All future in-migrants are from Hawaii. This would substantially mitigate some of the social impacts of rapid population growth.

     However, the methods used for the labor supply analysis in Table 9 would also indicate that projected new jobs in East Hawaii -- while fewer than in West Hawaii -- will (1) absorb all or most of natural increase in labor supply through 2005, and (2) require net in-migration to East Hawaii after 2005.

     Thus, any future "Hawaii in-migrants only" scenario must assume substantial migration from Oahu to both

West Hawaii and also the rest of the Big Island. The M-K model projects future Oahu job growth at a rate slightly less than observed natural population increase during the 1980's, so there is the possibility of some surplus labor from Oahu. However, it must be recognized that the three Neighbor Island counties would be in competition for any Oahu surplus, since the State M-K model estimates that 50% to 60% of the statewide population growth by 2010 will be due to net in-migration from outside Hawaii.

In reality, West Hawaii in-migrant workers will probably come from a variety of locations, including as well as some returning former Hawaii residents, foreign nationals, refugees, Pacific Islanders, and non-Caucasian Mainlanders. (In fact, deliberately imported laborers to Neighbor Islands in recent months have included Micronesian and Mexican-American agricultural workers.) And, while not desired, setbacks in other parts of the economy -- such as sugar in East Hawaii or military-related employment on Oahu -- could also provide additional labor supply for West Hawaii.

In short, the exact composition of the in-migrant workforce cannot be predicted at present. It may, however, be safely

predicted that the projected growth levels imply some types of very major shifts in the Big Island's overall population composition over the next 15 to 30 years.

3.0 COMMUNITY ISSUES AND CONCERNS

This section documents contemporary community issues and concerns of direct or indirect relevance to the proposed project:

- o Background issues independent of the project, but which may affect both community response and actual social impacts;
- o Project-specific preliminary concerns raised by some 88 community leaders interviewed for this study.

3.1 METHODS

Conclusions in this section are based on:

(1) Secondary data such as community surveys or published newspaper articles;

(2) Original community interviews conducted for this study (primarily in the North Kona area).

Most of the community interviews actually involved response to two separate but adjacent projects: the State's proposed Kealakehe housing development to the north and the proposal for a regional urban center at Keahuolu, to the south. Because portions of these two projects are adjacent and because CRI was separately contracted to conduct social impact assessments for both, the two clients (the State Housing and Finance Development Corporation for Kealakehe, and the Queen Liliuckalani Trust (QLT) for Keahuolu) agreed to the simultaneous community interview process.

Appendix A lists the 88 "key informants" who were interviewed. These individuals were selected on the basis of knowledge of the community and/or being tentatively identified as belonging to some potentially affected interest group such as nearby residents, business operators, Hawaiians and community leaders. Appendix A lists organizational affiliations in order to indicate some of the networks or interests of those interviewed. However, informants spoke as individuals and not as representatives of their organizations.

The purpose of the interviews, conducted in October and November 1989, was to identify major community issues and concerns (on a preliminary basis, since many planning details for both projects had yet to be finalized). It was not a random public opinion survey, and no attempt was made to measure the extent of project support or opposition.

Interviews were loosely structured, usually beginning with questions about background issues and them moving to the specifics of the two projects (to the the extent they were known at the time). Informants were told that overall input would be summarized in the social impact reports for the two EIS's, but that individual comments would remain confidential.

3.2 BACKGROUND ISSUES INDEPENDENT OF PROJECT

3.2.1 Information from Surveys and Other Secondary Sources

The most recent community survey shedding light on major issues in West Hawaii was the State Tourism Impact Management System (TIMS) study conducted in latter 1988. Preliminary results shown in Table 7 indicate that:

- Lack of affordable housing was the top issue throughout the island, but was ranked even more highly in West Hawaii -- and particularly in North Kona, where 76% said it was a "big problem" for that part of the island.

- Cost of food/clothing and traffic congestion were the next most important North Kona issues, rated as "big problems" by nearly 60%.

  For virtually all the issues on the list (except lack of jobs or urban amenities), North Kona residents were more likely than people elsewhere on the island to feel there was a serious problem. However, the gap was particularly large for traffic. The proportion of North Kona residents saying this was a "big problem" was twice as much as the rate for the island as a whole.

- Lack of sports/recreation facilities was also counted as a major problem by more than 50% of both North Kona and South Kona/Ka'u residents. This was of much less concern in areas such as Kohala or East Hawaii, where plantations and large ranches built gymnasiums and playing fields in earlier years.

- Environmental and/or crowding concerns (rapid population growth, crowded parks, destruction of natural beauty, pollution) were counted as "big problems" by more than a third of North Kona residents -- higher than in most other parts of the island.

- Overall quality of life was felt to have grown worse over the past five years by about a third of North Kona residents -- compared to only 18% islandwide. (However, 36% of North Kona residents felt it had grown better.

TABLE 7: GENERAL COMMUNITY ISSUES AND ATTITUDES, PRELIMINARY 1988 SURVEY RESULTS

		North Kona	N. & S. Kohala	S. Kona Ka'u	Hawaii County
COMMUNITY ISSUES -- %'S RATED "BIG PROBLEM IN YOUR PART OF ISLAND"					
Cost of housing		76%	60%	63%	48%
Cost of food and clothing		58%	41%	57%	44%
Traffic		56%	16%	32%	28%
Not enough sports and recreation facilities		52%	22%	52%	33%
Population growing too fast		43%	31%	29%	22%
Beauty of area being destroyed by development		38%	27%	29%	20%
Pollution of oceans or natural areas		34%	24%	20%	26%
Crowded beach parks		34%	22%	23%	21%
Crime		22%	7%	22%	22%
Lack of nearby jobs		18%	26%	46%	33%
Not enough nearby stores, restaurants, entertain.		12%	22%	24%	18%
Problems between people of different backgrounds		10%	4%	14%	7%
Too many tourists		8%	2%	10%	4%
QUALITY OF LIFE "IN THIS PART OF THE ISLAND" VS. FIVE YEARS AGO					
Today is ...	Better	36%	39%	37%	35%
	Worse	32%	15%	18%	18%
	Same	29%	43%	41%	45%
	Not Sure	3%	4%	4%	2%
TOURISM GROWTH -- %'S AGREEING WITH VARIOUS STATEMENTS					
In my part of the island, it's more important to keep things like they are than to have more tourism jobs.		56%	56%	63%	53%
It is time to stop building new hotels on this island.		54%	49%	53%	48%
We need more tourism jobs on this island.		44%	50%	53%	57%
Survey Base:		168	152	155	789

SOURCE: Hawaii State Department of Business and Economic Development, Tourism Branch, 1989. (Preliminary Results)

Statewide, North Kona was the only heavily resort-impacted area in which a few more people felt life had grown "better" rather than "worse." By comparison, in West Maui 63% said "worse" vs. just 16% "better.")

- Negative attitudes toward further tourism growth were prevalent throughout the island (and the state), but even more so in West Hawaii than elsewhere in Hawaii County. Statewide preliminary TIMS results indicate such attitudes largely reflect growth-related problems.

Both the TIMS survey and a recent study by the University of Hawaii School of Social Work (Matsuoka et. al., 1988) found that most Kona respondents thought tourism impacts to date had been, on balance, very positive because of the economic benefits. There were, however, strong concerns about continued growth.

The UH Social Work study -- which focused on particular groups rather than the Kona population at large -- also found significant attitudinal differences between business/developer interests on the one hand and environmentalists or human service professionals on the other hand. Longtime Kona residents engaged in farming or fishing were neither as negative as the environmentalists and social workers nor as positive as the business/developer group.

Surveys such as the TIMS study indicate broad background issues for entire populations. Specific controversies may involve a more limited group of people not necessarily representative of the entire population, but these individualized issues are often related to the more general themes.

A review of major Big Island publications (particularly the newspapers West Hawaii Today and the Hawaii Tribune-Herald) indicate a great variety of such issues and controversies relating to the North Kona area. A sampling from the latter part of 1989 would include:

- Plans for a commercial rocket launching facility in Ka'u produced strong public reaction in Kona. Some residents expressed concern with impacts on air quality, and consequently health, plant life, and the visitor industry. Another issue was the possibility of the island becoming a military target.

- A proposal to build a gymnasium on the State-managed part of the Old Airport Park and the subsequent decision by the County to build it on the County-leased section of the park were debated. Many thought that accessible sports facilities are much needed, and the Old Airport Park is a good site for these. Others thought the Park should remain dedicated to passive uses.

- The police in the Kona Station have complained that fumes from the adjacent dump enter the station and affect their health. (Community interviewees cited this as an example of poor government planning in Kona. See Sections 3.2.2 and 3.3.)

- The County review of the ohana zoning law responded to complaints in Kona that developers were creating double density, residential condominiums. Residents were concerned that developers are able to sell many extra units, straining the infrastructure.

  (Earlier, County officials were concerned that real estate professionals were raising land prices by obtaining ohana permits for lots. Also, they viewed ohana units as interfering with the planning process, since such units are constructed at the will of the individual homeowner (Jaworowski, 1988).)

3.2.2 Information from Community Interviews for This Study

As previously discussed, community interviews for this study included questions about issues and concerns independent of (although potentially related to) the proposed Kealakehe project.

The major issues emerging from these interviews were all generally linked to rapid growth and its control or management. They can be classified into three broad categories:

- Physical planning and infrastructure;
- Social infrastructure; and
- Socio-political concerns.

Physical Planning and Infrastructure

(1) General Patterns of Future Growth: County and State planning efforts have focused community attention on broad questions about patterns of future urbanization. There were different views about how Kona should grow, but most people seemed to feel that Kailua and areas north to the airport would be and/or should be a major focus of growth. There was a feeling that past growth around Kailua has been unplanned and haphazard.

(2) Preserving Coastal Areas for Public Use: A frequent theme during interviews was opposition to any substantial private development of coastal areas (whether sand beach or lava cliffs) north of Kailua.

(3) Traffic and Transportation Planning: A number of people suggested that traffic congestion is now the Number One problem in the Kailua area. Palani Road was felt to be particularly overburdened, and it was predicted that "people would start shooting" if there were any disruption to or further crowding of Palani Road.

Informants had many suggested solutions, including new roads in various locations, bike lanes, and public transportation. However, there was sharp disagreement between those who felt public buses were badly needed for the elderly and/or school children and those who said public transportation would surely fail because of Kona residents' love affair with automobiles.

(4) Water and Sewer Capacity: In addition to recognizing the key role of such infrastructure in guiding future growth, many informants expressed concern about the true extent of water resources -- either total capacity or government resources for maintenance and delivery. There were concerns about water contamination (or simple poor taste) from development-caused runoff.

Social Infrastructure

(1) Lack of Affordable Housing remains among the most pressing of Kona concerns. Community informants report that costs continue to escalate for both fee-simple and rentals, with some people in the real estate field claiming that rentals have as much as doubled in some areas during the last year alone.

Residents reportedly cope with the housing crisis primarily by taking extra jobs to earn more money, illegal rentals (e.g., converted garages or partitioned houses), and/or sharing housing units with other families. Crowded housing conditions, worker exhaustion, and increased physical and mental health problems were seen as more prevalent due to the situation. Some believed that social ills such as child abuse and incest are also more likely under these conditions.

(2) Lack of Child Care and/or Youth Recreational Opportunities: There are few child care centers for infants or pre-schoolers, although the demand is rising because of the increasing numbers of families in which all parents must work. Older children have few after-school recreational programs, in part due to the lack of gymnasiums and playing fields in the Kona area.

(3) Social Service Overload was reported by government case-workers and administrators who cannot find additional staff to deal with the previously described problems. Educators said that most Kona schools are overcrowded.

Socio-Political Issues

(1) Lifestyle: The transition from an agricultural to a service economy -- coupled with strains from rapid growth -- has resulted in a split between older retirees with the resources for a leisurely life and younger families who must work long hours in relatively low-paying jobs.

Many informants felt that Kona no longer has the "slow-paced" lifestyle which was once central to its charm.

(2) Perceived Risks and Disadvantages of a Tourism Economy: Many residents who are not in the visitor industry commented that the industry provides "dead-end jobs." they were concerned that the economy provides only limited opportunities for West Hawaii's young people. They thought service sector wages so low that many employees have to take second jobs to meet their needs, and live in fear of lay-offs. Some saw resort workers as lacking pride in their jobs. One social service professional even thought young adults in the visitor industry likely to suffer from personal and financial instability, and to experience little joy or hope for the future.

(3) Lack of Community Cohesion: Kona residents often characterize themselves as socially fragmented and contentious. They feel there is no single cohesive "core community," but a series of disconnected groups divided by geography, ethnicity, income, or age. Residents of the "mauka communities" south of Kailua are sometimes seen as more cohesive due to longer years in the community and some shared institutions (clubs, churches, etc.), but these residents constitute a smaller portion of the population as time goes by.

A few of those interviewed expressed optimism that Kona is pulling itself together through efforts such as the new "Greater Kona Community Council."

(4) Government Credibility: A number of informants were frankly suspicious of both State and County government. They questioned government's competence, integrity, and the ability of the State and County to work effectively with one another. The wisdom and effectiveness of recent government planning decisions were held in particular question.

Some longtime Kona residents felt that newcomers can be impatient with the lack of government services, not understanding the economic and logistical difficulties of service delivery to relatively small populations spread out over large distances. However, some people felt government officials "just don't like Kona people" for cultural or political purposes, and deliberately withhold quality service for such reasons.

(5) Queen Liliuokalani Trust Performance: Private organizations, as well as government agencies, were evaluated critically by citizens. Questions were raised during interviews concerning the Queen Liliuokalani Trust, since it is the owner of the Keahuolu Lands slated for development as a new urban center.

3.2.3 Public Responses to Planning Efforts for West Hawaii

Planning for growth in West Hawaii has been undertaken by State and County planning agencies. Also, the proposals for development of Kona lands by the State's Housing Finance Development Corporation and the Queen Liliuokalani Trust are responsive to anticipated growth, and amount to plans to manage some of the potential impacts of such growth. West Hawaii residents have responded with interest and concern:

(1) The State's Office of State Planning prepared a West Hawaii Regional Plan during 1988 and 1989.

At an August 1988 public meeting on the Regional Plan in Kona, one resident expressed concern that the designation of four resort "nodes" for all future West Hawaii resort developments excluded other possible sites. Questions were also asked about the adoption of a State impact fee schedule for developers (Flickinger, 1988).

(2) During 1989, Kona residents were also invited to comment on the County's Kailua to Keahole Plan, which identifies separate industrial, commercial, and residential areas for anticipated growth over the next 20 years. Public concerns raised at meetings in March and December 1989 centered on the site of a University of Hawaii campus, impacts on Kailua Village, and the possibly conflicting plans proposed by major area landowners (Flickinger, December 1989).

(3) The Kealakehe development was first announced by the County in 1986, and was discussed in the Hawaii County Council in 1987. West Hawaii residents in general first commented on then-current plans for Kealakehe at a hearing of the Housing Committees of the State House and Senate in February 1989. Kona residents objected strongly to plans to sell makai lands in order to finance affordable housing mauka of the highway. (NOTE: Those plans are not part of the current Kealakehe project.) Residents felt the sale would block future public use of the coastal area. Some also objected to the purchase of land by the State (from the Queen Liliuokalani Trust) when it is already a major area landowner (Flickinger, March 1989; Perez, 1989).

The next public response to the Kealakehe project came in September 1989, when the HFDC presented preliminary conceptual plans for 840 acres of mauka land. Residents

raised concerns about increased traffic on Palani Road and suggested the early construction of a mauka-makai road through Kealakehe (Flickinger, September 1989).

3.3 COMMUNITY ISSUES AND CONCERNS WITH REGARD TO CURRENT PROJECT

Table 8 summarizes the issues raised in the interviews. The following text first provides a general overview of residents' concerns, followed by more detailed discussion of individual issues and concerns.

3.3.1 Overview

Kona interviewees welcomed the Kealakehe project as the first major effort to address the area's need for affordable housing. Still, they were concerned that such a solution might further aggravate current problems with traffic congestion and other infrastructure.

Kona residents identified housing as a critical problem that had grown much more severe in the past two years. They felt the demand for houses in the proposed project would be strong since there are now so few units that the average Kona family can buy or rent.

The interviewees pointed out that the project's location would mean more traffic on Palani Road, a road they depend on greatly but they consider to be unsafe and a major traffic bottleneck.

More than anything else, the interviewees wanted to see all of the project's infrastructure in place before anyone moved into the project. They felt this would minimize traffic congestion and strain on water and sewer lines.

Kona residents identified several current social concerns in their area. They thought these could be either magnified or alleviated in the new Kealakehe community. They felt that if those problems were addressed in the planning and design of the project, then the new neighborhood would serve as a model community for the entire West Hawaii region. The Kealakehe project would, they hoped, respond to needs for affordable housing, recreational facilities, transportation, and child care, without straining the limited means of community residents.

Most of those interviewed said they hoped the proposed housing would be available to the average Kona resort workers and others who currently have little chance of owning a home. People wondered if the housing would actually be priced in a range affordable for young Kona families.

The interviewees clearly wanted the development to be attractive and a source of pride to its residents. They suggested

TABLE 8: COMMUNITY ISSUES AND CONCERNS RELATED TO THE PROJECT

Primary	Secondary	Occasional
Kealakehe as a Constructive Response to West Hawaii Social Problems		
Housing Approval for first effort to address affordable housing shortage in Kona	Size and density of project hard to visualize; number of homes and people is unnerving	
Infrastructure Must install roads and utilities before new residents move in (to reduce impact on Palani Road and sewer, water, and electrical services) Major concern with the impact of additional traffic on Palani Road	Infrastructure considered fragile and threatened	Suggestion for reducing traffic impacts -- no access to Palani Road, or more traffic signals at Kealakehe intersections
Public Transportation and Pedestrian Access	Students and resort workers could benefit the most from public transportation	New neighborhoods should have sidewalks and pedestrian access to adjacent commercial areas
Recreational Facilities Need for passive park space, playgrounds, shade trees, grass, picnic areas and good maintenance Need active recreational facilities, gym, pool, fields, courts, and supervised activities	After school, supervised recreational activities would reduce hours children are unsupervised	Need for a place for meetings and social gatherings
Parental Supervision Shortage of child care options, particularly affordable programs	New neighborhood must encourage or provide a range of services	
Schools High school should be built now to end students' long commute		Overcrowding of schools affects the quality of education

(Continued)

TABLE 8 (Cont.)

	Primary	Secondary	Occasional
Project Characteristics and Organization			
Who will live in the community?			
	Preference should go to Kona families, resort workers, and first-time home buyers	If housing is expensive, Yuppies and Mainland U.S. retirees will live there	Housing could attract needed resort and other skilled professional workers, in-migrants could come from other Big Island districts or Honolulu
	Will average resort worker be able to afford new Kealakehe homes? Will it be a bedroom community for West Hawaii resort workers?	A community of resort workers could mean additional social service requirements	Additional social service need could further strain an already overburdened system
Governance			
	Must have strong community associations to enforce strict community standards		Would like project developer to be sensitive to community needs
Financing			
	Must assist first time home buyers with a variety of financing methods	Needs a system to qualify buyers that considers uniqueness of the local economy, low wages, tip income, and seasonal layoffs	To reduce costs, houses could be leasehold with buy back and shared appreciation provisions
	Owner-occupants desired; no private profit from investment in or sublets of affordable units; rules establishing buyback provisions and a State share in appreciation		
Design			
	An attractive project is desired with open space and room between the units	Housing should not all look alike and should have a range of products for large families, renters and the elderly	
	Must integrate housing of difference prices, not isolate the lowest cost housing		

(Continued)

TABLE 8 (Cont.)

Primary	Secondary	Occasional
Concerns about Nearby Areas		
Opposition to development of Kealakehe parcel makai of the Queen Kaahumanu Highway	Opposition to the State's purchase of land from the Queen Liliuokalani Trust	A municipal golf course is needed and it serves as an attraction for selling homes
	Concern about the possibility of more traffic and crime in the area, making it less desirable	Multifamily housing becomes more desirable with proximity to new houses and a commercial area
		Concern that single family housing could be less desirable if project isn't attractive or well maintained
		Honokohau Harbor use will increase, compounding traffic problems at the Harbor entrance

NOTE: Issues and concerns listed as "PRIMARY" were mentioned more frequently than comments about the same topics listed under the other two headings. The number of comments on each of the three general topics and on particular issues differed. Topics and issues listed first in this table were more often mentioned than subsequent topics and issues. Again, "SECONDARY" comments were more frequent than "OCCASIONAL" ones on a given issue, but less frequent than "PRIMARY" comments.

financing methods to enable average working families to buy homes. They felt the area could remain desirable if strong community associations enforced housing standards. Many commented on lot sizes, setbacks, the mix of houses in the community. and the overall layout of the project. Most wanted the project to include recreational facilities.

Kona people raised concerns about the relation of the Kealakehe project to surrounding areas. First, some residents expressed very strong concern regarding possible future uses of the State's property makai of the Queen Kaahumanu Highway. (That property is not part of the present project.) Some suggested that the golf course be located makai of the Highway, to block other uses of that area. Others were divided in their views of the most appropriate site for the proposed municipal golf course. Next, several persons were concerned about impacts of the project on nearby residential areas and on Honokohau Harbor.

3.3.2 Kealakehe as a Constructive Response to Kona's Problems

Most of those interviewed discussed the Kealakehe project in terms of what they saw as Kona's social problems.

Most interviewees thought that project design and provision of needed services could minimize or avoid social problems in the new neighborhoods. They suggested what they wanted to see in the new Kealakehe community with the hope that the new neighborhoods could show West Hawaii ways to address social problems. On the other hand, some predicted that, if the future residents of Kealakehe were predominantly young, less affluent and employed in resorts, then existing problems would probably intensify in the new neighborhoods.

Lack of affordable housing was identified as one of Kona's most pressing problems. The Kealakehe project was seen as a much needed solution to the housing problem. They went on to comment:

- The plans were described by some as "wonderful" and "giving our children a chance".
- Most people, including current Kealakehe residents, thought the location was good and in keeping with general growth patterns.
- Some interviewees commented that the project could help people move out of crowded lodgings and give working people a chance to own their own homes.
- However, most people had a hard time visualizing a 3,000- to 4,000-unit subdivision. Many remarked they "didn't want to see another Honolulu."

- A few people raised the possibility that future growth in Kona would be so great that Kealakehe would not be able to meet the demand for affordable housing.

- Current Kealakehe residents and a smaller number of others said the plans involved so many people that it scared them. They felt that if so many people were expected to live close together, social problems such as crime and noise would increase.

Kona residents were unanimous in expressing concerns about the project's possible impact on the area's infrastructure, particularly traffic:

- Many insisted that the project's infrastructure should be put in before project residents moved in. They sought to minimize congestion on Palani Road during construction and to make sure developers would not "run out of money" and leave existing systems more burdened.

- Residents described their infrastructure as "life threatening" when emergency vehicles are stuck in traffic, "fragile," and "like in a third world country."

- Increased traffic on Palani Road was a major concern of Kona residents. They felt the proposed mauka-makai road in the project area would not fully mitigate the additional pressure on Palani Road.

- Residents' suggestions for mitigating measures ranged from allowing no project access to Palani Road to placing traffic signals at the Kealakehe intersections with Palani Road.

- A few people doubted that the infrastructure could ever keep pace with the growth in the area. They questioned the County's capacity to meet rising demand.

The lack of public transportation and pedestrians' needs in Kona were often mentioned after discussions of the bad traffic situation. People felt young people were greatly disadvantaged by the total reliance on private cars.

- Some thought that mass transit would be of value to students and to resort workers. (Another viewpoint was that mass transportation cannot work in Kona, as people are too attached to their automobiles.)

- Many interviewees said the new Kealakehe neighborhood should have sidewalks, pathways, and pedestrian access from Kealakehe to the commercial development proposed on

the adjacent Queen Liliuokalani Trust property -- encouraging residents to depend less on their automobiles.

Kona people, regardless of age or occupation, mentioned the need for playgrounds and other recreational facilities. Several mentioned that the only real playground was at the McDonald's restaurant, and so most children now play in the streets.

- Most wanted the Kealakehe project to have passive parks, with grass, shade trees, and picnic areas that are well maintained and close to residential areas.
- Some residents also saw a need for more active recreational facilities such as a gymnasium and swimming pool in the Kealakehe project. A frequent comment was that they would like to have "eveything that Hilo has."
- Several suggested that the facilities should have supervised activities for children to reduce the afterschool hours they spend alone.
- A smaller group of people mentioned a need for a community center for meetings and social gatherings.

In a resort economy, with round the clock work shifts, many children have little parental supervision. School personnel noted that many children were alone during afterschool hours or during vacation and sick days. They felt those children were more likely to have academic and behavioral problems.

- Generally, people felt there was shortage of child care options, particularly affordable services.
- They felt the new Kealakehe neighborhoods should provide or encourage child care services ranging from babysitting to summer programs in the schools.

People also expressed a more generalized fear that Kona youth are being locked out of economic opportunities in the area. Businessmen and educators observed that the young people who go away to college rarely return, and those who remain have few job opportunities. Interviewees were aware of the need for a high school and another elementary school in Kealakehe.

- Many would like the schools built right away so Kealakehe area high school students will not have to spend so much time commuting to Konawaena High School.

- Residents who work in the Kealakehe elementary and intermediate schools said these are currently overcrowded. The crowding makes regular classrooms a priority, so these schools cannot have specialized facilities, such as music rooms,.

3.3.3 Project Characteristics and Organization

Project Residents: Most of those interviewed showed concern and uncertainty about the population that would eventually live at Kealakehe. They hoped that Kealakehe housing will be within the means of young working families from West Hawaii. Various interviewees wanted the residents to include people born and raised in Kona, average resort workers, and/or first time home buyers.

Interviewees made several different predictions about the future inhabitants of the project and their role in West Hawaii:

- Some interviewees predicted that homes would be bought by mainland retirees.

- Others expected "Yuppies" and professionals to live in the project.

- The project was seen by a few as attracting needed skilled and professional workers. Other people thought the project could attract the large volume of workers required by future hotels.

- Several thought the project's residents would include mostly in-migrants from Hamakua, Hilo, and Honolulu. However, they thought these groups might not like the Kona lifestyle, and would not fit in with the larger Kona community.

- Several felt certain that resort workers would not be able to purchase homes in the Kealakehe project.

- However, several others thought resort workers could afford the Kealakehe homes. A few were concerned that problems allegedly frequent among resort employees, notably stress and drug use, would occur at the Kealakehe project.

Project Governance: One of the most frequent comments people made about the housing proposal was that they wanted the

housing to be a source of pride to residents. They felt quality building and good governance would help to instill pride in homeownership, which would in turn assure good maintenance and appearance.

Many Kona residents said the key to keeping the Kealakehe neighborhoods desirable is strong, mandatory community associations which would enforce subdivision standards. Prohibitions on abandoned vehicles, animals, noise, and unsightliness were mentioned as valuable. People suggested such associations are the only way to adjudicate housing-based conflicts.

Several people wanted to see the project handled by a developer who is sensitive to the social needs of the new residents. They felt an exceptional developer with a more caring attitude and a post-construction phase commitment to the area would make it a desirable place to live.

Project Financing: Most Kona interviewees thought special financing should be made available to insure that the average family needing housing in Kona could afford to buy a Kealakehe house. They said they would like to see subsidized mortgages, assistance with down payments, and provisions for temporary loss of income. Once project residents were given a chance to buy a house, it was predicted that they would do everything in their power to keep up payments.

Kona residents wanted a fair system for qualifying home buyers. Such a system would take into account unique factors of the Kona workforce such as seasonality and income from tips. People were concerned that if qualifications are too rigid, many area residents will not qualify.

Many interviewees wanted to see the affordable units at the project made available to owner-occupants, not investors. They supported controls against private rentals or sublets. They wanted strict buyback provisions to keep the housing affordable and to give the State a share of any appreciation.

A smaller number of residents suggested that the State lease the property, rather than making it fee simple, in order to lower prices. They proposed a lease-to-buy program with the same buyback and shared appreciation considerations as proposed for fee-simple homes.

Project Design: People said they wanted a creative approach to design. They did not want conventional street grids or rows and rows of identical housing. They would like to see the new neighborhoods laid out with considerations for open areas, adequate room between units and ample setbacks of the units from the streets.

Most of the key informants expressed a concern about the mix of housing units of differing prices in the project. They wanted

the lowest priced housing not to be isolated and stigmatized as a low-income area.

Many residents often used other Kona housing developments as a point of reference when describing what they would like to see built at Kealakehe. A number of people said they did not want the new project to look like the Pines, a recently constructed project of zero-lot-line condominium homes. Interviewees also mentioned the homes in Queen Liliuokalani Village, a leasehold subdivision on the mauka side of Palani Road in Kealakehe, as too closely spaced.

People thought the zero-lot-lined units were too much alike and could deteriorate quickly. Queen Liliuokalani Village was cited as having inadequate governance.

A few residents found the recently built Lailani rental housing project a good example of inexpensive housing. They liked the cluster design of the units and the spacious lay out of the entire project. An even smaller group found the Pines project not objectionable and said that similar densities were inevitable to keep future housing projects affordable.

Many Kona residents hoped that the lots in the proposed neighborhoods would be a minimum of 10,000 square feet, particularly if ohana zoning were allowed. A slightly smaller group found lot sizes between 5,000 and 10,000 square feet acceptable. While people believed ohana zoning would increase the density of the area beyond levels planned or desired, more people saw it as a necessity in making housing affordable than those who wished to prohibit it.

Many key informants said the proposed Kealakehe development should include housing units of various sizes. They recognized needs for units for large families and smaller units for the elderly. They also thought that rental units were necessary to serve those could not afford to buy a home. They thought some tenants might need rental subsidies.

Several people expressed concern that the rental units follow the same standards set for the rest of the project. Otherwise, poor quality rentals would have a negative impact on the market-priced housing.

Most interviewees mentioned recreational facilities as needed neighborhood amenities. Churches were also mentioned by some. External design elements proposed by a few interviewees included underground utilities and carports.

A few interviewees suggested that HFDC should sell developed lots, allowing buyers to build their own homes.

3.3.4 Concerns Related to Nearby Areas

There were some complaints and objections to the State's proposal to purchase land for the project from the Queen Liliuokalani Trust. Realtors were especially likely to suggest that if the goal of the project is low-cost housing, then it would make more sense for the State to build on the large quantity of land it already ownes in the area, rather than purchasing additional land.

Kona residents were aware that earlier plans for the Kealakehe project included selling the State's Kealakehe property makai of the Queen Kaahumanu Highway to private resort developers. The proceeds would have subsidized the cost of the housing mauka of the Highway. Several interviewees explicitly mentioned this land, commenting:

- They opposed any resort or residential development on the site;
- They wanted the area to remain open or to be used for public recreational purposes;
- They were concerned that the State's silence about the makai property could imply a continuing intention to sell the land to a private developer; and
- They wanted the proposed municipal golf course located in the makai parcel in order to occupy that area.

  (Others were not concerned with the site of the golf course. They felt that a municipal golf course was needed in Kona, and that it would serve as an attraction in marketing the proposed Kealakehe housing.)

  A further consideration raised by some the interviewees was the cost of pumping effluent from the sewer plant on the makai land across the Highway and uphill to the currently proposed golf course site.

Some concerns were raised about possible impacts of the Kealakehe project on adjacent or nearby residential areas. Residents in the existing Kealakehe subdivisions were concerned about the construction traffic coming through residential streets. They also anticipated an increase in crime due to an increase in population.

A few Kealakehe residents assumed that the existing Kealakehe multi-family housing would become more desirable due to proximity to new housing and the commercial development of the Queen Liliuokalani Trust property. However, there was also concern that existing single family homes in Kealakehe could become less desirable. Many interviewees were concerned that the

project might "become a slum" which would adversely affect nearby areas as well as the project.

Residents of residential areas adjoining or near the project were concerned mostly about traffic impacts on Palani road during and after construction.

Commercial development at the Honokohau Harbor was expected to benefit from the increased number of boaters and others living close to the Harbor. Since there are no immediate plans for an increase in the number of boat slips, the few informants who raised this issue assumed that boaters would have to store their boats upland and bring them to the Harbor on trailers. The trailer traffic was seen as compounding traffic problems at the access to the Harbor from Queen Kaahumanu Highway.

4.0 SOCIO-ECONOMIC IMPACTS

4.1 INTRODUCTION

This section provides a consultant's assessment of socio-economic impacts of the Kealakehe project, in the light of anticipated trends in the economy and society of West Hawaii. Both quantifiable impacts (population and employment) and more qualitative impacts associated with the project are discussed.

The preceding section, on Community Issues and Concerns, should be considered as part of the overall assessment of social impacts. The affected community's reaction to a development is part of the impact of the project, and that community is often the best judge of qualitative impacts. The qualitative impacts discussed in this section were chosen partly on the basis of community input, partly on the basis of consultant judgment and knowledge of the West Hawaii area.

The impacts considered in this section include:

- Quantifiable socio-economic impacts;
- Impacts on housing and residential communities in West Hawaii; and
- Impacts on specific areas near the project site.

In socio-economic impact assessment, an "impact" is usually defined as the difference between two possible futures: future conditions which will occur even without the project, and future conditions with the project.

West Hawaii is expected to see at least a fourfold increase in visitor unit inventory by 2005, and a doubling of the population by that date, with or without the Kealakehe project (Section 2.2). Major in-migration of workers (as well as full-time resort residents and hotel visitors), is likely to result in substantial socio-political change.

If it is assumed that the employment and population growth outlined in Section 2.2 will definitely occur, then residential development is needed to support the new population. The "impact" of the Kealakehe project is a matter of:

- where residential development takes place in West Hawaii, not whether it takes place;
- the availability of housing for those who wish to own, or just to live apart in, their own homes;

- o whether homes are built in planned communities or in a variety of locations and clusterings; and

- o the provision of homes for some -- owners of vacation homes -- who earn their income outside Hawaii and hence introduce capital to the state.

Arguably, preventing support activities could prevent tourism growth by interfering with labor supply. Few workers might move to West Hawaii without places to live or shop. However, many of the resorts already have their approvals and can be expected to proceed with development even if it is necessary to attract workers with makeshift solutions (e.g., dormitories). Building new resorts without providing support services for new population would produce extreme negative impacts on cost of living and quality of life for existing residents.

Therefore, the major socio-economic impacts of the project will involve location, opportunities for homeownership, and community planning.

The alternative future, for comparative purposes, would generally be an unplanned and dispersed development of homes (and other housing, such as dormitories) in and near West Hawaii.

4.2 QUANTITATIVE IMPACTS

Major quantifiable social aspects of the proposed development are population and employment. This section deals with the resident population at the project, employment associated with the project, both during construction and after buildout, and indirect and induced employment linked to the project.

4.2.1 Population

The project will be built out over about 20 years -- sooner or later depending partly on demand for affordable housing in West Hawaii. A market assessment has shown that a range of 3,620 to 5,530 units could be absorbed at Kealakehe by about the year 2010 (KPMG Peat Marwick, 1989).

Table 9 shows the number of units in three major segments (affordable rental, affordable ownership, and market units), and the population expected on-site. The column showing population at full occupancy indicates that about 10,000 to 15,100 persons could be at the project site if all units were occupied -- an unlikely event, even at peak times such as Christmas. A more realistic approximation is shown in the right-hand column, which takes occupancy levels into account.

TABLE 9: POPULATION AT THE KEALAKEHE PROJECT AT BUILDOUT

Unit Type	Number of Units (1)	Household Size (2)	Population With Full Occupancy	Average Occupancy Percentage (3)	Number of Occupants
Affordable Ownership Units	1,800 to 2,100	2.9	5,220 to 6,090	95%	4,960 to 5,790
Affordable Rental Units	690 to 1,160	2.9	2,000 to 3,360	95%	1,900 to 3,200
Market Units	1,130 to 2,270	2.5	2,830 to 5,680	59%	1,670 to 3,350
All units	3,620 to 5,530	2.7	10,050 to 15,130	83%	8,530 to 12,340

NOTES:

(1) Number of units from KPMG Peat Marwick, 1990, exhibit V-C.

(2) Household size estimated on the basis of County trends and market assessment recommendations for unit sizes and pricing.

(3) Average occupancy from (a) assumption of a 5% vacancy rate; (b) assumptions that 50% of the market units will be used as vacation homes by non-Hawaii residents, and that vacation homes will be occupied only 25% of the time. Vacation home percentage derived from analysis of a total of 125 North Kona sales in 1989 (single-family homes costing $200,000 to $300,000, and condominiums costing $150,000 to $250,000 -- excluding the Keauhou resort area).

The expected population at the Kealakehe project site is likely to reach about 8,500 to 12,300 after buildout.

Part-time residents from outside Hawaii are assumed to own approximately 50% of the market units, based on an analysis of recent North Kona sales. Since these occupants are less likely to be in their homes than others, they only account for about 6% to 7% of the total on-site population.

4.2.2 Employment

Employment associated with a project such as Kealakehe includes:

- Construction jobs, which are generated for a limited period;
- Operational jobs, which are presumed to last the lifetime of the project; and
- Indirect and induced jobs in the larger State economy, created as the development and project workers buy goods and services from other establishments.

  Indirect and induced jobs are estimated using a model of the State economy. It can be used to calculate the employment effects of any project or enterprise.

Construction Employment: As Table 10 shows, project construction is estimated as generating a total of 3,830 to 5,570 direct jobs over the entire construction period. The actual average number of construction jobs in any given year is expected to be in the range of 190 to 280 jobs, while the number of jobs on-site will be somewhat smaller.

(Estimates of construction employment are averages -- the size and composition of the workforce on a project will vary during the course of construction. Also, the length of time over which construction will occur is not yet certain for the Kealakehe project, so annual figures depend on an approximation for this figure.)

The indirect and induced jobs generated by construction of the project are calculated as amounting to roughly 8,000 to 12,000 jobs over the construction phase, of which about 3,000 to 5,000 could be located in Hawaii County -- yielding an estimated annual average of 170 to 250 indirect and induced jobs in Hawaii County. The total direct, indirect, and induced jobs for project construction would then average about 360 to 530 in Hawaii County annually.

TABLE 10: CONSTRUCTION EMPLOYMENT, KEALAKEHE PROJECT

Assumptions:

(1) Total construction cost will be $420 million to $610 million (1989 dollars) over the entire construction phase (according to general estimates, not based on detailed engineering for the site, provided by Belt Collins & Associates, January 17, 1990).
(2) The ratio of construction jobs to construction spending in the State of Hawaii for 1988 -- nearly $110,000 per job -- will continue.
(3) While the length of the construction phase has not been set, it is assumed to last about 20 years.
(4) About 80% of the construction workforce is, on average, on-site.
(5) Construction costs for infrastructure, golf course, and commercial center are assumed not to depend on the number of houses built, and will total $113 million.
(6) To calculate indirect and induced employment, multipliers for single-family construction are used for residential construction, and for "other construction" for all other construction work.
(7) Indirect and induced jobs are estimated for the State economy. The County share of such employment is estimated as 40% (based on Anderson et al., 1975).

Direct Construction Jobs:

Project size	3310 units	5260 units
Construction Spending	$420,000,000	$612,000,000
Total Construction Jobs	3,830	5,570
Average Annual Construction Jobs	190	280
Average Annual On-Site Construction Jobs	150	220

Indirect and Induced Jobs

Direct Jobs on Residential Construction	2,800	4,540
Direct Jobs on Other Construction	1,030	1,030
Indirect + Induced Jobs, Residential	6,410	10,400
Indirect + Induced Jobs, Other Const.	2,030	2,030
Indirect + Induced Jobs (Statewide)	8,440	12,430
Hawaii County Share, Indirect + Induced Jobs	3,380	4,970
Total Direct, Indirect, and Induced Jobs (Statewide)	12,270	18,000

SOURCE: 1982 Input-Output Model, Hawaii State Department of Business and Economic Development, Research and Economic Analysis Division, 1989.

Operational Employment: On-site jobs will be created as the residential and other components in the project are developed. After buildout, the project is estimated as providing about 370 to 470 direct jobs, as shown in Table 11.

Jobs created when people who would live in Hawaii in any event move to a new place cannot be treated as new impacts of developing that site. Those impacts of project operations can be specified by identifying the extent to which non-residents' income supports on-site operations.

Table 12 shows non-residents' share in project operational jobs and uses State multipliers to calculate the total direct, indirect, and induced jobs associated with project operations -- some 50 to 80 jobs -- due to the flow of capital to Hawaii from outside.

4.3 IMPACTS ON HOUSING AND RESIDENTIAL AREAS IN WEST HAWAII

The project will affect both the West Hawaii housing stock and, by offering a development organized in response to perceived needs for residential communities near Kailua-Kona, residential life in the area. In this section, indications of the extent of the housing crisis are surveyed, and impacts of the project on housing stock and residential life are analyzed.

4.3.1 The Housing Crisis in West Hawaii

During the 1980's, the West Hawaii housing inventory grew more slowly than did the resident population, meaning that more people must share living quarters. From 1980 - 1988, population increased by more than 48% (Table 4). However, County figures in Table 13 indicate that, even by March 1989, the total West Hawaii housing unit inventory had increased by only 26%. In the rest of Hawaii County, proportionate growth in housing units more closely matched growth in population.

Furthermore, Hawaii Visitors Bureau data indicate that nearly 2,000 of the 16,000 West Hawaii housing units are actually condominiums for visitor use. (Condominiums in resort areas may be made available for visitor use during peak travel years, then revert to long-term residential rentals when tourism declines.) An unknown number of West Hawaii single-family homes may also now be reserved for visitor rentals or second homes.

The value of single-family housing construction has increased in recent years, but not as fast as the entire Big Island construction industry. Figure 4 shows that single-family construction spending has been little affected by economic ups and downs, while multifamily construction was more responsive to industry, and general economic, trends until 1985. In recent years, multifamily housing construction has dwindled.

TABLE 11: DIRECT OPERATIONS EMPLOYMENT AT BUILDOUT, KEALAKEHE PROJECT

A. ASSUMPTIONS

1. Neighborhood commercial center will include a supermarket, one to two fast food outlets, a gas station, and two shops.
2. Golf course will have a clubhouse with dining room, and a small pro shop.
3. With continuing high employment, residents' need for child care will be great. Both family providers and child care centers are assumed to be located on the project site.

B. DIRECT EMPLOYMENT

Area Industry (1)	Subtotals 3,310 homes	Subtotals 5,260 homes	Industry Totals 3,310 homes	Industry Totals 5,260 homes	
Neighborhood Commercial Center					
Retail Trade			100	125	(2)
Eating and Drinking			55	55	
Auto Repair			6	6	
Golf Course					
Amusement Services					
grounds:	20	20	30	30	
golf staff:	10	10			
Eating and Drinking			5	5	
Residential and Community Areas					
Personal Services					
Child care:	27	39	43	70	
Elderly/special needs care:	3	5			
Housecleaning:	13	26			
Other Industries:			32	64	(3)
Education (4)					
School employees	94	138	97	143	
After School Program	3	5			
TOTAL			368	468	(5)

NOTES:

(1) Industries are as listed in State Input-Output Model.
(2) Includes jobs at stores, 8 jobs at gas station.
(3) Landscaping and maintenance/security for market units.
(4) Public school staff needed to serve project residents' children. Staff ratio based on 1989-90 Hawaii District staffing. Estimate covers all grades, although only elementary and high school students are likely to attend schools on-site.
(5) Estimate excludes regular DOE employees.

TABLE 12: DIRECT, INDIRECT, AND INDUCED EMPLOYMENT IMPACTS, OPERATIONAL PHASE AT BUILDOUT

INDUSTRY	DIRECT JOBS	NON-RESIDENT SHARE (1)	INDUSTRY MULTIPLIER	DIRECT, INDIRECT, AND INDUCED EMPLOYMENT
Retail Trade	100 to 125	6.0%	1.57	9 to 12
Eating and Drinking				
Comm. center	55	6.0%	1.89	6
golf course	5	15.2%	1.89	1
Auto Repair	6	6.0%	1.49	1
Amusement Services	30	15.2%	1.49	7
Personal Services (Housecleaning)	13 to 26	12.5%	1.82	3 to 6
Other Industries	32 to 64	50.0%	1.61	26 to 52
Education	97 to 143	0.0%	0.00	0
TOTALS				---
(3,310 homes)				53 to 84
(5,260 homes)				

NOTES:

(1) Non-resident share based on:
- -- vacation units' inhabitants as % of project population (6%).
- -- vacation units' share in number of market units (50%)
- -- amount of time vacation units are in use, as % of time all market units are in use (13%).
- -- visitor use of golf course (according to KPMG Peat Marwick (1990) market assessment, 70 rounds of 460 per day -- 15.2%).

(2) Industry multipliers from 1982 State Input-Output Model. Unpublished tabulations, Hawaii State Department of Business and Economic Development, Research and Economic Analysis Division, 1989.

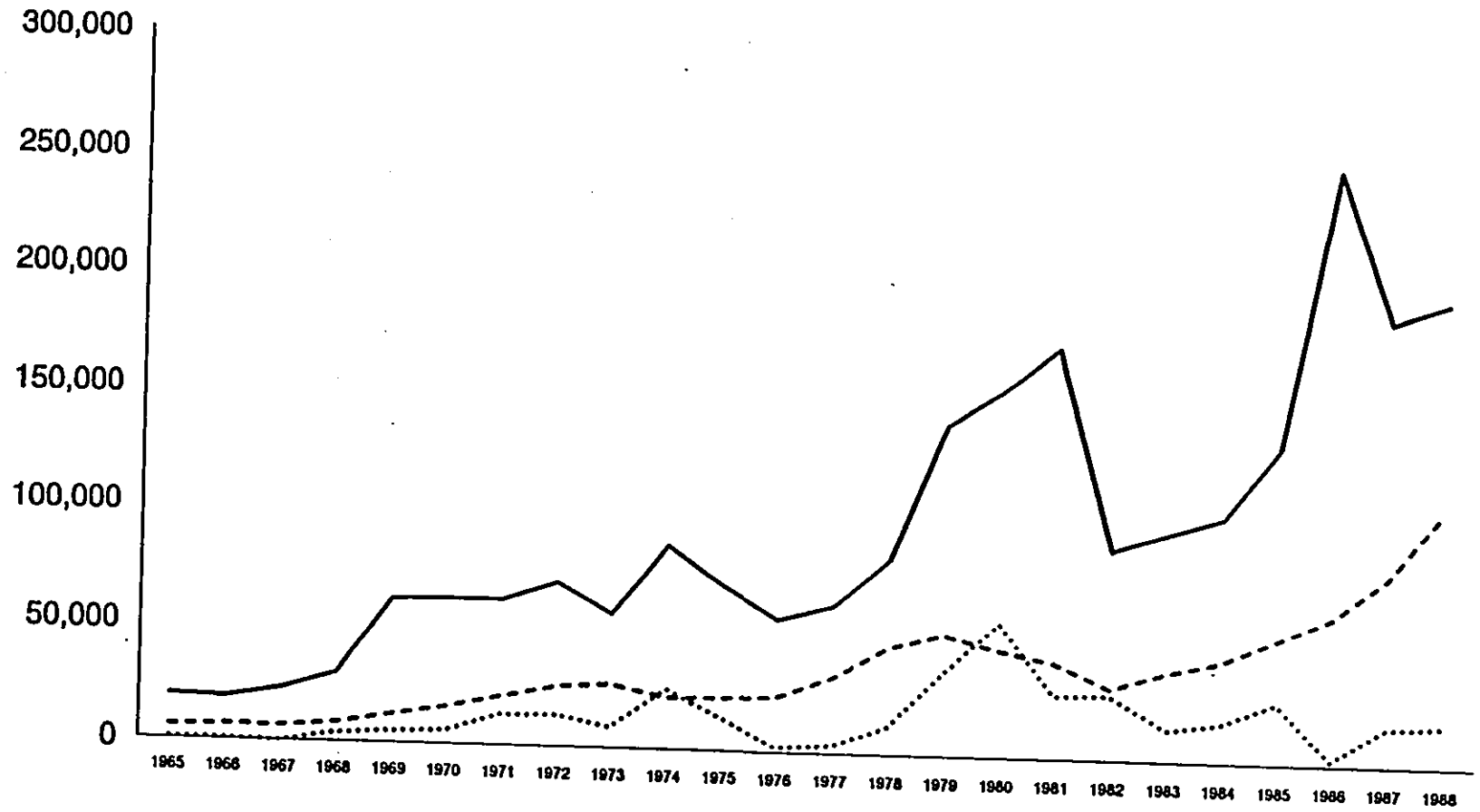
TABLE 13: HOUSING UNIT INVENTORY, COUNTY OF HAWAII AND WEST HAWAII DISTRICTS, 1980 AND 1989

	1980	1989	% Change, 1980-1989
WEST HAWAII			
North Kona			
-- Single-Family	4,105	5,322	29.6%
-- Duplex	122	146	19.7%
-- Multi-Family	2,934	4,109	40.0%
-- Other	379	N/A	
-- District Total, All Units	7,540	9,577	27.0%
South Kona			
-- Single-Family	1,631	1,974	21.0%
-- Duplex	28	34	21.4%
-- Multi-Family	48	88	83.3%
-- Other	15	N/A	
-- District Total, All Units	1,722	2,096	21.7%
North Kohala			
-- Single-Family	1,092	1,235	13.1%
-- Duplex	12	14	16.7%
-- Multi-Family	7	7	0.0%
-- Other	11	N/A	
-- District Total, All Units	1,122	1,256	11.9%
South Kohala			
-- Single-Family	1,692	2,236	32.2%
-- Duplex	10	84	740.0%
-- Multi-Family	511	653	27.8%
-- Other	5	N/A	
-- District Total, All Units	2,218	2,973	34.0%
TOTAL STUDY AREA			
-- Single-Family	8,520	10,767	26.4%
-- Duplex	172	278	61.6%
-- Multi-Family	3,500	4,857	38.8%
-- Other	410	N/A	
-- TOTAL, ALL UNITS	12,602	15,902	26.2%
REST OF COUNTY			
-- TOTAL, ALL UNITS	22,370	26,287	17.5%
HAWAII COUNTY			
-- TOTAL, ALL UNITS	34,972	42,189	20.6%

NOTE: "N/A" -- Category no longer used by County.

SOURCE: Data file, Land Use Inventory, County of Hawaii Planning Department, March 1989

FIGURE 4: CONSTRUCTION TRENDS, HAWAII COUNTY, 1965 - 1988



NOTE: Values are in thousands of dollars.

SOURCE: Bank of Hawaii, 1989.

Further indications that the supply of housing for residents in West Hawaii is severely limited are:

- West Hawaii homes in 1988 had an average resale price at least $65,000 more than the average resale price for the rest of the island. Prices throughout the island increased in 1989, but West Hawaii retained its lead (Pang, 1989).

- The average price of residential properties in all West Hawaii districts was over $200,000 in 1989 -- over twice the amount which would be affordable for a family with a median income.

- As shown in Table 14, 1980 housing costs were roughly 50% higher in West Hawaii, except for North Kohala, than in East Hawaii, suggesting that West Hawaii residents have struggled with a lack of affordable housing for years.

- The supply of units for rent to residents diminished during most of the 1980's, until there were nearly no vacancies in West Hawaii in 1987. More rental housing has become available since 1987 (KPMG Peat Marwick, 1990).

- Rental prices have increased steadily by about 10% per annum since 1980 in both Hilo and Kailua.

- Vacant rental units were also in short supply back in 1980. The percentage of vacant rentals in South Kona, South Kohala and North Kohala was much lower than the vacancy percentage county-wide. North Kona's higher vacancy rate was due to the large number of units used by the visitor market. (See Table 14.)

The current shortage of affordable housing is well known to West Hawaii residents, who call the need "critical", "severe", and "drastic." They cited several telling examples:

- No houselots near Kailua are available for under $100,000.

- Recently, only three fee simple homes were listed in the greater Kailua area for less than $200,000.

- Kona area low- to moderate-income rental projects are filled, and have waiting lists.

- At one rental complex, the prospective tenants at the top of the waiting list have been there for at least six months to a year.

TABLE 14: HOUSING STOCK AND CHARACTERISTICS -- STATE AND COUNTY OF HAWAII, AND WEST HAWAII DISTRICTS, 1970 AND 1980

	COUNTY OF HAWAII		NORTH KONA		SOUTH KONA		SOUTH KOHALA		NORTH KOHALA	
	1970	1980	1970	1980	1970	1980	1970	1980	1970	1980
TOTAL YEAR-ROUND HOUSING UNITS	18,939	33,954	1,975	6,894	1,131	2,052	798	1,959	941	1,121
	%	%	%	%	%	%	%	%	%	%
vacant (total)	9.0	13.9	27.4	33.3	6.4	9.7	18.5	24.3	6.6	8.8
vacant for sale	0.6	1.3	3.2	3.2	0.0	2.9	0.1	2.9	0.7	0.3
vacant for rent	2.0	5.5	8.3	18.9	0.3	2.1	1.9	4.1	1.1	1.8
TOTAL YEAR-ROUND OCCUPIED UNITS	17,260	29,237	1,431	4,602	1,059	1,853	650	1,483	879	1,022
TENURE	%	%	%	%	%	%	%	%	%	%
owner-occupied	56.9	60.6	44.7	55.1	36.9	52.7	48.8	59.3	66.6	67.7
renter-occupied	43.1	39.4	55.3	44.9	63.1	47.3	51.2	40.7	33.4	32.2
SELECTED CONDITIONS										
lacking some or all plumbing	17.1	6.4	26.3	7.3	55.8	28.4	15.4	2.0	17.6	7.3
1.51 or more persons/room	6.5	5.0	14.1	6.1	13.1	10.1	8.2	5.3	9.7	3.1
PERSONS/HOUSEHOLD	3.61	3.09	3.36	2.92	3.71	3.14	3.51	3.07	3.75	3.16
1980 MEDIAN RENT (renter-occupied)	N/A	$223	N/A	$331	N/A	$200	N/A	$307	N/A	$153
1980 MEDIAN VALUE* (owner-occupied)	N/A	$70,300	N/A	$114,000	N/A	$102,600	N/A	$95,700	N/A	$64,200

Notes * Median values are for non-condominium housing units.
N/A: "Not Available."

Sources U.S. Bureau of the Census, 1970 Census of Population and Housing--Census Tracts--Honolulu, Hawaii, PHC(1)-88; 1980 Summary Tape File 1-A; State of Hawaii, 1973, Community Profiles for Hawaii.

- According to some Kona Realtors, there are sub-unit rentals in 50% to 80% of the homes in certain neighborhoods.

- One realtor observed that 70% of all potential single family home buyers are looking for homes with rental units.

- Some see certain neighborhoods as overcrowded because the original buyers' households now contain their grown children and grandchildren.

- Many residents know of single-family houses in which three or more families live, or one-bedroom apartments sheltering or families with four or more children.

- The Hawaii Tribune Herald reported that County officials and advocates for the homeless estimate as many as 800 people in the County lack permanent shelter (Harada-Stone, 1989).

The lack of affordable housing has meant some people must work more than one job, or live in overcrowded conditions, which can generate other social problems. Social service professionals recognized housing problems as a major cause of stress in families with domestic problems. In such families:

- Adults become overwhelmed by the demands of work schedules, with no time to supervise their children;
  - Some adults grow more irritable and the stress may bring out anger that leads to abusive acts; or
  - They may drink to relax, and may become abusive when they are drunk.
- Children are unsupervised and may be exposed to the dangers dues to substandard housing or inadequate plumbing; and
- Children are often absent from school, ill-fed, and ill-clothed;
- Often such children become major family caretakers; and
- Respiratory infections and head lice circulate easily among residents of crowded households, leading to higher rates of infection.

In the past, stress was more likely to be seen in families with large mortgages. Now, with higher rents, the same stress is seen in renters.

Social service professionals said the lack of affordable housing affects severely special needs groups such as the disabled and mentally ill, who would benefit from independent living situations.

4.3.2 Expected Housing Trends

Proposals for housing developments in West Hawaii would, if all were built, yield over 21,000 new housing units, not including the project (KPMG Peat Marwick, 1990). Many of these developments have no permits as yet, and it is likely that fewer units will be built in the next twenty years or so.

Affordable housing commitments by resort developers would, when the resorts and the associated housing are built, yield over 3,000 units for low-income, moderate-income, and gap group families. Also, about 3,650 of the housing units in proposed developments are targeted as affordable units.

The total demand for new housing in West Hawaii is projected as about 25,150 units by 2010 (Table 5) -- more than is likely to be built in all the projects proposed so far. Also, the need for affordable units for homeowners is great -- if housing ownership patterns continued as they have in recent years, the number of families owning their own homes in West Hawaii would be about 4,000 below that mandated by the State, according to the market assessment for this project (KPMG Peat Marwick, 1990).

New private residential projects may well account for a much part of construction spending than in recent years in West Hawaii (Figure 3), but these projects are not likely to meet the demand for new housing, especially for affordable units.

4.3.3 Impacts on Housing Markets

By adding thousands of units to the West Hawaii housing supply, the project is likely to have a stabilizing effect on the price of housing and rentals. By providing units for families with low, moderate, and gap-group incomes, the project will address needs of existing West Hawaii residents -- it will:

- Give many families a chance to own their own homes;
- Encourage less crowding in existing households; and
- Help to decrease stress and social problems that can accompany crowded living conditions.

Impacts on project residents' incomes will vary. Renters are likely to benefit from lower rents and/or a decrease in the rate of appreciation of rents. Many new homeowners will pay more

for housing than they would in rental housing, but they will be gaining equity.

The project will most obviously benefit its residents. Others who will also be affected by a larger housing supply include in-migrants and commuters:

- More rentals for low- and moderate-income families can encourage working in-migrant couples (from other counties of Hawaii, or outside Hawaii) to stay in the area, leading to lower transience among new in-migrants;
- New in-migrants attracted by visitor sector jobs will be more likely to find appropriate housing in the future than they have in recent years;
- Some of the "working homeless" -- commuters from other parts of Hawaii County who work in West Hawaii but live in their cars during the work week -- are likely to find better shelter; and
- As West Hawaii's affordable housing supply increases, commuters and new West Hawaii employees from elsewhere in Hawaii will move to West Hawaii in increasing numbers.

4.3.4 Impacts on West Hawaii Residential Areas

The creation of a large-scale planned community in West Hawaii will affect residential life in the larger West Hawaii area both directly and by example:

- The project's community association and enforcement of controls on building and use violations (such as illegal rentals) will serve as a model for other neighborhoods;
- With an increased housing supply, the demand for illegal rental units and the need for families to double up will decrease, leading to lowered population density in some neighborhoods; and
- If the community's rules allow licensed child care providers to operate in residential and/or community areas, the project can meet growing needs among West Hawaii families for child care and can set an example for community support of regulated child care arrangements.

  (Demand for both family-based and center-based child care is growing in West Hawaii (personal communication, Heidi Lehmann, West Hawaii Co-ordinator, PATCH, January 23, 1990). With increasing labor force participation, the demand is likely to become much stronger in the future.

Also, with many in-migrants in the future population, the proportion of families in West Hawaii that can depend on grandparents and the like for child care will be lower than the Statewide average.)

4.4 IMPACTS ON NEARBY AREAS AND ACTIVITIES

4.4.1 Residential Areas

As West Hawaii's population grows, residents of existing neighborhoods will see residential areas grow, and new residential areas created, where there now is open space.

With a large-scale residential project located in Kealakehe, residents of existing Kealakehe neighborhoods and adjacent neighborhoods are likely to see their surroundings as changing markedly the project will make those neighborhoods part of a large residential area. The Keahuolu project for a new urban center will also have an impact, bringing existing and projected residential areas close to the regional center.

By increasing the nearby area's population, the project is likely to bring mixed impacts:

- According to residents, increased traffic congestion on Palani Road is highly likely. (An independent expert consultant will report on this issue.)

- With greater population, the frequency of crime and domestic disturbances in the nearby area is likely to increase. However, the proposed mauka/makai road will reduce the travel time between the police station and the Palani Road subdivisions, improving police response time.

- The project's commercial area will include stores and services of use to residents, so nearby residents will no longer have to go down Palani Road to Kailua for their shopping.

- Public facilities, infrastructure, and services developed in or in connection with the project may benefit nearby residential areas as well. The location of a high school at Kealakehe, for example, will greatly reduce commuting time for students living north of Kailua-Kona.

  Again, a municipal golf course, while of benefit to golfers living throughout West Hawaii, will be especially convenient for nearby residents.

The project is likely to have little impact on housing values in the immediate area, if prudent planning is exercised and community standards are upheld. In particular:

- By locating homes with larger lots near existing market-price subdivisions, and by mixing product types within the project, the project will avoid creating the low-income "slum" that some area residents fear could be created near them.

- Improved access to public facilities on the project site, such as the proposed high school, is likely to add to the value of area homes.

4.4.2 Industrial and Commercial Areas

Queen Liliuokalani Trust (QLT) Property: Existing, planned and proposed commercial areas are located on QLT land south of the project:

- The Kona Industrial Subdivision is a 67-acre, 52-parcel area located makai of Queen Kaahumanu Highway. First developed in 1966, it is now undergoing a transformation from industrial and service tenants to retail shops, offices and restaurants.

- Expansion of the subdivision onto 100 acres of land to the north is already planned.

- QLT's proposed Keahuolu lands project includes the creation of large new commercial areas dedicated to retail use and, eventually, general business expansion. These areas will be located on both sides of Queen Kaahumanu Highway.

The Kealakehe residential project's impact on businesses at these sites is generally positive. A large residential population in the immediate vicinity would help to support retail, amusement, and service establishments.

Increased traffic flow on Queen Kaahumanu Highway -- likely if the QLT commercial areas attract many customers -- would have a negative impact on these sites. Road improvements are accordingly planned as part of the Keahuolu Lands project. (Drivers making left turns into and out of the existing QLT commercial area now experience delays.) The project is likely to provide some pedestrian traffic, reducing slightly the number of cars travelling to these commercial areas, and so is expected to have a mildly positive impact on this issue.

Industrial Areas North of Kealakehe: Several landholders with property mauka of Queen Kaahumanu Highway, north of Kealakehe, intend to continue or gradually develop light industrial and commercial uses of their properties. (Lanihau Corporation, McClean Trust, and Isemoto/SJA/Taylor lands are adjacent to the Kealakehe site.)

Since the areas will not be relying on retail shoppers, the impact of the nearby Kealakehe resident population should be small. It is unlikely that the industrial uses of the properties will occur along their Kealakehe boundary (Helber, Hastert & Kimura, 1990). Development of the McClean and Isemoto properties is expected to occur along a feeder road reaching the Highway about 800 feet north of the project boundary.

4.4.3 The Proposed New Urban Center

Queen Liliuokalani Trust is proposing to develop 1,135 acres of its land along the Kealakehe southern boundary. Their plans include 350 acres of housing at the higher elevations, adjacent to existing Kealakehe homes and across Palani Road from Queen Liliuokalani Village. Between Queen Kaahumanu Highway and the proposed QLT housing, the Trust would like to develop a new regional center serving all of West Hawaii with shopping, office and governmental facilities.

The impact of the Kealakehe residential project on the QLT urban center would be a steady supply of shoppers, doctors' patients, workers and seekers of government service. Kealakehe residents will be in such close proximity that many would be likely to use the center facilities beyond regular working hours.

Kealakehe project residents will likely be able to reach QLT facilities via secondary roads and sidewalks. Such access would encourage the use of the QLT center by Kealakehe residents without cars, lessening the impact of the center on major roadways.

4.4.4 Makai Areas near the Kealakehe Project

Honokohau Harbor and Beach: Development of the Kealakehe residential project will increase the number of users of the Honokohau boat harbor, commercial area, and shoreline, since these will be easily accessible to residents. As a result:

- Demand for boat slips will increase. Since no plans for basin enlargement are definite, boat owners living in the Kealakehe project will likely keep their boats on trailers. Increased use of Queen Kaahumanu Highway to transport boats is likely.

- The existing commercial area and an additional 20 parcels being developed by the State will benefit from increases in the nearby population of potential customers and workers.

- Honokohau Beach is now used by fishermen and nudists along with others. Increased use by Kealakehe and other residents may limit current uses.

The Remainder of the State's Makai Land: No plans for the use of the remaining State makai land in Kealakehe have been set, except for the new sewage treatment plant and a proposed shoreline road that would parallel the Queen Kaahumanu Highway from the Harbor to Kailua. The road would likely be used regularly by project residents travelling to shoreline recreational areas and Kailua village.

4.4.5 Other Nearby Property and Activities

Adjacent Pasture Land: The Lanihau Corporation and Palani Rand run cattle on two parcels adjacent to the northern boundary of Kealakehe at the mid-level elevation. Incidents of trespassing, causing conflict between ranchers and residents, are likely when pasture land is located next to residential areas. Landowners hope that fencing can keep hunters, children, dogs, and others out of the area (personal communication, James Greenwell, Jr., President, Lanihau Management Corporation, January 12, 1990).

Nearby Shoreline Recreational Space: The growth in population at Kealakehe will mean an increased demand on the Old Airport State Park. The Park is now the only major park in the Kailua-Kona area and its open space and limited sports facilities will be more easily accessible to Kealakehe residents using the new mauka/makai road through Kealakehe and the proposed shoreline road.

Increased use of the Harbor area, Old Airport Park and the QLT property makai of the highway will mean more people will be closer to the Trust's family camping program at Papawai Beach. The program may be impacted slightly by the presence of more people along the shoreline, more neighborhood lighting, and increased noise. (However, the Kealakehe project's contribution to that impact is minor.)

4.5 SOCIAL IMPACTS OF GOLF COURSE DEVELOPMENT

By providing a public golf course, the project will offer West Hawaii residents a less expensive alternative to resort courses. Demand from residents is projected as generating high levels of play on the course (KPMG Peat Marwick, 1990).

Only limited locational impacts of golf course development are evident. Its placement could minimize potential difficulties with the siting of a residential development adjacent to industrial areas, if necessary. Golf course frontage would increase the value of adjacent lots, providing additional subsidies for affordable housing and encouraging the development of a wide range of units in the project's product mix.

APPENDIX A: LIST OF PEOPLE INTERVIEWED FOR REPORT

(Note that those interviewed provided their comments as individuals and not as representatives of their organizations. Organizational affiliations are provided only to indicate some of the networks and interests of those interviewed.)

Pamela Burla Acoba	Realtor, Ron Burla and Associates
Robert Aeder	President, Kona Heavens Homeowners Association
Joe Almeida	General Manager, Kona Palisades
Joseph W. Augustine	Realtor, dh Realty, Inc.
Fanny Au Hoy	Curator, Hulihee Palace Member, Hawaiian Civic Clubs
Alan Beall	Restaurant developer
Teresa Nakama Bellah	Clerk typist, Kamehameha Investment Corporation
Scott Berg	Owner, Scott's Pet and Feed Shop, Scott's Knife Center Kona Acres resident
Ian Birnie	District Manager, Harbors Division, Department of Transportation
John F. Burns	Owner, McDonald's Restaurants
Thea Brown	Owner, Honokohau Marine Services
Connie Charles	Executive Director, Kona Kohala Chamber of Commerce
Jill T. Chavez	Branch Manager, Pioneer Federal Savings and Loan
Keola Childs	Developer
Irma Chillingworth	Member: Hawaiian Civic Club, Ahahui Kaahumanu Group, Daughters of Hawaii Founder, West Hawaii Today

(Continued)

Lisa Choquette	Owner, Dive Makai Treasurer, The Ocean Recreation Council of Hawaii
Jeanne Comer	Member, Hawaii Planning Commission Queen Liliuokalani Village Resident
Bill Crockett	General Manager, Lanihau Center Secretary, Kailua Village Improvement Association Member, County Board of Ethics
Wanda Dettling	President, The Greater Kona Community Association Council Realtor-Associate, Bradley Properties Ltd.
John P. Dinmore	Architect Member, Chamber of Commerce Planning Group Resident, Palani Road
Reed Flickinger	Reporter, West Hawaii Today
Jo Ann Freed	Program Director, West Hawaii Family Support Services
Joseph Fagundes, III	Attorney Past President, Hawaii State Bar Association
Rose Fujimori	President, Hawaiian Civic Club
Halle Ladd Galvin	Administrative Assistant, Kona Family YMCA Kalaoa resident
Michael Galvin	West Hawaii Program Manager, Classroom Training Project, Kalaoa resident
Mary Green	Member, Kai Opua Canoe Club, Azabu Cultural Advisory Committee, La Hui O Hawaii
James Greenwell, Jr.	President, Lanihau Management Corporation
R. Kelly Greenwell	Landscape Contractor
Helene Hale	Member, Hawaii County Council (Continued)

R.T. "Doc" Halliday	Principal Broker, "Doc" Halliday Realty
Harry Hasegawa	President and Principal Broker, A'ala Realty and Management Inc. Business Manager, Local 5 AFL-CIO Kainaliu farmer
Clara Hayashi	Kealakehe resident
Fred Hayashi	Kealakehe resident
Virginia Isbell	Member, Hawaii State House of Representatives
David W. Jennings	President, West Hawaii Youth Council
Tracy Kaneakua	Teacher, Kealakehe Elementary School
Hai Kamakau	Regent, Daughters of Hawaii Volunteer, Hulihee Palace Member, Napoopookakeei Honaunau Community Association, Friends of Kealakekua Bay
Paul H. Kealoha	Community Relations Officer, Hawaii County Police Department, Kona Station
Cari Kojima	Teacher, Kealakehe Elementary School Kealakehe resident
Russell Kokubun	Chairman, Hawaii County Council
William Kowalski	President: Hawaii Fish Distributors Inc., Transpacific Ventures Inc.
Kiyono Kunitake	Founder, Friends of Old Kona Airport State Beach Park Keopu farmer
Walter Kunitake	Director of University of Hawaii - Hilo, West Hawaii Member, Friends of Old Kona Airport State Beach Park

(Continued)

Scott Leithead	Director, Hawaii County Office of Housing and Community Development
Andrew Levin	Member, Hawaii State Senate
H. Peter L'Orange	President, Hawaii Leeward Planning Conference
Ruby Keanaaina McDonald	Liaison - West Hawaii, Office of Hawaiian Affairs
Hugh MacIssac	Mental Health Supervisor, Adult Services, Department of Health
Michael Mackin	Realtor, dh Realty, Inc.
Greg Mooers	Development Manager, Nansay Hawaii
Reginald Morimoto	Branch Manager, First Hawaiian Bank
Marge Mulhall	Member, League of Women Voters, Business and Professional Women of Kona
Roy Mushrush	President, Kona Palisades Homeowners Association
Wally Nakamoto	Businessman Board Member, Kona Coffee Festival Member, Kainaliu Business and Professional Association
Brian Nakashima	Principal, Kealakehe Intermediate School
Edwin Okada	Principal, Kealakehe Elementary School
Ray Otaguro	Teacher, Kealakehe Intermediate School
Osamu Otsuka	Managing Broker, Gold Coast Realty
Paul Pastoor	General Manager, Hotel King Kamehameha
Patricia Provalenko	Assistant Property Manager, Bedford Properties

(Continued)

Robbie Robertson	Governor's Liaison, West Hawaii
Howard Rogers	Chiropractor Member, American Youth Soccer Association
Jerry Rothstein	President, Public Access Shoreline Hawaii, Kahakai Neighborhood Association
Alva Sachs	Psychologist, Department of Health Member, West Hawaii Family Support Services, Kona Community Advisory Council, Crisis Shelter for Abused Women and Children
Norman Sakata	Supervising Investigator Department of Commerce and Consumer Affairs President, Kona Lions Club
Sue Sanders	Realtor, Bradley Properties Inc.
Robert G. Salomone	General Manager, Kona Hilton Resort Member, Kailua Village Improvement Association
Lori Sasaki	Kealakehe resident
Liz Smith	Owner, King Kamehameha Divers
Mike Sohriakoff	Realtor, Mike Sohriakoff Realty
Joseph K. Spencer III	Resort Manager, Kamehameha Investment Corporation
Leon K. Sterling	Pastor, Kauwa No Ka Kino O Kristo Church Member, Kona Hospital Advisory Board, Kona Hawaiian Civic Club, West Hawaii Housing Foundation, Kona Coffee Festival
Judy Sweeney	Program Coordinator, West Hawaii Pilot Project, Department of Human Services

(Continued)

Larry Tanimoto	Deputy Managing Director for West Hawaii, County of Hawaii
Laurie Tina	Member, American Youth Soccer Association, West Hawaii Youth Council
Robert D. Triantos	Attorney Member, Kailua Village Design Commission
Rebecca Transue	Community Coordinator, Child and Family Services
Mark Van Pernis	Attorney
Leighton Wakata	Special Assistant, Department of Transportation
Ben Watai	Manager, Jack Hall Housing, Kealakehe
Debbie Wiley	Assistant Supervisor, Public Health Nursing, Department of Health
Ross Wilson, Jr.	Assistant Vice President, Manager, First Federal Savings and Loan Association
Susan Wong	Health Aide, Kealakehe Elementary School
Jennie S. Wung	Administrator, Kona Hospital
Mae Yamasaki	Principal, Konawaena High School
Kahue Young	Maintenance, Kona Surf Hotel Member, Board of Human Services, Department of Human Services
Kenny Young	Realtor, K.M. Young and Associates

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TRAFFIC IMPACTS

TRAFFIC IMPACT ASSESSMENT REPORT

for

KEALAKEHE PLANNED COMMUNITY

Kealakehe, Hawaii

July 1990

Prepared for:

State of Hawaii Housing Finance & Development Corporation

Prepared by:

Pacific Planning & Engineering, Inc.
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TABLE OF CONTENTS

APPENDICES

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

Pacific Planning & Engineering, Inc. (PPE) was engaged to undertake a study to identify and assess Year 2010 traffic impacts resulting from the State of Hawaii Housing Finance and Development Corporation's (HFDC) proposed Kealakehe Planned Community project. The report focuses on the following intersections:

- Queen Kaahumanu Highway with Kealakehe Parkway
- Queen Kaahumanu Highway with Palani Road
- Palani Road with Mamalahoa Highway
- Mamalahoa Highway with Kealakehe Parkway Extension

This report presents the findings and recommendations from the traffic study.

PROJECT DESCRIPTION

The State of Hawaii HFDC is proposing the development of the Kealakehe Planned Community which will be completed by the year 2010. The project is a master planned community which will include housing, recreational uses, schools, public facilities, and commercial areas. Also included in the project site is a 196-acre area located immediately east (mauka) of the Queen Kaahumanu Highway which is reserved for development by the County of Hawaii. This area will be primarily an

effluent disposal area for the County's Kealakehe Sewage Treatment Plant which is presently under construction on the west (makai) side of the highway. The total master planned area encompasses approximately 960 acres located between Palani Road and Queen Kaahumanu Highway.

The Kealakehe Planned Community is served internally by two proposed arterial roadways. The first roadway is an extension of the existing Kealakehe Parkway. The existing Kealakehe Parkway will be realigned to the south and the extension will extend west to east from Queen Kaahumanu Highway to Mamalahoa Highway. The Kealakehe Parkway Extension is planned to be a four to six lane arterial roadway within a 120-foot right-of-way.

The second arterial roadway, called the Mid-Level roadway, bisects the project site and extends north to south. It is proposed by the County of Hawaii to serve as a major arterial with a 120-foot right-of-way paralleling Queen Kaahumanu Highway and extending from Palani Road to the northern end of the project site.

Road "A" will be a two-lane roadway that will run in the north-south direction. This roadway will provide access to Palani Road for vehicles in the project site .

The master plan proposes the development of approximately 618 acres of the project site for residential land uses, with a total of 4,379 housing units. These single family and multi-family units are distributed among fourteen villages with an average village size of just over 300 units. Each village will feature a mix of residential units with 60% affordable and 40% market priced.

A 196-acre site situated on the lower portion of the project area is proposed for transfer to the County of Hawaii for development of an 18-hole public golf course and effluent disposal area for the County sewage treatment plant being constructed makai of Queen Kaahumanu Highway. The proposed golf course area includes a three-acre club house site which is readily accessible from major roadways and the surrounding community.

The proposed master plan includes three separate parks, each approximately four acres in size, and two environmentally sensitive areas that are proposed to be set aside as natural open space preserves.

Two school sites are proposed for development within the community. One school is proposed to be an elementary school which will serve up to 900 students and be operated by the State Department of Education. The other is to be a public high school which can accommodate a maximum of 1,700 students.

In the vicinity of the existing police station, makai of the Kealakehe landfill is a 30 acre area designated for a Civic Center. It is proposed that the Civic Center include the existing police station, a fire station, county government office building, a judicial complex serving West Hawaii, and similar public buildings.

Also proposed in the master plan are two 3-acre sites which have been set aside for quasi-public facilities and would consist of a church/day-care center complex and three commercial areas proposed to be developed as three community shopping centers.

CONCLUSIONS AND RECOMMENDATIONS

The Kealakehe Planned Community Project, when completed in 2010, will have a major impact on Queen Kaahumanu Highway and Palani Road.

Due to the extensive growth projected in the West Hawaii region over the next twenty years travel demand and travel patterns in the year 2010 will clearly not reflect those of today. The change in the distributions of jobs and population will result in directional changes in traffic along the major arterials in the area such as Queen Kaahumanu Highway.

Even without the project in 2010, Queen Kaahumanu Highway, Mamalahoa Highway and Palani Road will be over capacity. Queen Kaahumanu Highway will need to be widened to four lanes in the vicinity between Palani Road and Keahole Airport. Palani Road will also need to be widened to four lanes, as well as Mamalahoa Highway between Palani Road and Kaimi Nani Drive. The signalized intersection of Palani Road and Queen Kaahumanu Highway will also be over capacity and will need to be converted to a grade separated interchange. The intersection of Palani Road and Mamalahoa Highway will need to be signalized when warranted. The minor intersections along Palani Road that access the existing subdivision such as Kealakaa Street will also need to be signalized when warranted.

It was assumed that the four-lane, mauka-makai Kealakehe Parkway running between Queen Kaahumanu Highway and Mamalahoa Highway would be constructed along with the project. It would serve as the major

access road to both Queen Kaahumanu and Mamalahoa Highways for the Kealakehe community. With the capacity available with Kealakehe Parkway and its alternative route to and from Queen Kaahumanu with comparable travel times, traffic along Palani Road will not be greatly affected by the project.

Due to the impact of the traffic volumes generated by the Kealakehe Planned Community development, the following are recommended:

1. A grade separated interchange should be constructed at the intersection of Queen Kaahumanu Highway and Kealakehe Parkway due to the requirement of the State Department of Transportation for non-interrupted flow along Queen Kaahumanu Highway.

2. Signalized intersection at Mamalahoa Highway and Kealakehe Parkway.

3. The Kealakehe Parkway extension between Queen Kaahumanu and Mamalahoa Highways should be constructed as a four-lane roadway. Depending on the number of intersections accessing the project, additional improvements such as the following may be necessary:

   a. Signalize the major intersections along Kealakehe Parkway when warranted.

   b. Auxiliary lanes may be necessary along Kealakehe Parkway and the minor streets, i.e. left turn storage lanes.

PROJECT DESCRIPTION

The State of Hawaii Housing Finance and Development Corporation (HFDC) is proposing the development of the Kealakehe Planned Community which will be completed by the year 2010. The project is a mixed-use master planned community which will include housing, recreational uses, schools, public facilities, and commercial areas. Also included in the project site is a 196 acre area located immediately east (mauka) of the Queen Kaahumanu Highway which is reserved for development by the County of Hawaii. The area will be primarily an effluent disposal area for the County's Kealakehe Sewage Treatment Plant which is presently under construction on the west (makai) side of the highway.

The total master planned area encompasses approximately 960 acres located between Palani Road and Queen Kaahumanu Highway. Figure 1 and Figure 2 shows the project location and roadway network in the vicinity. Table 8 in the section "Projected Traffic Conditions" shows a summary of the proposed developments for the project.

PROJECT ROADWAYS

The Kealakehe Planned Community is served internally by two proposed arterial roadways. The first roadway is an extension of the existing Kealakehe Parkway. The existing Kealakehe Parkway will be realigned to the south and the extension will extend west to east from Queen

Kaahumanu Highway to Mamalahoa Highway. The Kealakehe Parkway Extension is planned to be a four to six lane arterial roadway within a 120-foot right-of-way.

The second arterial roadway, called the Mid-Level roadway, bisects the project site and extends north to south. It is proposed by the County of Hawaii to serve as a major arterial with a 120-foot right-of-way paralleling Queen Kaahumanu Highway and extending from Palani Road to the northern end of the project site.

Road "A" will be a two-lane roadway that will run in the north-south direction. This roadway will provide vehicles in the project site access to Palani Road.

PROJECT LAND USES

The master plan proposes the development of approximately 618 acres of the project site for residential land uses, with a total of 4,379 housing units. These units are distributed among fourteen villages with an average village size of just over 300 units. Each village will feature a mix of residential units with 60% affordable and 40% market priced. The affordable units are targeted for the elderly, assisted (very low income and lower income), and gap-group (moderate income) families and persons. The market units are targeted for families and persons of upper moderate income and those earning incomes greater than 140% of the area's median income.

Of the 4,379 residential units, 3,035 units will be single family units intended for sale. These units, which include both affordable and market units, are distributed throughout the fourteen villages on a total of approximately 506 acres of land with an average density of six units per acre. Affordable and market units are scattered within each village rather than clustered to ensure a heterogeneous distribution.

Multi-Family units for sale total 486 units with a general density of 12 units per acre and will occupy a total of 41 acres. Most of the multi-family units are distributed in clusters from two to four acres in size with one five-acre cluster. More than half of the total number of units are market units situated in small clusters fronting the public golf course fairways and clubhouse and the remaining units are situated in small clusters near major public facilities such as schools and shopping areas.

To accommodate the elderly and lower income, 858 units on 72 acres have been set aside as multi-family rental units. These units are clustered in areas averaging about 7 acres and are located adjacent to schools, commercial areas, parks and recreation areas.

A 196-acre site situated on the lower portion of the project area is proposed for transfer to the County of Hawaii for development of an 18-hole public golf course and effluent disposal area for the County sewage treatment plant being constructed makai of Queen Kaahumanu Highway. As presently designed, the proposed sewage treatment plant will require a minimum of 150 acres for the disposal of effluent derived from the treatment process. The proposed golf course area includes a three acre club house site near the central lobe of three lobes. This site is accessible from major roadways and the surrounding community.

The proposed master plan includes three separate parks, each approximately four acres in size. The first park is located at the mauka end of the planned community in Village #2 adjacent to the existing multi-family development along Kealakehe Street. A second park is located near the intersection of the Mid-Level roadway and Kealakehe Parkway in Village #6 adjacent to two multi-family unit projects. The third park is situated in Village #14 near Palani Road. Adjacent to the second park is a proposed three acre recreation center site. It will be located at the corner of Kealakehe Parkway and the Mid-Level roadway.

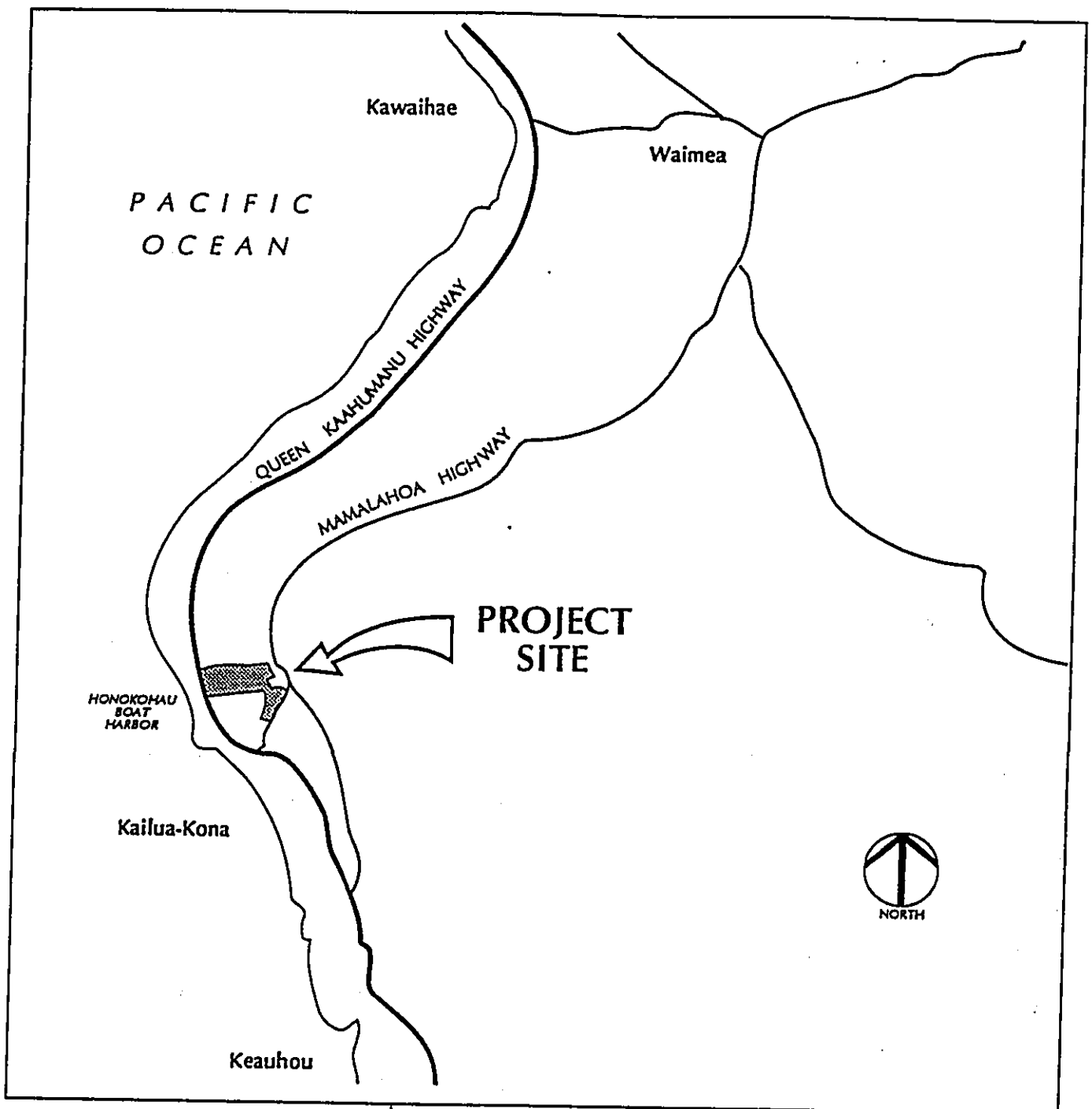
There are two areas that are proposed to be set aside as natural open space preserves. One is a twenty-one acre area located in the northeastern corner of the project area. It contains a number of unique archaeological sites that have been proposed for preservation. The second preserve consists of a five acre site about midway between the property boundaries near the 550 foot elevation.

Two school sites are proposed for development within the community. One ten acre site, for an elementary school, is located near the project's southern property boundary and is to be operated by the State Department of Education. The proposed facility will serve up to 900 students, and provide space for play courts, a library, dining room and administrative building. A public high school is proposed on forty-five acres on the makai side of the Mid-Level roadway, south of Kealakehe Parkway. The high school is expected to accommodate a maximum of 1,700 students within 75 classrooms and will include facilities for administrative offices, a dining hall, library, physical education building, gymnasium, football/soccer and baseball fields, and tennis courts.

In the vicinity of the existing police station, makai of the Kealakehe landfill is a 30 acre area designated for a Civic Center. It is proposed that the Civic Center include the existing police station, a fire station, county government office building, a judicial complex serving West Hawaii, and similar public buildings such as a public library and federal post office.

Two three-acre sites have been set aside for quasi-public facilities, which would consist of a church/day care center complex. The first site is located in Village #4 between the proposed Elementary school and a preservation site. The second site is located within Village #7 near the entrance of Kealakehe Parkway into the project area.

Three commercial areas are proposed to serve the Kealakehe Planned Community. One area is a 20-acre site located at the intersection of Kealakehe Parkway and Queen Kaahumanu Highway. This site is expected to be developed as a community shopping center and will include a major grocery store and department store as well as specialty shops and consumer oriented retail outlets. The other two three acre areas are expected to be smaller neighborhood commercial centers. The first is located at the northern border of the property at the point where the Mid-Level roadway enters the project area. The second will be located near Palani Road.



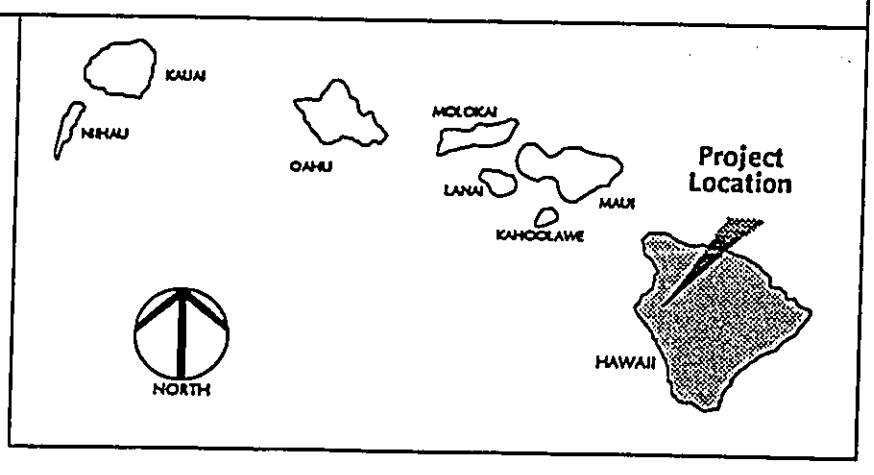


Figure 1. Project Location Map

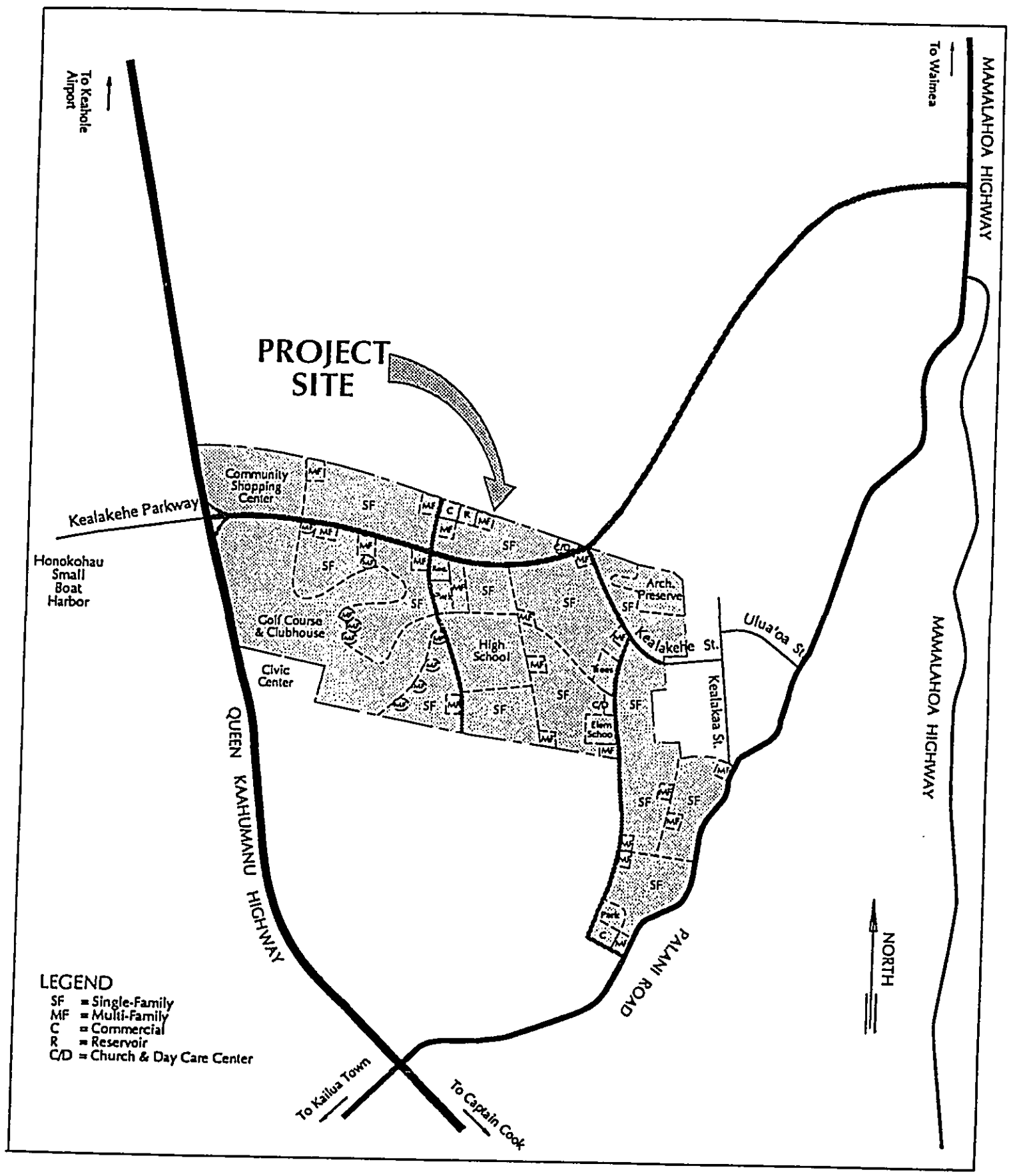


Figure 2. Project Site Plan

EXISTING CONDITIONS

A survey of existing conditions and surrounding land uses was conducted to baseline reference for assessing the future traffic impact of the proposed project. The survey included the existing land uses in the general area, roadway facilities and existing traffic conditions.

EXISTING LAND USES

The project site is located in the Kealakehe district and is owned by the State of Hawaii. The site consists predominantly of undeveloped land composed primarily of lava terrain with some brush and shrubs.

The Kealakehe Landfill is currently located on the western portion of the project site mauka of Queen Kaahumanu Highway. The Amfac Distribution Center is located along Queen Kaahumanu Highway near the Kealakehe Landfill on the project site. The Kona Police Station, which serves the Kona district, is also located along Queen Kaahumanu Highway north of the landfill and distribution center.

Much of the land surrounding the project site consists of lava fields with a few developments immediately surrounding the project area. Developments mauka of the project site along Palani Road include residential subdivisions, and an Elementary and Intermediate school which serves the neighboring communities. On the makai side of the

project site is the Honokohau Small Boat Harbor. To the north of the project site are other residential subdivisions and Kaloko Industrial Park. On the south side of the project site lies Keahuolu district.

Located along Queen Kaahumanu Highway further north of the Kealakehe district, Keahole Airport is a major air carrier airport which serves the West Hawaii region. Beyond the airport, along the coastline makai of Queen Kaahumanu Highway, are various resort developments in the South Kohala District.

The Kona Industrial Subdivision is located south of the project site, makai of Queen Kaahumanu Highway and beyond the industrial subdivision is Kailua-Kona Town which consists of resorts and hotels, shopping malls, businesses and beaches for recreational use.

EXISTING ROADWAY FACILITIES

The major roadways in the North Kona region are Queen Kaahumanu Highway, Palani Road, and Mamalahoa Highway. Queen Kaahumanu Highway and Mamalahoa Highway are parallel facilities.

Queen Kaahumanu Highway is the main highway in the Kona region running in a north-south direction along the coastline between Kailua-Kona and Kawaihae. It is a State maintained two-lane undivided highway having a 24 foot-wide pavement and variable speed limits of 35 to 55 mph. The major intersections along Queen Kaahumanu Highway are channelized with left-turn storage lanes, deceleration and acceleration lanes.

Queen Kaahumanu Highway forms a 4-way signalized intersection with Palani Road at the main entrance of Kailua-Kona Town. This major intersection is widely utilized in the Kona region. The posted speed limit for Queen Kaahumanu Highway is reduced to 35 mph near this intersection. For southbound vehicles along Queen Kaahumanu Highway there is a 370 foot left-turn and 440 foot right-turn storage lane and for northbound vehicles, a 710 foot left-turn and 480 foot right-turn storage lane. The intersection also has right-turn acceleration lanes, and 220 foot left-turn storage lanes for vehicles along Palani Road entering and exiting Kailua Town. Queen Kaahumanu Highway and Palani Road both have 7 foot paved shoulders at the intersection.

Mamalahoa Highway is a two-lane roadway running in a north-south direction parallel to Queen Kaahumanu Highway which serves the higher elevated areas between Waimea and North Kona. This State highway was built over a former horse-and-buggy trail, and is a winding sub-standard roadway with a pavement width varying between 18 and 24 feet.

Palani Road is a two-lane roadway running in a northeast direction from Kuakini Highway on the coastline of Kailua Town mauka to Mamalahoa Highway. It serves as the major mauka-makai connector road between Queen Kaahumanu Highway and Mamalahoa Highway in the North Kona Region. Palani Road is a Hawaii County maintained road having 12 foot wide lanes and a posted speed limit of 25 mph. Palani Road currently serves as the main vehicular access road for the existing Kealakehe and surrounding residential subdivisions.

Kealakaa and Ulua'oa Street are relatively new two-lane roadways maintained by Hawaii County primarily serving the Kealakehe subdivision

area. Both roads are located makai of Palani Road and form unsignalized T-intersections with Palani Road. They both have speed limits of 25 mph. Kealakaa Street has 18 foot wide paved lanes, and generally runs in a north-south direction. Kealakaa Street is widely used for school related traffic because Kealakehe Intermediate and Elementary schools are located near its intersection with Palani Road. Ulua'oa Street generally runs in a mauka-makai direction and has 16 foot wide paved lanes.

Kealakehe Parkway Road is a two-lane roadway running in a mauka-makai direction with 12 foot wide paved lanes. It forms an unsignalized T-intersection with Queen Kaahumanu Highway and travels makai to the Honokohau Small Boat Harbor. The posted speed limit is 25 mph.

EXISTING TRAFFIC CONDITIONS

A review of State DOT 1988 vehicular traffic counts for Queen Kaahumanu Highway and Palani Road near the project site indicates that the peak hours along Queen Kaahumanu Highway and Palani Road generally occur between 7:00 and 9:00 in the morning and 3:30-5:30 in the afternoon.

Manual traffic counts were taken for the intersections of Queen Kaahumanu Highway with Palani Road and Kealakehe Parkway Road, and Palani Road with Kealakaa Street and Ulua'oa Street on January 16 and 17, 1990. Manual counts were also taken on May 15 and 16, 1990 at the intersection of Mamalahoa Highway with Palani Road, and on May 2 and 3, 1990 at the intersection of Queen Kaahumanu Highway with Kaiwi Street.

These recent field counts are used as a baseline condition with which future estimated traffic volumes are compared. Figures 3 and 4 show the present volumes and movements of vehicular traffic at the study intersections. The recorded traffic counts are shown in Appendix B.

Manual counts were taken of passenger cars, trucks, buses, bicycles, motorcycles and pedestrians by turning movements and approaches. During the field counts on January 16, 1990, the weather was cloudy with slight rain, and the road pavement was wet. During the field counts on January 17, 1990, the weather was clear and the road pavement dry. The following observations were also noted during the counts on both days:

1. At the signalized intersection of Queen Kaahumanu Highway with Palani Road, drivers were observed using the paved shoulder for making right-turns accessing or exiting Queen Kaahumanu Highway.

2. At the intersection of Palani Road with Kealakaa Street, drivers travelling northbound on Palani Road were observed using the paved shoulder to bypass vehicles making left-turns onto Kealakaa Street.

Field counts of the Palani Street-Mamalahoa Highway intersection were taken on May 15 and 16, 1990. During the field counts on May 15, 1990, the weather was cloudy with a light rain. On May 16, 1990, during the field counts, the skies were clear and the pavement was dry.

Observed Traffic Conditions

The following observations were noted during the counts on both days:

1. Some drivers travelling on Palani Road, Kailua bound, turned left into the Waimea bound lane of Mamalahoa Highway.

2. Buses blocked Kailua bound through traffic on Palani Road at bus stops causing vehicles to overtake in the oncoming traffic lane.

3. Vehicles travelling on Palani Street Kailua bound would use the shoulder to pass vehicles waiting to make a left turn onto Mamalahoa Highway.

The vehicular 24 hour traffic counts for each approach of the study intersections taken by the Department of Transportation in 1988 are shown in Figure 5.

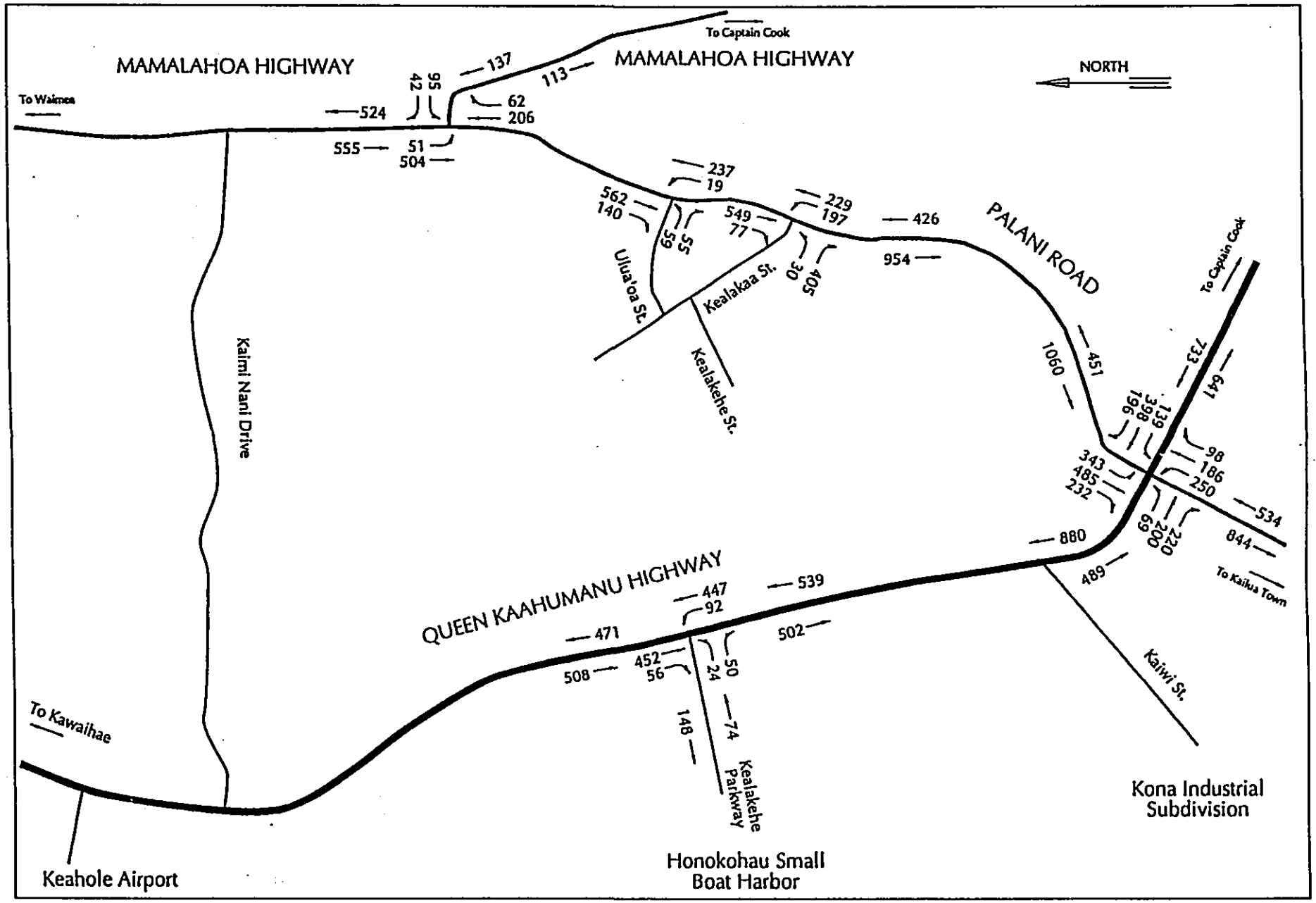


Figure 3. Existing Morning Peak Hour Volumes

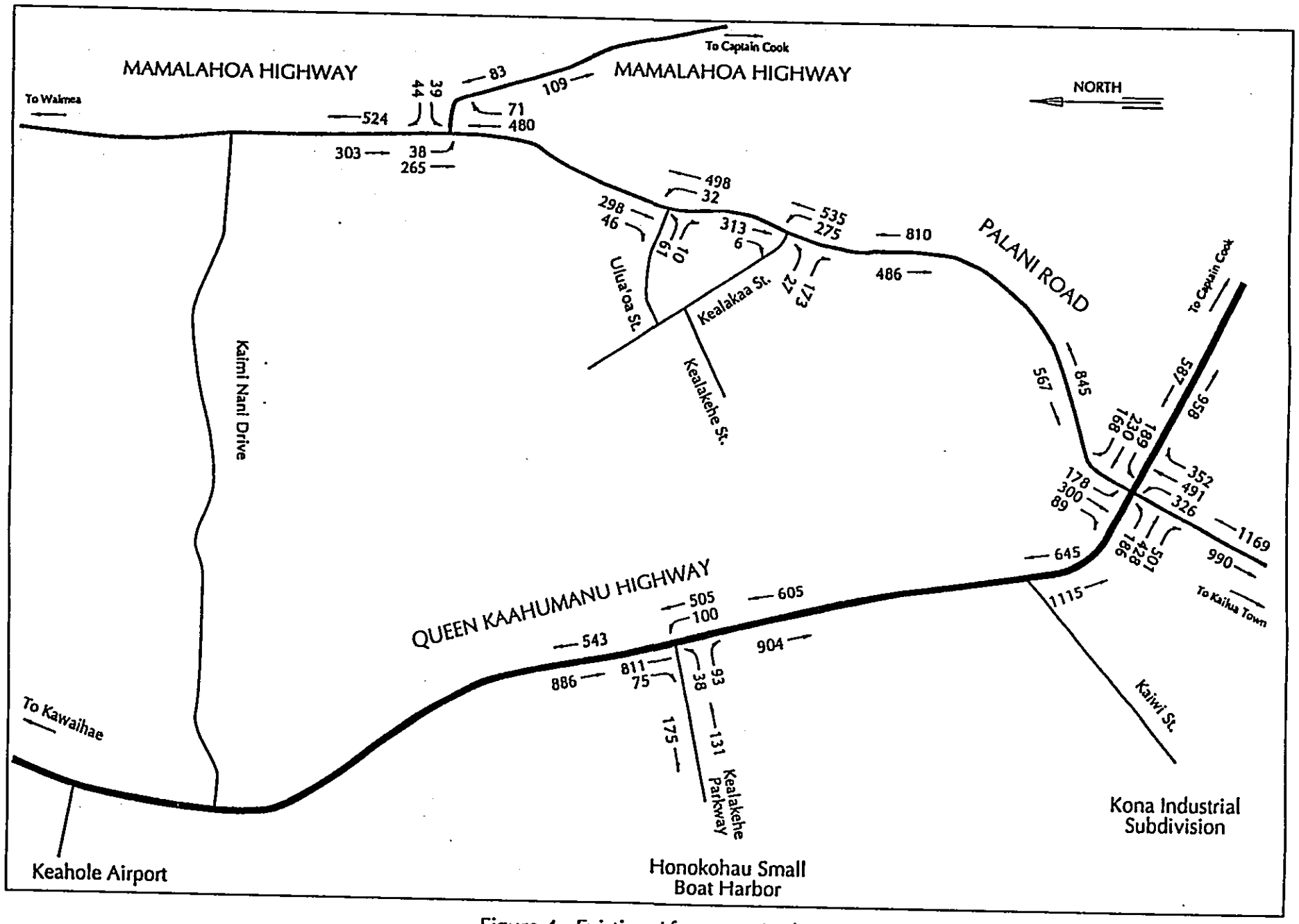


Figure 4. Existing Afternoon Peak Hour Volumes

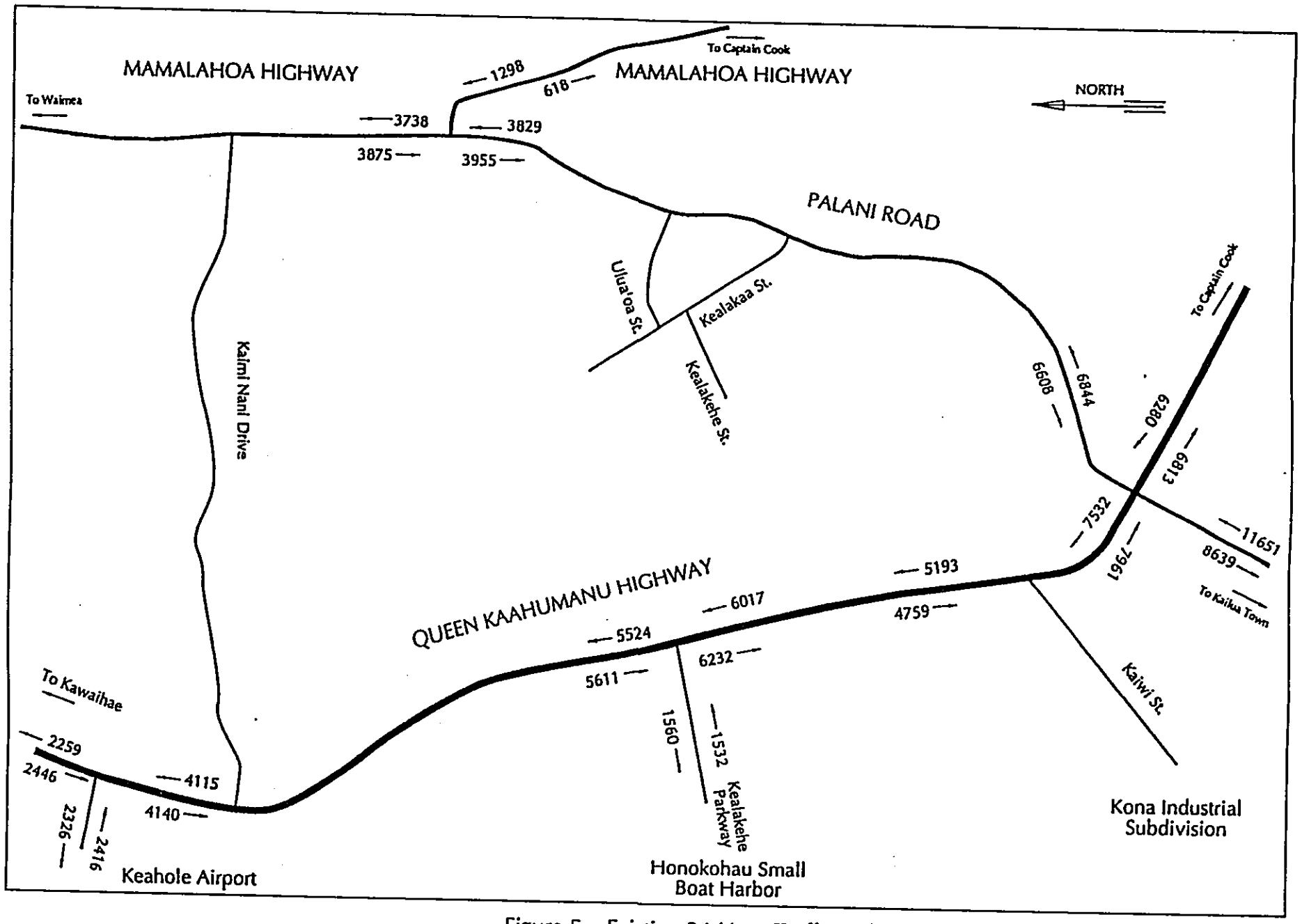


Figure 5. Existing 24-Hour Traffic Volumes

PRESENT LEVEL-OF-SERVICE

Based on the survey of existing conditions, traffic volumes at the study intersections were analyzed to determine the present level-of-service of the roadway network.

The capacity of existing roadways was estimated using procedures contained in the Highway Capacity Manual (HCM), Special Report 209 (1985). Intersection level-of-service (LOS) analysis was performed using the analysis methods for unsignalized and signalized intersections. In addition, level-of-service analysis for two-lane rural highways was also performed using the methods described in the HCM. A detailed explanation of each level of service category for all methods are provided in Appendix A.

The level-of-service for unsignalized intersections is determined by the amount of unused reserve capacity of a lane with the potential capacity limited by the size and frequency of gaps in conflicting traffic. Level-of-service ranges between A to F with LOS A representing little or no delays and LOS F representing extreme delays.

Level-of-service for signalized intersections is the quantitative measurement describing the operational conditions within a traffic stream, and defined in terms of average delay per vehicle in seconds. Delay is a measure of driver discomfort, freedom to maneuver, traffic interruptions, safety, and lost travel time. Level-of-service for signalized intersections also vary from LOS A to LOS F, however, these levels range from 5 seconds delay (LOS A) to over 60 seconds of delay (LOS F).

Analysis of Unsignalized Intersections

The results of level-of-service analysis for existing traffic conditions at *unsignalized* study intersections is shown below in Table 1. Through traffic and right turns from major streets are not analyzed in the HCM unsignalized intersection analysis, since these movements are generally not affected by other traffic flows.

Table 1. Existing Level-of-Service - Unsignalized Intersections

Turning Movement		AM Peak	PM Peak
Queen Kaahumanu Highway and Kealakehe Parkway			
Queen Kaahumanu Highway			
Northbound	LT	A	C
Kealakehe Parkway			
Eastbound	LT	D	E
	RT	A	C
Palani Road and Kealakaa Street			
Palani Road			
Northbound	LT	B	A
Kealakaa Street			
Eastbound	LT	D	D
	RT	D	A
Palani Road and Ulua'oa Street			
Palani Road			
Northbound	LT	A	A
Ulua'oa Street			
Eastbound	LT	C	D
	RT	A	A
Palani Road and Mamalahoa Highway			
Palani Road			
Southbound	LT	A	A
Mamalahoa Highway			
Westbound	LT	D	C
	RT	A	A

At the intersection of Queen Kaahumanu Highway with Kealakehe Parkway, drivers experience less delays during the morning peak hour than during the afternoon peak hour. While northbound drivers turning left from Queen Kaahumanu onto Kealakehe Parkway experience little or no delays (LOS A) during the morning peak hour, they experience LOS C, or average delays, during the afternoon peak hour. The same situation holds true for the drivers turning right from Kealakehe Parkway onto Queen Kaahumanu Highway. Vehicles turning left onto Queen Kaahumanu Highway from Kealakehe Parkway experience long delays (LOS D) during the morning peak hour and experience very long delays during the afternoon peak hour.

The intersection of Palani Road with Kealakaa Street operates with short delays to long delays during the morning peak hour. Vehicles turning left from Palani Road experience short delays (LOS B) while vehicles exiting Kealakaa Street experience long delays (LOS D). During the afternoon peak hour, vehicles turning left onto Palani Road experience LOS D (long delays) while vehicles turning right from Kealakaa Street into Palani Road and vehicles turning left into Kealakaa Street experience LOS A which means that they experience little or no delays.

At the intersection of Palani Road with Ulua'oa Street, vehicles turning left into Ulua'oa Street and vehicles turning right onto Palani Road experience little or no delays (LOS A) during both the morning and afternoon peak hours. Drivers turning left from Ulua'oa Street experience average delays (LOS C) during the morning peak hour and experience long delays (LOS D) during the afternoon peak hour.

The intersection of Palani Road with Mamalahoa Highway experiences from little or no delays to long delays. During the morning peak hour, drivers turning left from Mamalahoa Highway experience LOS D or long delays while drivers for the other movements experience little or no delays (LOS A). During the afternoon peak hour, drivers turning left from Mamalahoa Highway experience average delays (LOS C) while the other movements continue to experience little or no delays (LOS A).

Analysis of Signalized Intersections

The results of the operational analysis for the *signalized* intersection of Queen Kaahumanu Highway with Palani Road during the existing morning and afternoon peak hours are shown on Table 2.

Table 2. Existing Level-of-Service - Intersection of Queen Kaahumanu Highway and Palani Road

Movements	AM Peak	PM Peak
Queen Kaahumanu Highway		
Northbound	E	E
Southbound	E	E
Palani Road		
Eastbound	E	F
Westbound	E	F

The results of the analysis indicate that presently the intersection of Queen Kaahumanu Highway with Palani Road is operating at capacity during the morning peak hour with a LOS E indicating extremely long traffic delays for drivers. During the afternoon peak hour, the intersection operates at capacity with a LOS E indicating extremely long traffic delays. Vehicle approaches along Queen Kaahumanu Highway have a LOS E while approaches along Palani Road operate over capacity with a LOS F.

Analysis of Two-Lane Highways

This analysis method determines the level-of-service of specific sections on rural highways. The service flow rates of Queen Kaahumanu Highway, Mamalahoa Highway, and Palani Road were analyzed using the Two-Lane Rural Highway analysis from the Highway Capacity Manual[1].

Level-of-service for two-lane rural highways addresses the mobility and accessibility drivers have, and are described by average travel speed, percent time delay and utilization of capacity. The primary measure is percent time delay reflecting both mobility and access, and is defined as the average percent of time that all vehicles are delayed while travelling in platoons due to the inability to pass.

Level-of-service is classified into six categories ranging from LOS A to LOS F (summarized in Appendix A). The LOS for Rural Highways is not comparable to the LOS for Signalized or Unsignalized Intersections. The results of the analysis is shown in Table 3.

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[1] Highway Capacity Manual, Special Report 209, 1985 Edition, by the Transportation Research Board

The analysis indicates that on Queen Kaahumanu Highway, between Keahole Airport and Kealakehe Parkway, drivers notice an increase of platoon formation, platoon size, and frequency of passing impediment (LOS C) during the morning peak hour and during the afternoon peak hour, passing becomes extremely difficult (LOS D). In the section of the highway between Kealakehe Parkway and Kailua-Kona, drivers during the morning and afternoon peak hours experience, LOS D and LOS E, respectively.

Table 3. Existing Level-of-Service - Two Lane Rural Highway

	AM Peak			PM Peak		
	Capacity	Flow Rate	LOS	Capacity	Flow Rate	LOS
Queen Kaahumanu Highway						
Keahole Airport - Kealakehe Parkway	2447	850	C	2524	1391	D
Kealakehe Parkway - Palani Road	2472	1119	D	2527	1677	E
Palani Road						
Queen Kaahumanu Hwy - Ulua'oa St.	1423	1643	F	1354	1394	F
Kealakaa Street - Mamalahoa Hwy	1423	1188	E	1354	971	E
Mamalahoa Highway						
Palani Road - Kaimi Nani Drive	1607	1240	E	1706	899	E

Palani Road was analyzed on the segments between Queen Kaahumanu Highway and Ulua'oa Street, and between Kealakaa Street and Mamalahoa Highway. The results of the analysis shows that for the segment between Queen Kaahumanu Highway and Ulua'oa Street, the roadway operates

with heavily congested flow with traffic demand exceeding capacity (LOS F) during the morning and afternoon peak hours. The capacity values are based on studies of similar conditions. The measured volumes indicate a situation which exceeds most traffic volumes experienced in similar conditions.

For the segment on Palani Road between Kealakaa Street and Mamalahoa Highway, drivers experience LOS E (percent time delay is greater than 75 percent) during the morning and afternoon peak hours. For the section along Mamalahoa Highway between Palani Road and Kaimi Nani Drive, drivers also experience LOS E during both peak hours. The results indicate that drivers along Queen Kaahumanu Highway generally experience LOS C or D between Keahole Airport and Palani Road during the morning and afternoon peak hours.

PROJECTED TRAFFIC CONDITIONS

The Island of Hawaii is currently experiencing considerable growth in population and employment with the majority of growth concentrated in the West Hawaii region (the West Hawaii region includes the South Kohala, and North and South Kona Districts).

By the year 2010, 37% of the residential units on the island of Hawaii will be located in the North Kona District. South Hilo will have 26% of the island's residential units and South Kohala will have 13%. Of the three districts projected to have the most residential units, two (South Kohala and North Kona) are located in the West Hawaii region. North Kona will also have the most resort condominiums (66.5% of the island total) and hotel units (51.9% of the island total) by 2010. South Kohala follows with 32% of the island's resort condominiums and 40% of the hotel units.

FUTURE LAND USES

Future traffic forecasts without and with the project were forecasted for the year 2010 when the project is expected to be completed and fully occupied.

The forecasted growth in population and employment for Hawaii was obtained directly from projections by the County of Hawaii. The projections provide estimates of population and employment growth for each judicial

district from the baseline year 1987 until the year 2010. The forecasts are shown below in Tables 4 and 5. According to the County of Hawaii, in 1987, there was a population of approximately 114,300 people and 46,100 jobs on Hawaii. By the year 2010, these totals are projected to rise to 206,100 people and 85,025 jobs, an increase of 80% and 84%, respectively. This will result in a corresponding increase in the traffic.

Table 4. Population Forecasts for Hawaii

District	1987	2010	Growth	% Growth
Puna	19,003	39,865	20,862	110%
South Hilo	45,303	55,520	10,217	23%
North Hilo	1,495	1,500	5	0%
Hamakua	5,303	8,085	2,782	52%
North Kohala	3,602	8,470	4,868	135%
South Kohala	7,097	22,300	15,203	214%
North Kona	20,503	52,620	32,117	157%
South Kona	7,293	10,660	3,367	46%
Ka'u	4,700	7,080	2,380	51%

As indicated in Table 4, the Puna, South Hilo, South Kohala and North Kona Districts are forecasted to have the most population growth. North Kona is expected to have the greatest growth, with a growth of over 32,000 people, (157%).

Table 5. Employment Forecasts for Hawaii

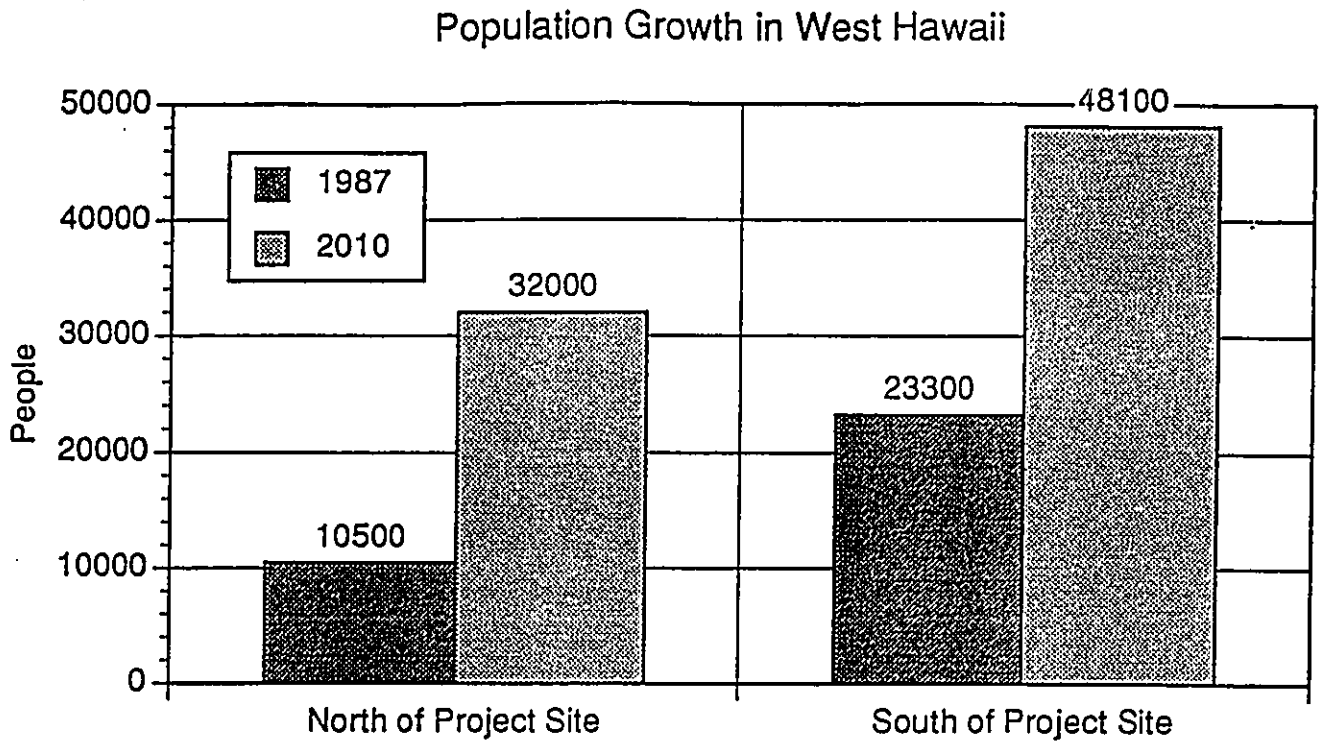
District	1987	2010	Growth	% Growth
Puna	4,407	6,990	2,583	59%
South Hilo	18,797	25,244	6,447	34%
North Hilo	288	212	-76	-26%
Hamakua	2,023	2,725	702	35%
North Kohala	786	1,290	504	64%
South Kohala	4,246	15,333	11,087	261%
North Kona	13,276	26,189	12,913	97%
South Kona	302	4,459	4,157	1376%
Ka'u	1,974	2,583	609	31%

As indicated by Table 5, the South Kohala, and North Kona districts are projected to have a dramatic increase in employment. South Kohala is forecasted to have a growth of over 11,000 jobs (261%) and North Kona is expected to increase employment by almost 13,000 jobs, (97%). North Hilo is the only district expected to have a decrease in jobs (76 jobs or a 26% decrease).

As a result of the forecasted growth of the West Hawaii region, a large area was used to model the traffic pattern created by this growth. The South Kohala, North Kona and South Kona districts will have the most impact on the planned community due to their close proximity to the project site and because of their large forecasted growth. The considerable growth in the West Hawaii region will create a tendency for more people to travel between the South Kohala and Kona Districts changing the general traffic pattern in the area.

The population of the areas north of the project site (South Kohala and areas in North Kona north of the project site) will increase from approximately 10,500 people in 1987 to over 32,000 people in 2010, an increase of 21,500 people. South of the project site (South Kona and areas south of the project site in North Kona), there was a 1987 population of 23,300 people and a forecasted population of over 48,100 people, an increase of 24,800 people by 2010. (See Figure 6.) Total population growth in the North and South Kona and South Kohala Districts would equal 46,300 people. Employment in the area will also increase dramatically by 2010.

In 1987 there were approximately 4,500 jobs in the areas north of Kealakehe and 13,300 jobs south of Kealakehe. Of the forecasted 2010 employment in these three districts, approximately 21,100 jobs will be located north of the Kealakehe Planned Community and 22,300 jobs will be located to the south. The net effect of these forecasts is an increase of 16,600 jobs north of the project and 9,000 jobs south of the project site. Since there will be a larger increase in population below the project and a larger increase in employment north of the project, it is expected that there will be an increased likelihood of travel between these districts in 2010. (See Figure 7.)



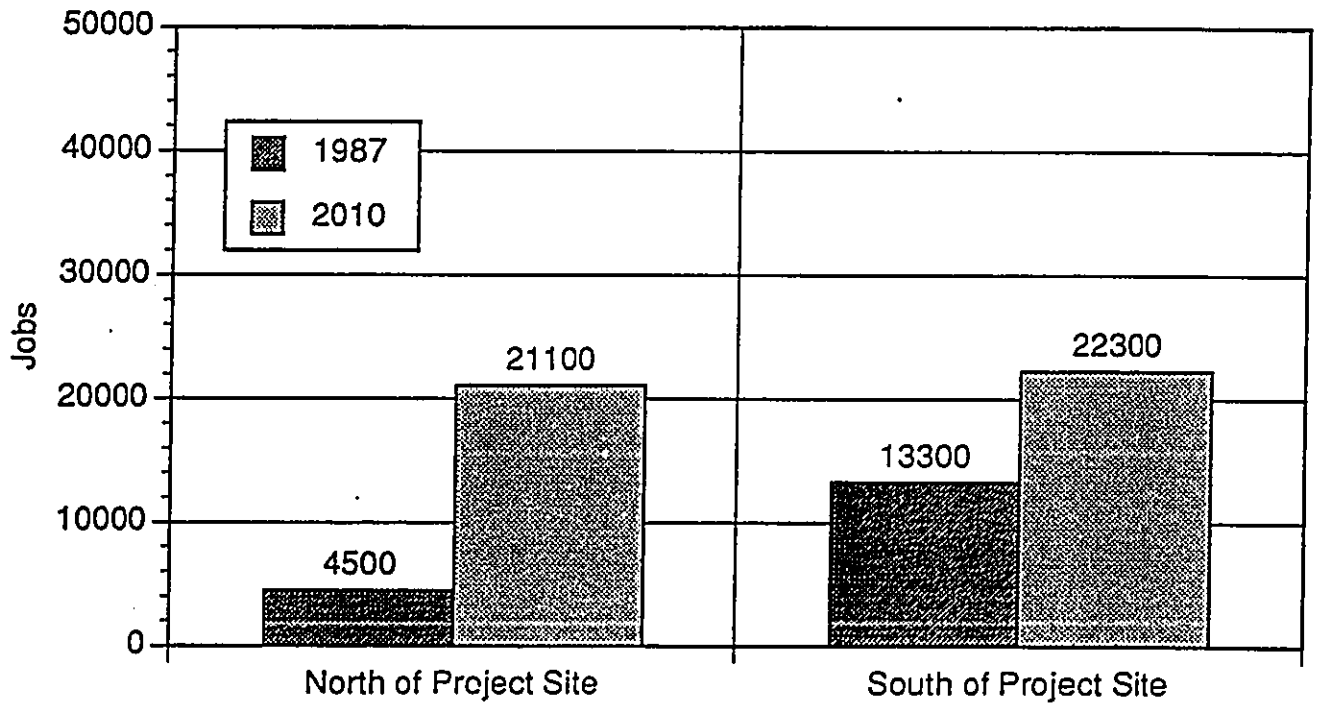


Figure 6. Population & Employment Growth in West Hawaii

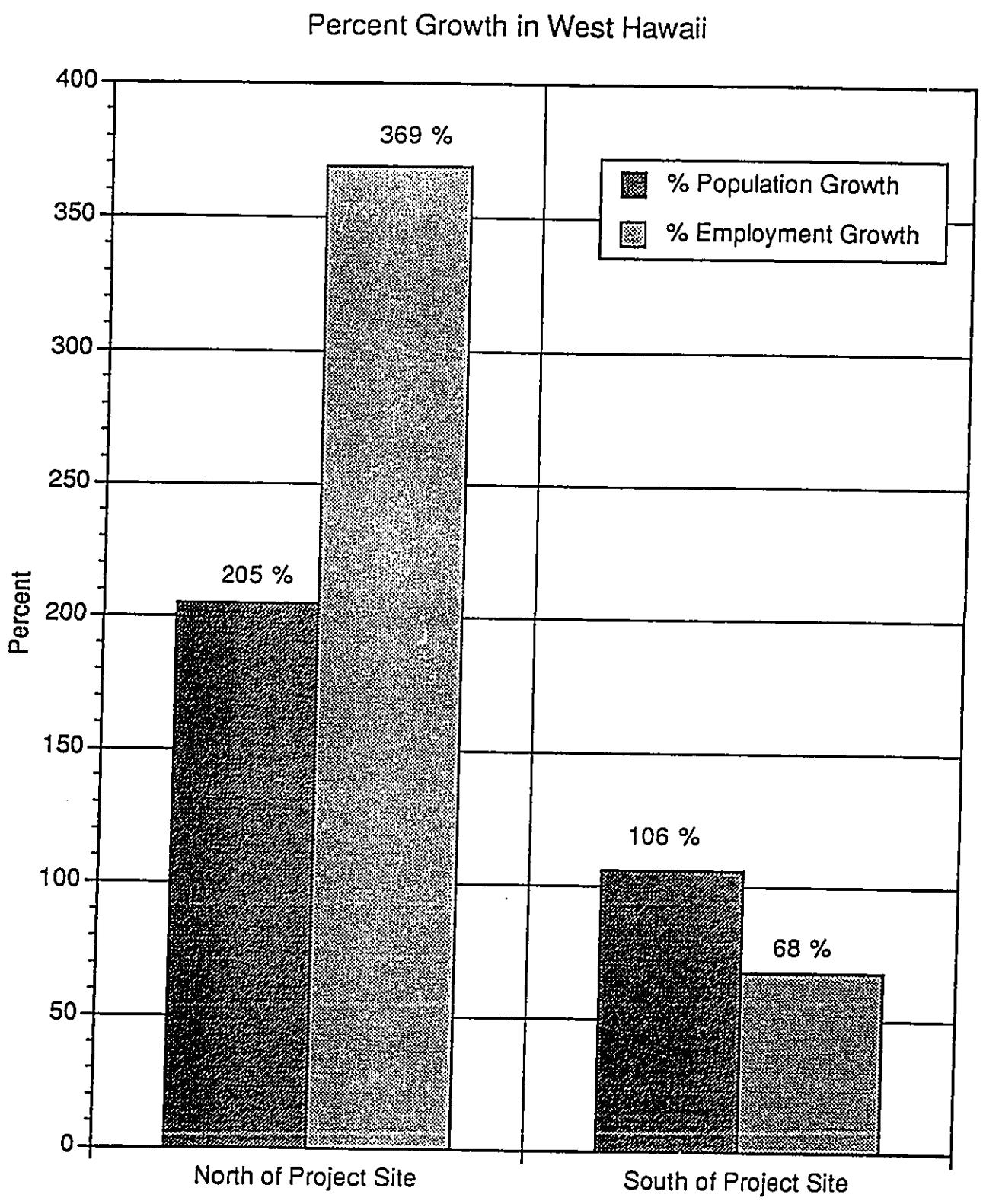


Figure 7. Percent Growth in West Hawaii

FUTURE ROADWAY FACILITIES

Currently, the County of Hawaii is planning to expand existing roadways and building new roadways to accommodate the expected growth in the region between Keahole and Kailua. According to the Draft Keahole To Kailua Development Plan dated September 1989, by R. M. Towill Corporation, two of the major roadways being planned are the Palani Bypass Road and the Queen Kaahumanu Highway Expansion.

The Palani Bypass Road is proposed to connect with the existing Palani Road near Kailua town and bypass and the residential areas Palani Road serves near Kealakehe. The Bypass Road will then connect with Palani Road near the intersection of Palani Road with Mamalahoa Highway. The proposed Palani Bypass Road is planned to be a minor arterial road with a right-of-way width of 100 feet, length of 2.6 miles, and have 4 to 6 lanes.

Queen Kaahumanu Highway is planned for expansion of 7.8 miles in the approximate area between Keahole Airport and just south of Palani Road. The existing two lane Queen Kaahumanu Highway is proposed to be expanded to be a 6 lane divided major arterial with a right-of-way width between 150 to 300 feet.

The Kealakehe Planned Community is served by two proposed arterial roadways. The first roadway is an extension of the existing Kealakehe Parkway. The existing Kealakehe Parkway will be realigned to the south and the extension will extend west to east from Queen Kaahumanu Highway to Mamalahoa Highway. The Kealakehe Parkway Extension is planned to be a 4 to 6 lane arterial roadway within a 120-foot right-of-way.

The second arterial roadway, called the Mid-Level roadway, bisects the project site and extends north to south. It is proposed by the County of Hawaii to serve as a major arterial with a 120-foot right-of-way paralleling Queen Kaahumanu Highway and extending from Palani Road to the northern end of the project site.

Road "A" will be a two-lane roadway that will run in the north-south direction. This roadway will provide vehicles in the project site access to Palani Road.

Collector roads will serve to provide access to the various developments within the Kealakehe Planned Community.

TRAFFIC FORECASTS

In order to forecast traffic in the study area, the Island of Hawaii was divided into zones. Since the State of Hawaii has divided the island into 190 Traffic Assignment Zones (TAZ) for an island wide study, these same zones were used for this study. The land uses for each district were based on information provided by the County of Hawaii who also used the TAZ zones as a framework for their land use forecasts.

Forecasting for the project was done using a computer model. The model was constructed to simulate the general roadway network of the island of Hawaii and a more detailed roadway network for the Kona subarea. The network in the computer model consists of centroids, which represent land areas such as Puna, Hilo, and Kailua-Kona; nodes, which represent intersections; and links, which represent the roadways. Each centroid, node, and link has its own respective attributes.

Centroid attributes consist of the number of retail and non-retail employment, the number of dwelling units and intrazonal travel time which the model uses to determine the amount of trips produced by or attracted to that particular centroid. The node attributes consist of through, left and right turning penalties which is meant to simulate the waiting time a driver experiences when going through or turning at an intersection. Link attributes consist of travel time and capacity which is used to simulate the size and quality of a roadway.

The computer model accomplishes its forecast by first determining the number of vehicle trips that begin and end in each zone. This step in the model is called "trip generation". The number of trips that begin in a zone

is called that zone's "trip production". The number of trips that end in a zone is called that zone's "trip attraction".

The model separately determines trip productions and trip attractions for three purposes: home-based work (people travelling to and from home to work); home-based nonwork (people travelling to non job related activities from home); and nonhome-based (people running errands from places other than home). Trip productions and trip attractions are estimated for a full weekday.

The model divides a trip into two legs: (1) going to a destination, and (2) returning from the destination. It estimates trip productions and attractions for both legs at once. Trip attractions are calculated from the following relationship:

$$A_{ik} = b_k E_i^r + c_k E_i^h + d_k H_i$$

where

A_{ik} = trip attraction of zone i for purpose k;

b_k, c_k, d_k = trip attraction parameters for purpose k;

E_i^r = retail employees in zone i;

E_i^n = nonretail employees in zone i; and

H_i = dwelling units in zone i.

Table 6. Trip Attraction Rates [2]

Purpose	Retail Employees	Non Retail Employees	Dwelling Units
Home-based Work	1.7	1.7	0.0
Home-based Nonwork	10.0	0.5	1.0
Nonhome-based	2.0	2.5	0.5

[2] source: NCHRP report 187, p. 15

Trip productions are found by first finding the total number of trips produced in a zone for the three trip purposes and the allocating this total to each purpose.

Trip productions are calculated using the following relationship:

$$P_{ik} = P_{it}\, w_{ik}$$

where

P_{ik} = Production of zone i for purpose k;
P_{it} = total trips produced in zone i;
w_{ik} = factor for trip purpose k

$w_{ik} = w_{uk} / 100$ for $k = 1, 2, 3$
(percentage of total production that should be allocated to purpose 1, 2, or 3; see Table 7.)

Table 7. Trip Production Parameters [3]

Parameter	Size of Urban Area (1,000's) 100-250
Average Trip Production	10.0
Home-based Work Percent	20.0
Home-based Nonwork Percent	57.0
Nonhome-based Percent	23.0

[3] source: NCHRP report 187, p. 13-14 and ITE Trip Generation Manual

Trips generated by the future land uses from each zone were based on the dwelling units, resort units, and employment in each zone.

The second step in the forecast is to determine for each purpose the number of person trips that go from any given "origin" zone to any given "destination" zone. Two such zones are referred to as an "O-D pair". An O-D pair receives a relatively large allocation of trips if (1) the trip productions in the origin zone are large, (2) the trip attractions in the destination zone are large or (3) the travel time between the zones is small. This step in the gravity model is called "trip distribution".

Trips produced in one zone were distributed to other zones using the gravity model. This model is based on the assumption that all trips

"produced" from one zone are attracted to all other zones in direct proportion to the "attractions" in these zones and in inverse proportion to the spatial separation or travel impedance between the zones. Attractions which would motivate people to make trips include employment, shopping, and recreation. Travel impedance is related to human behavior and is based on estimated travel times between zones. The more difficult the trip (long distance to travel or long travel time) the less likely a driver would make the trip.

The gravity model method can be mathematically expressed as:

$$T_{ij} = P_i \frac{A_j F_{ij}}{\sum_{j=1}^{n} A_j F_{ij}}$$

where,

T_{ij} = trips produced in zone i, and attracted to zone j;
P_i = total trip production at i;
A_j = total trip attraction at j;
F_{ij} = friction factor for trip interchange ij;
i = origin zone number, i=1, 2, 3,...n;
n = number of zones

The computer model was used to derive an initial trip distribution table. This table was then adjusted manually outside of the computer model based on knowledge of the West Hawaii area that the computer model could not implement in its calculations. The manually adjusted trip table was then reinserted into the model.

The third step in the traffic forecast is to determine which roadway links will be used by the traffic traversing between the O-D pair. This step is called "trip assignment". Trip assignment places traffic on a specific route on the roadway network that a driver will take from origin to destination. Assignment to the roadways are done based on the shortest path and the capacity of the roadways between the O-D pair.

Due to the tourism oriented economy of West Hawaii, the distribution of tourist traffic was treated specially in the computer model. A trip distribution table was manually derived based upon projected resort and hotel developments around the Island of Hawaii and imported into the computer model separately. The main generators and attractors for tourist traffic were Keahole Airport, South Kohala and Kailua-Kona.

Project Generated Traffic

Vehicle trips generated by the Kealakehe project was calculated manually using the ITE Trip Generation Report. The project traffic was then inserted into the computer model in addition to the ambient traffic which the computer had generated. This allowed for sufficient control and detail in determining the project generated traffic. Table 8 shows the trips generated by the project during the morning and afternoon peak hours.

Table 8. Trip Generation for Kealakehe Project

Land Use	Size	Units	Morning Enter	Morning Exit	Afternoon Enter	Afternoon Exit
Residential development						
Single Family Market	1270	DU	220	595	747	439
Single Family Affordable	1535	DU	262	707	893	524
Single Family Market (120%-140%)	230	DU	46	126	150	88
Multi Family Market	258	DU	29	105	105	57
Multi Family Affordable	228	DU	26	92	93	50
Multi Family Rental	858	DU	98	347	350	189
Total Residential Trips	**4379**	**DU**	**681**	**1972**	**2388**	**1347**
Shopping Center Development						
Community Center	218	1000 sf	195	84	443	500
Neighborhood Center	64	1000 sf	124	52	338	352
Total Shopping Center Trips	**282**	***1000 sf***	**319**	**136**	**781**	**852**
School Development						
Elementary School	900	students	119	79	6	8
High School	1700	students	437	236	26	44
Total School Trips	**2600**	**students**	**556**	**315**	**32**	**52**
Recreational Development						
Recreational Center	10	employees	40	27	31	47
Community Park	8	acres	10	20	14	12
Public Golf Course	200	parking	52	9	10	42
Total Recreational Trips			**102**	**46**	**55**	**101**
Other Developments						
Church	40	1000 sf	4	2	6	6
Day Care	30	1000 sf	180	160	178	192
Civic Center	1000	employees	488	60	216	480
Total Other Trips			**672**	**222**	**400**	**678**
TOTAL PROJECT GENERATED TRIPS			**2330**	**2691**	**3606**	**3030**

TOTAL TRAFFIC WITHOUT AND WITH PROJECT

Table 9 shows the existing and forecasted turning movements with and without the project for the morning peak hour at the study intersections. Table 10 shows the existing and forecasted turning movements with and without the project for the afternoon peak hour. For the without project condition, it was assumed that Kealakehe Parkway would not exist and was therefore excluded from the without project scenario.

The ambient traffic volumes were generated, distributed and assigned by the computer model with Kealakehe totally excluded except for the existing residential development. This was used to obtain forecasts for the daily traffic in *2010 without project* case. These values were then factored down to 8% to derive the peak hour volumes which were then directionally split by the model to determine am and pm peak hour volumes *without* project, and are shown in Figures 8 and 9.

The traffic generated by the Kealakehe project was calculated using ITE Trip Generation, inserted into the computer model which then assigned the traffic to the links to obtain with project daily traffic volumes. Am and pm peak hour volumes *with project* were derived in the same manner as mentioned above, and are shown in Figures 10 and 11.

Table 9. Morning Peak Hour Forecast Traffic

Turning Movement		Existing Traffic 1990	Without Project 2010	With Project 2010
Queen Kaahumanu Highway at Kealakehe Parkway				
Queen Kaahumanu Highway				
Northbound	LT	92	200	220
	TH	447	2010	1690
	RT	N/A	N/A	500
Southbound	LT	N/A	N/A	930
	TH	452	1350	910
	RT	56	100	50
Kealakehe Parkway				
Eastbound	LT	24	70	50
(Honokohau Harbor)	TH	N/A	N/A	70
	RT	50	120	220
Westbound	LT	N/A	N/A	470
(Project Rd)	TH	N/A	N/A	60
	RT	N/A	N/A	1010
Queen Kaahumanu Highway at Palani Road				
Queen Kaahumanu Highway				
Northbound	LT	139	310	230
	TH	398	1250	1370
	RT	196	320	610
Southbound	LT	69	150	70
	TH	200	820	610
	RT	220	390	290
Palani Road				
Eastbound	LT	250	550	670
	TH	186	510	530
	RT	98	210	210
Westbound	LT	343	510	610
	TH	485	1230	1640
	RT	232	290	100

N/A - Not Applicable

Table 9. Morning Peak Hour Forecast Traffic (continued)

Turning Movement		Existing Traffic 1990	Without Project 2010	With Project 2010
Palani Road at Mamalahoa Highway				
Palani Road/Mamalahoa Highway				
Northbound	TH	206	710	500
	RT	62	40	80
Southbound	LT	51	95	140
	TH	504	1325	560
Mamalahoa Highway				
Westbound	LT	95	75	100
	RT	42	60	95
Mamalahoa Highway at Kealakehe Parkway				
Mamalahoa Highway				
Northbound	LT	N/A	N/A	100
	TH	524	770	630
Southbound	TH	555	1420	470
	RT	N/A	N/A	460
Kealakehe Parkway				
Eastbound	LT	N/A	N/A	770
	RT	N/A	N/A	100

N/A - Not Applicable

Table 10. Afternoon Peak Hour Forecast Traffic

Turning Movement		Existing Traffic 1990	Without Project 2010	With Project 2010
Queen Kaahumanu Highway at Kealakehe Parkway				
Queen Kaahumanu Highway				
Northbound	LT	100	100	220
	TH	505	1280	1390
	RT	N/A	N/A	400
Southbound	LT	N/A	N/A	1530
	TH	811	2400	1170
	RT	75	70	50
Kealakehe Parkway				
Eastbound	LT	38	80	50
	TH	N/A	N/A	70
	RT	93	100	220
Westbound (Project Rd)	LT	N/A	N/A	620
	TH	N/A	N/A	60
	RT	N/A	N/A	400
Queen Kaahumanu Highway at Palani Road				
Queen Kaahumanu Highway				
Northbound	LT	189	240	240
	TH	230	900	900
	RT	168	250	250
Southbound	LT	186	550	510
	TH	428	1080	1090
	RT	501	610	630
Palani Road				
Eastbound	LT	326	460	460
	TH	491	1010	1010
	RT	352	500	590
Westbound	LT	178	290	290
	TH	300	760	760
	RT	80	230	230

N/A - Not Applicable

Table 10. Afternoon Peak Hour Forecast Traffic (continued)

Turning Movement		Existing Traffic 1990	Without Project 2010	With Project 2010
Palani Road at Mamalahoa Highway				
Palani Road/Mamalahoa Highway				
Northbound	TH	480	1245	640
	RT	71	95	80
Southbound	LT	38	15	140
	TH	265	835	440
Mamalahoa Highway				
Westbound	LT	39	70	110
	RT	44	85	90
Mamalahoa Highway at Kealakehe Parkway				
Mamalahoa Highway				
Northbound	LT	N/A	N/A	40
	TH	524	1360	540
Southbound	TH	303	830	620
	RT	N/A	N/A	890
Kealakehe Parkway				
Eastbound	LT	N/A	N/A	300
	RT	N/A	N/A	100

N/A - Not Applicable

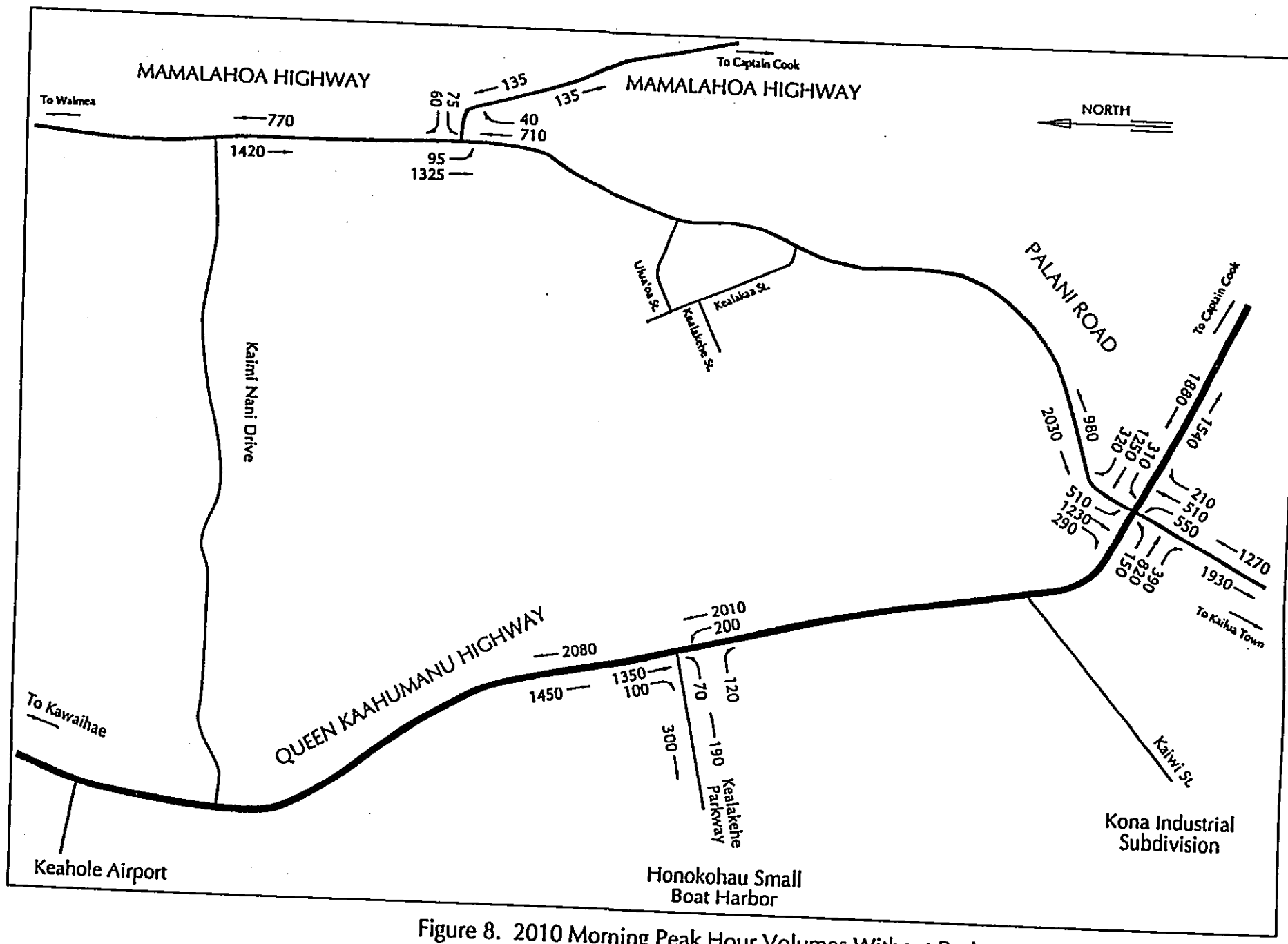


Figure 8. 2010 Morning Peak Hour Volumes Without Project

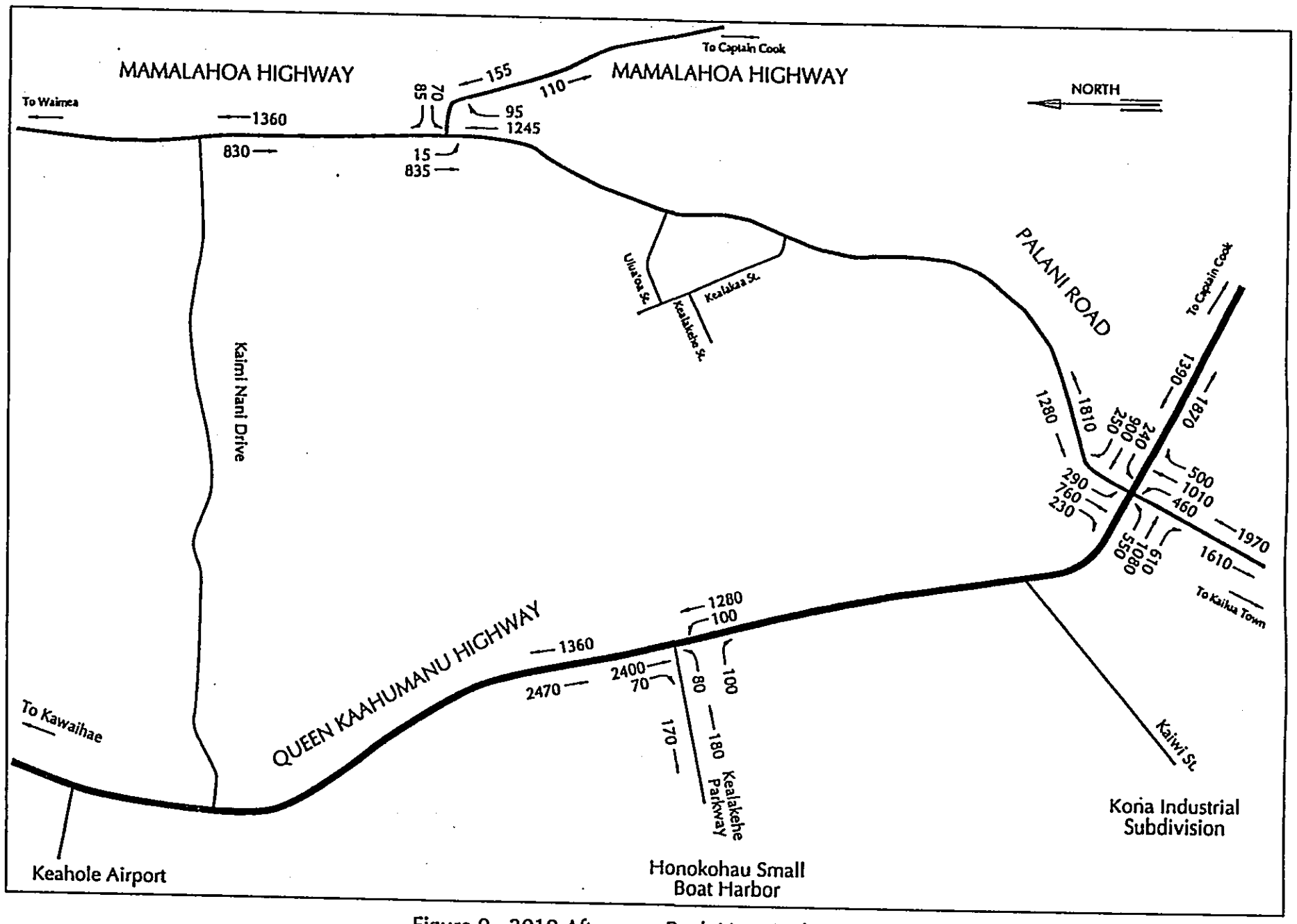


Figure 9. 2010 Afternoon Peak Hour Volumes Without Project

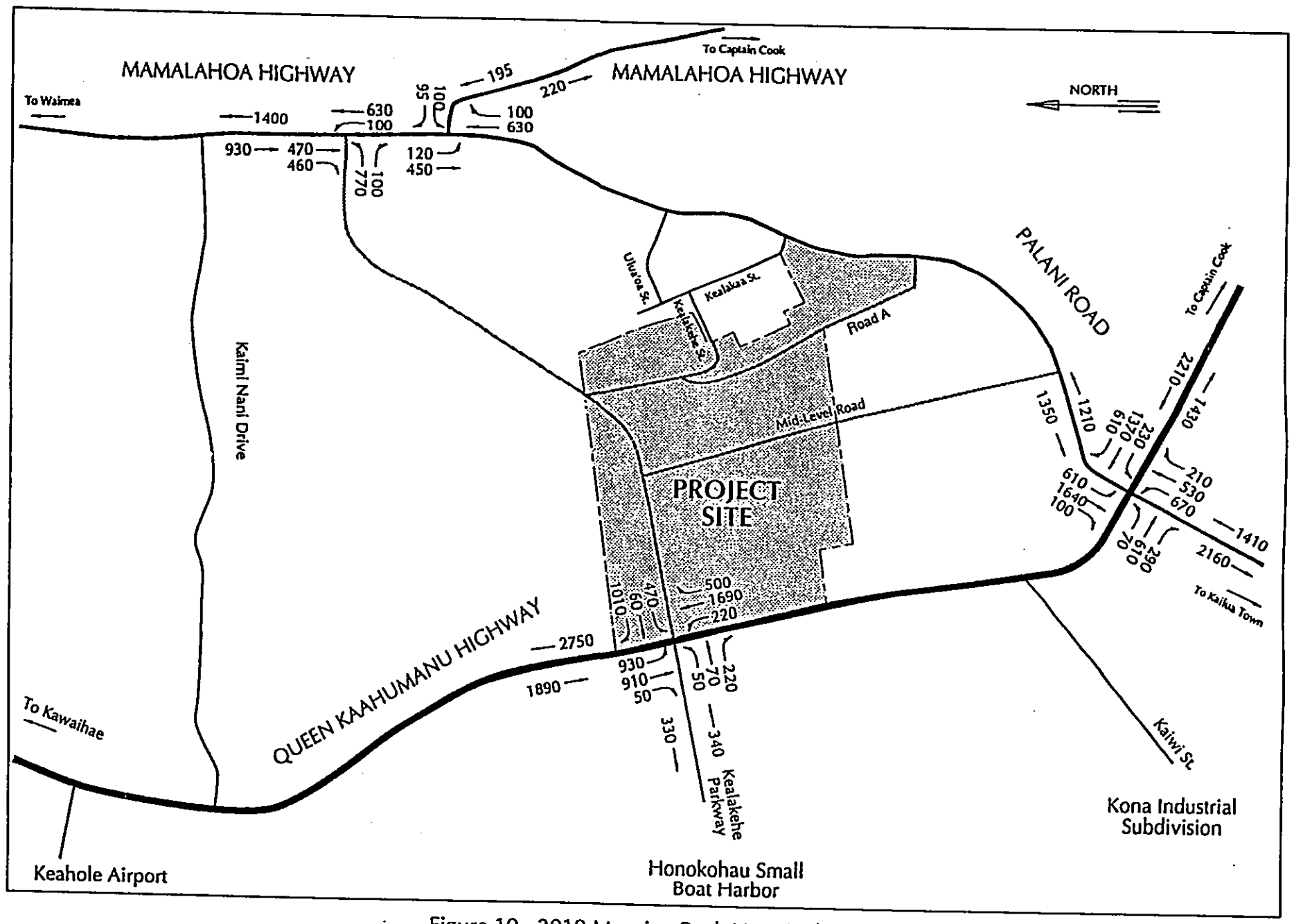


Figure 10. 2010 Morning Peak Hour Volumes With Project

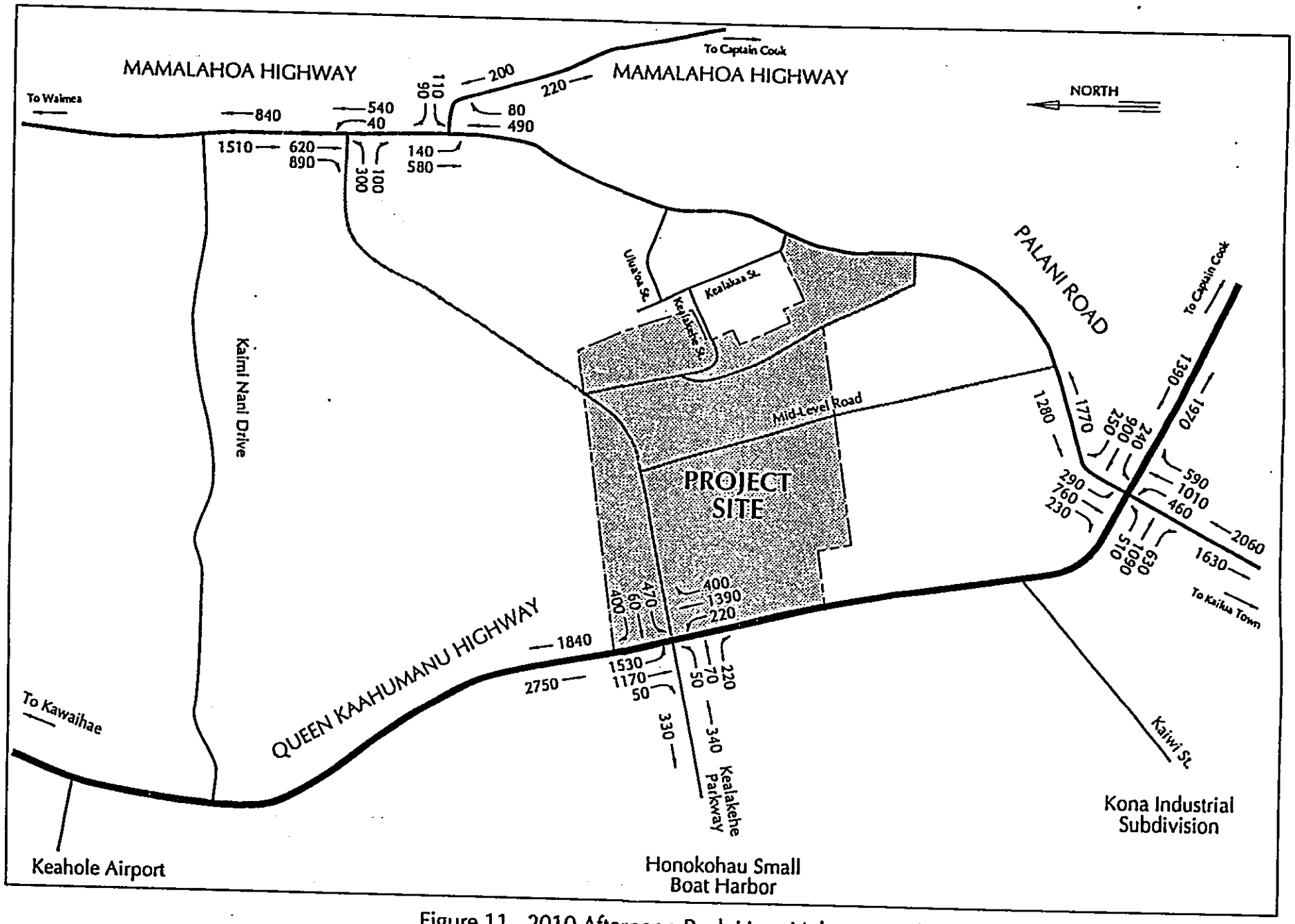


Figure 11. 2010 Afternoon Peak Hour Volumes With Project

TRAFFIC IMPACT ANALYSIS

As background, it is important to note that population and employment in the West Hawaii Area is projected to more than double by the year 2010. This will cause a corresponding increase in traffic in the area. Even without the Kealakehe Planned Community, roadway facilities will not have the capacity to handle forecast traffic volumes at an acceptable level-of-service (as shown in the following analysis). Therefore, extensive roadway network improvements are necessary. Due to the expected lack of adequate roadway facilities by the year 2010, traffic impacts were measured by the capacity analysis method.

Traffic impacts resulting from the Kealakehe Planned Community project were measured by determining first the improvements required to accommodate forecast traffic *without the project* for the year 2010 then determining the additional improvements required to accommodate traffic *with the project*. The additional improvements are a measure of the impact of the project.

Highway capacity, intersection capacity, and level-of-service (LOS) were used to determine the needed improvements for without and with project. Highways were sized (number of lanes) using LOS D as the minimum acceptable LOS, intersections were sized to operate under capacity when signalized, and unsignalized intersections were signalized if minor streets encountered extreme delays. At major intersections where signalization was deemed unacceptable, grade separated interchanges were considered.

It is important to differentiate between future roadway improvements that would be necessary to mitigate traffic growth from planned developments and those improvements required to mitigate impacts from the Kealakehe Planned Community project . The required roadway improvements are listed under the subsequent sections titled: "2010 Roadway Network Without Project," and "2010 Roadway Network With Project."

2010 ROADWAY NETWORK WITHOUT PROJECT

Even without the project, extensive roadway improvements will be necessary to handle the projected future traffic from other planned developments in the West Hawaii area. The following improvements (or of similar magnitude) are required based on our analysis of the forecast traffic without the project to the year 2010:

- Widen Queen Kaahumanu Highway to 4 lanes between Palani Road and the Keahole Airport,

- Widen Palani Road to 4 lanes between Mamalahoa Highway and Queen Kaahumanu Highway,

- Widen Mamalahoa Highway to 4 lanes between Kaimi Nani Street and Palani Road,

- Signalize the intersection of Mamalahoa Highway and Palani Road when warranted,

- Provide a grade separated interchange at the intersection of Queen Kaahumanu Highway and Palani Road, and

- Signalize intersection of Queen Kaahumanu/Kealakehe Parkway until a frontage road is in place to connect to Kealakehe Parkway. (This is to conform with State DOT policy regarding uninterrupted traffic flow condition along Queen Kaahumanu Highway.)

Highway Analysis

The following roadways were analyzed using methods from the HCM to determine the roadway facilities necessary to accommodate forecast 2010 traffic without the project:

- Queen Kaahumanu Highway,
- Mamalahoa Highway, and
- Palani Road.

The results of the highway analysis are shown in Table 11.

Table 11. Level-of-Service - Highway Analysis

	Existing Roadway Existing Conditions		Existing Roadway Without Project		With Roadway Improvements Without Project		With Roadway Improvements With Project	
	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
	Queen Kaahumanu Hwy. (2-lane)				Queen Kaahumanu Hwy. (4-lane)			
Keahole Airport & Kealakehe Parkway								
Northbound	C	D	F	F	C	B	D	C
Southbound	C	D	F	F	B	D	C	D
Kealakehe Parkway & Palani Road								
Northbound	D	E	F	F	B	B	C	B
Southbound	D	E	F	F	B	B	B	B
	Palani Road (2-lane)				Palani Road (4-lane)			
Mamalahoa Highway & Ulua 'oa Street								
Northbound	E	E	F	F	C	C	B	B
Southbound	E	E	F	F	C	B	B	B
Kealakaa Street & Queen Kaahumanu Highway								
Eastbound	F	F	F	F	B	D	C	D
Westbound	F	F	F	F	D	C	C	C
	Mamalahoa Highway (2-lane)				Mamalahoa Highway (4-lane)			
Palani Road & Kaimi Nani Drive								
Northbound	E	E	F	F	A	B	B	A
Southbound	E	E	F	F	B	A	A	B
	Kealakehe Parkway (2-lane)				Kealakehe Parkway (4-lane)			
Kealakehe Parkway & Queen Kaahumanu Highway								
Eastbound	n/a	n/a	n/a	n/a	n/a	n/a	C	D
Westbound	n/a	n/a	n/a	n/a	n/a	n/a	C	B

Queen Kaahumanu Highway

1990 Existing Traffic on Existing 2 Lane Queen Kaahumanu: As described in the "Existing Conditions" chapter, the existing LOS on Queen Kaahumanu Highway is LOS C and LOS D during the morning and afternoon peak hours, respectively, between Keahole Airport and Kealakehe Parkway. Between Kealakehe Parkway and Palani Road, Queen Kaahumanu drivers during the morning and afternoon peak hours experience LOS D and LOS E, respectively.

2010 Forecast Traffic Without Project on Existing 2 Lane Queen Kaahumanu: Without the project by the year 2010, the level of service is expected to drop to LOS F during the morning and afternoon peak hours. The demand will exceed the capacity and there will be heavily congested flow. Since Queen Kaahumanu would operate at LOS F with two lanes, it was assumed that this highway would be a four lane highway by 2010.

2010 Forecast Traffic Without Project on 4 Lane Queen Kaahumanu: With Queen Kaahumanu widened to 4 lanes by 2010, the highway will generally operate at LOS B during the morning and afternoon peak hours between Keahole Airport and Palani Road. The only exception would be southbound drivers between the Airport and the Parkway will experience LOS D during the afternoon peak hour.

Palani Road

1990 Existing Traffic on Existing 2 Lane Palani: The existing LOS along Palani Road, between Queen Kaahumanu Highway and Ulua'oa

Street, is LOS F during the morning and afternoon peak hours. The roadway operates with heavily congested flow with traffic demand exceeding capacity during both peak hours. For the segment along Palani Road between Kealakaa Street and Mamalahoa Highway, drivers experience LOS E during the morning and afternoon peak hours.

2010 Forecast Traffic Without Project on Existing 2 Lane Palani: Without the project by the year 2010, the level of service is expected to operate at LOS F during both morning and afternoon peak hours between Mamalahoa to Queen Kaahumanu. Since Palani would operate at LOS F with two lanes, it was assumed that this highway would be a four lane highway by 2010.

2010 Forecast Traffic Without Project on 4 Lane Palani: With Palani widened to 4 lanes by 2010, the road will generally operate at LOS C during the morning and afternoon peak hours between Uluaoa and Mamalahoa. Between Kealakaa Street and Queen Kaahumanu the road will operate at LOS D for eastbound drivers during the afternoon peak hour and LOS D for westbound drivers during the morning peak hour. The other movements along the road would operate at LOS B or C.

Mamalahoa Highway

1990 Existing Traffic on Existing 2 Lane Mamalahoa: For the section of Mamalahoa Highway between Palani Road and Kaimi Nani Drive, drivers currently experience LOS E during both peak hours.

2010 Forecast Traffic Without Project on Existing 2 Lane Mamalahoa: Without the project by the year 2010, the level of service is expected to be LOS

F during the morning and afternoon peak hours. The demand will exceed the capacity and there will be heavily congested flow. Since Mamalahoa would operate at LOS F with two lanes, it was assumed that this highway would be a four lane highway by 2010.

2010 Forecast Traffic Without Project on 4 Lane Mamalahoa: With Mamalahoa widened to 4 lanes, the highway will operate at LOS A or B during the morning and afternoon peak hours in 2010.

Intersection Analysis

The following intersections were analyzed using methods from the HCM to determine the intersection requirements necessary to accommodate forecast 2010 traffic without the project:

- Queen Kaahumanu Highway and Kealakehe Parkway,
- Queen Kaahumanu Highway and Palani Road,
- Mamalahoa Highway and Palani Road, and
- Palani Road and Minor Streets (Uluaoa Street and Kealakaa Street).

The intersection analysis of traffic impacts for 2010 forecasted traffic *without the project* was based on intersection approaches with increased laneage. Queen Kaahumanu Highway, Mamalahoa Highway, and Palani Road were identified as needing four lanes in the preceding highway analysis. The results of the intersection analysis are shown in Table 12.

TABLE 12. INTERSECTION IMPROVEMENTS

	Queen Kaahumanu Highway with Kealakehe Parkway	Queen Kaahumanu Highway with Palani Road	Mamalahoa with Palani Road	Mamalahoa with Kealakehe Parkway
Existing Conditions	**1. Unsignalized Intersection** Minor Street LOS E	**1. Signalized Intersection** Intersection LOS E	**1. Unsignalized Intersection** Minor Street LOS D	Not Applicable
2010 Without Project (All Roadways 4-lane)	**1. Unsignalized Intersection** Minor Street LOS F Therefore, signalize intersection **2. Signalized Intersection** Operates Under Capacity However due to DOT policy, connection to frontage road system may be required to provide uninterrupted flow.	**1. Signalized Intersection** Intersection LOS F Therefore, 4-lane Queen K Hwy and Palani Rd needed **2. Signalized with 4 lanes** Operates Over Capacity Therefore, 6-lane Queen K Hwy and Palani needed However due to DOT policy, and intersection size, Grade Separated Interchange possible alternative **3. Grade Separated Interchange w/ 4-lane roadways** Ramp LOS D or better	**1. Unsignalized Intersection** Minor Street LOS F Therefore, signalize intersection **2. Signalized Intersection** Operates Under Capacity	Not Applicable
2010 With Project (All Roadways 4-lane)	**1. Signalized Intersection with Kealakehe Parkway Extension** Operates Over Capacity However due to DOT policy, and potential intersection size, Grade Separated Interchange possible alternative **2. Grade Separated Interchange w/ 4-lane roadways** Ramp LOS D or better	**1. Grade Separated Interchange w/ 4-lane roadways** Ramp LOS D or better	**1. Signalized Intersection** Operates Under Capacity	**1. Unsignalized Intersection w/ 4 lane roadways** Minor Street LOS F. **2. Signalized Intersection** Operates Under Capacity

Queen Kaahumanu and Kealakehe Parkway

1990 Existing Traffic on Existing Unsignalized Intersection: Currently, Kealakehe Parkway is a T-intersection. Drivers along Queen Kaahumanu currently encounter little delays due to traffic turning into and out off Kealakehe Parkway. This intersection is channelized with a left turn storage lane. However, drivers exiting the minor street encounter long delays.

2010 Forecast Traffic Without Project, Unsignalized Intersection with Four Lanes on Queen Kaahumanu: Without the project, Kealakehe Parkway intersection will remain a T-intersection with no mauka leg. Northbound drivers along Queen Kaahumanu attempting left turns into Kealakehe Parkway are expected to encounter very long delays (LOS F) due to heavy traffic along Queen Kaahumanu heading to Kailua-Kona. Drivers exiting the minor street are also expected to encounter long to extreme delays (LOS F). Since the minor street would operate with extreme delays, it was assumed that this intersection would be signalized when warranted but prior to 2010:

As a signalized intersection, analysis results indicate that this intersection would operate under capacity with the following improvements:

1. Fully channelize intersection,
2. Left turn storage lane along Queen Kaahumanu Highway,
3. Acceleration and deceleration lanes along Queen Kaahumanu Highway, and
4. Separate left and right turn lanes exiting Kealakehe Parkway.

Although this signalized intersection will operate under capacity, *DOT policy is to provide uninterrupted traffic flow conditions along Queen Kaahumanu Highway (i.e. no signalization).* This intersection would therefore need to be grade separated with a frontage road system to provide free flow conditions for Queen Kaahumanu traffic.

Connection to a Future Frontage Road System: A grade separated interchange would minimize the delays to traffic on both Queen Kaahumanu and the Kealakehe Parkway, how much reduction of delay depends on the configuration of the interchange. However, the benefit/cost ratio of an interchange project would likely be very small, considering the amount of traffic it would serve. Therefore, it is recommended that this intersection be signalized until Kealakehe Parkway can be connected to the frontage road system to be developed by DOT. (It is assumed that the construction of the frontage roads, widening of Queen Kaahumanu will require several years, and in that period traffic signals would handle traffic at below capacity levels.

Queen Kaahumanu Highway and Palani Road

1990 Existing Traffic on Existing Signalized Intersection: Drivers at this intersection currently encounter average delays of 50 seconds per vehicle (LOS E) during the morning peak hour and 50 seconds per vehicle (LOS E) during the afternoon. This intersection is fully channelized with a left turn storage lane at each approach. The long delays are partially due to the current signal timing.

2010 Forecast Traffic Without Project, Signalized Intersection with Four Lanes on Queen Kaahumanu and Palani: Even with the additional laneage along Queen Kaahumanu and Palani, this signalized intersection would operate over-capacity during the morning and afternoon peak hours in 2010 . Therefore, additional lanes on the approaches of Queen Kaahumanu and Palani will be necessary to bring the intersection to operate below capacity.

Increase Laneage at Intersection: In order for the signalized intersection to operate under capacity the following improvements would be needed:

1. Three through lanes along Queen Kaahumanu and Palani for perhaps at least 1000 feet beyond each direction of the intersection,
2. Double left turn storage lanes along all approaches,
3. Double right turn lanes along some approaches, and
4. Fully channelize intersection.

Due to the resultant size of such an intersection and number of lanes required to operate under capacity, a grade separated interchange is a possible alternative and would be in conformance with DOT's policy of uninterrupted traffic flow along Queen Kaahumanu Highway.

2010 Forecast Traffic Without Project with Four Lanes on Queen Kaahumanu and Palani and a Grade separated Interchange: A grade separated interchange would minimize the delays to traffic on both Queen

Kaahumanu and Palani. An interchange would also satisfy DOT policy to provide free flow conditions along Queen Kaahumanu Highway (i.e. no signalization).

A detailed interchange configuration is not within the scope of this study since it will require road design analysis to take into account cost, right-of-way acquisition, and access to surrounding land uses via a DOT approved frontage road system.

Preliminary analysis indicates the LOS for single lane on and off ramps for the proposed interchange ramps would operate at LOS D or better. However, such critical questions rights-of-way or topography was not a part of this study.

Mamalahoa Highway and Palani Road

1990 Existing Traffic on Existing Unsignalized Intersection: This T-intersection is configured with Mamalahoa/Palani forming the major through movement and Mamalahoa also being the minor street. During the morning peak hour, drivers turning left from Mamalahoa onto Palani experience long delays (LOS D) while drivers for the other movements experience little or no delays (LOS A). During the afternoon peak hour, drivers all movements experience average delays (LOS C) or better.

2010 Forecast Traffic Without Project, Unsignalized Intersection with Four Lanes on Mamalahoa/Palani: Drivers attempting left-turns from Mamalahoa (minor street) onto Palani (major street) will experience extremely long delays (LOS F) during both morning and afternoon peak

hours. Other movements will experience average delays (LOS C) or better. Due to the delays expected for the minor street, it was assumed that this intersection would be signalized by 2010.

Signalize Intersection when Warranted: As a signalized intersection, this intersection would operate under capacity with the following improvements:

1. Fully channelize intersection and
2. Left turn storage lane along Mamalahoa Highway (major approach).

Palani Road and Minor Streets

1990 Existing Traffic on Existing Unsignalized Uluaoa Intersection: Drivers turning left from Ulua'oa onto Palani currently experience average delays (LOS C) during the morning peak hour and experience long delays (LOS D) during the afternoon peak hour. The other turning movements experience little or no delays (LOS A) during both the morning and afternoon peak hours.

1990 Existing Traffic on Existing Unsignalized Kealakaa Intersection: Drivers turning left from Kealakaa onto Palani currently experience average delays (LOS C) during the morning peak hour and experience long delays (LOS D) during the afternoon peak hour. The other turning movements experience little or no delays (LOS A) during both the morning and afternoon peak hours.

2010 Forecast Traffic Without Project, Signalized Intersection with Four Lanes on Palani: All intersections will require signalization without

the project by 2010. All minor cross street approaches would require separate left and right turn lanes onto Palani. All northbound approaches on Palani should have a left turn auxiliary lane. It is also desirable to have right turn lanes on the southbound approaches for drivers turning makai towards the project area. However, the study did not include the road design analysis of cost, geometrics, right-of-way, and topography and the above statements must consider the physical constraints as well alternative means.

2010 ROADWAY NETWORK WITH PROJECT

The Roadway Network which includes improvements required by 2010 was used as the base network to determine the additional improvements necessary for the Project. In addition to those improvements required even without the Project, the following improvements were identified based on our impact analysis of the total forecast traffic including that of the the project in the year 2010:

- Provide a four lane Kealakehe Parkway,
- Signalize the intersection of Mamalahoa Highway and future Kealakehe Parkway, and
- Provide a grade separated interchange at Queen Kaahumanu Highway and Kealakehe Parkway.

Highway Analysis

The following roadways were analyzed using methods from the HCM to determine the impact and possible roadway improvements necessary to accommodate forecast 2010 traffic with the project. The traffic impact results are shown in Table 11.

- Queen Kaahumanu Highway,
- Mamalahoa Highway,
- Palani Road, and
- Kealakehe Parkway.

Queen Kaahumanu Highway

2010 Forecast Traffic With Project on 4 Lane Queen Kaahumanu: With Queen Kaahumanu widened to 4 lanes, the highway will continue to operate at LOS D *or better* during the morning and afternoon peak hours between Keahole Airport and Palani Road.

Palani Road

2010 Forecast Traffic With Project on 4 Lane Palani: With Palani widened to 4 lanes, the road will continue to operate at LOS D *or better* during the morning and afternoon peak hours.

Mamalahoa Highway

2010 Forecast Traffic With Project on 4 Lane Mamalahoa: With Mamalahoa widened to 4 lanes, the highway will continue to operate at LOS A or B during the morning and afternoon peak hours.

Kealakehe Parkway

2010 Forecast Traffic With Project on 2 Lane Parkway: With a two lane Parkway, the highway will operate at LOS F during the morning and afternoon peak hours. Therefore, it was assumed that this highway would be a four lane highway by 2010.

2010 Forecast Traffic With Project on 4 Lane Parkway: With a four lane Parkway in 2010, the highway will operate at LOS D during the morning and afternoon peak hours.

Intersection Analysis

The following intersections were analyzed using methods from the HCM to determine the intersection traffic impacts and improvements necessary to accommodate forecast 2010 traffic with the project:

- Queen Kaahumanu Highway and Kealakehe Parkway,
- Queen Kaahumanu Highway and Palani Road,
- Mamalahoa Highway and Palani Road,
- Palani Road with Minor Streets (Uluaoa Street, Kealakaa Street, and Road A, and
- Mamalahoa Highway and Kealakehe Parkway.

The 2010 Roadway Network Without Project Improvements were used as the base network to determine the additional improvements necessary with the Project. The traffic impact results of the are shown in Tables 12.

Queen Kaahumanu and Kealakehe Parkway

2010 Forecast Traffic With Project, Grade Separation with Four Lanes on Queen Kaahumanu: Due to the volume of vehicles generated by the Kealakehe Planned Community, a connection to Queen Kaahumanu Highway is needed. Since DOT policy is to provide free flow conditions along Queen Kaahumanu Highway (i.e. no signalization), this intersection would need to be grade separated. The Parkway would divert a portion of traffic from Palani Road onto the Parkway, reducing the volume of traffic on portions of Palani.

A grade separated interchange would minimize the delays to traffic on both Queen Kaahumanu and the Kealakehe Parkway, the size of reduction depends on the configuration of the interchange. Preliminary analysis of an assumed diamond interchange indicates LOS D or better operation.

Queen Kaahumanu Highway and Palani Road

2010 Forecast Traffic With Project with Four Lanes on Queen Kaahumanu and Palani and a Grade separated Interchange: Even without the project, major improvements are required. Because of DOT policy (i.e. a signalized intersection is not acceptable for the long term), a grade separated interchange at Queen Kaahumanu and the Palani is assumed, with reduced vehicle delays.

With the project, preliminary analysis of a possible diamond interchange indicates ramp operation at LOS D or better in 2010.

Mamalahoa Highway and Palani Road

2010 Forecast Traffic With Project, Signalized Intersection with Four Lanes on Mamalahoa/Palani: Signalization is required even without the project. With the project, this intersection would operate under capacity.

Mamalahoa Highway with New Kealakehe Parkway

2010 Forecast Traffic With Project, Unsignalized Intersection with Four Lanes on Mamalahoa and Parkway: (Does not exist without the project.) With four lanes on Mamalahoa and Kealakehe Parkway, drivers attempting left-turns from the extended Kealakehe Parkway onto Mamalahoa Highway will experience extremely long delays (LOS F) during both morning and afternoon peak hours. Drivers turning left from Mamalahoa Highway onto Kealakehe Parkway will experience average delays (LOS C) during the morning peak hour while drivers attempting right-turns from Kealakehe Parkway will experience little delays (LOS B). During the afternoon peak hour, drivers attempting right-turns from Kealakehe Parkway and left-turns from Mamalahoa Highway will both experience very long delays (LOS D). Due to the delays expected for the minor street (Kealakehe Parkway), this intersection will require signalization.

2010 Forecast Traffic With Project, Signalized Intersection with Four Lanes on Mamalahoa/Parkway: With signalization, this intersection would operate under capacity with the following improvements:

1. Fully channelize intersection,
2. Provide exclusive right and left turn lanes exiting Kealakehe Parkway onto Mamalahoa, and
3. Provide left turn storage lane along Mamalahoa.

Palani Road and Minor Streets Serving the Project

All intersections will require signalization without the project by 2010. All minor cross street approaches would require separate left and right turn lanes onto Palani. All northbound approaches on Palani should have a left turn auxiliary lane. It is also desirable to have right turn lanes on the southbound approaches for drivers turning makai towards the project area. However, the study did not include the road design analysis of cost, geometrics, right-of-way, and topography and the above statements must consider the physical constraints as well alternative means.

CONCLUSIONS AND RECOMMENDATIONS

The Kealakehe Planned Community Project, when completed in 2010, will have a major impact on Queen Kaahumanu Highway and Palani Road.

A much greater impact will arise without the project. Extensive growth projected in the West Hawaii region over the next twenty years will result in population and employment increasing to 100% or more. Major infrastructure needs exist to handle such growth. Traffic volumes and travel patterns in the year 2010 will be different than those of today. The predicted change in the location and amount of jobs and population (as envisioned by the County land use forecasts) will result in directional changes in traffic along the major arterials in the area such as Queen Kaahumanu Highway.

Even without the project in 2010, Queen Kaahumanu Highway, Mamalahoa Highway and Palani Road will be over their capacities to handle predicted traffic demand with drivers encountering intersection congestion and delays. Queen Kaahumanu Highway will need to be widened to four lanes (or similar magnitude project) in the vicinity between Palani Road and Keahole Airport. Palani Road will also need to be widened to four lanes (or similar magnitude project), as well as Mamalahoa Highway between Palani Road and Kaimi Nani Drive.

The signalized intersection of Palani Road and Queen Kaahumanu Highway will also be over capacity and will need to be either vastly widened or converted to a grade separated interchange. The intersection of Palani

Road and Mamalahoa Highway will need to be signalized when warranted. The minor intersections along Palani Road that access the existing subdivision such as Kealakaa Street will also need to be signalized even without the project.

It was assumed that a four-lane, mauka-makai Kealakehe Parkway running between Queen Kaahumanu Highway and Mamalahoa Highway would be constructed along with the project's development. It would serve as the major access road to both Queen Kaahumanu and Mamalahoa Highways for the Kealakehe community. Therefore, with the construction of Kealakehe Parkway, traffic along Palani Road will not be significantly affected by the project because of the assumed driver choice of the routes' relative travel times.

Due to the impact of the traffic volumes of the Kealakehe Planned Community development, the following actions are deemed necessary:

1. A grade separated interchange at the intersection of Queen Kaahumanu Highway and Kealakehe Parkway due to traffic demand and the requirement of the State Department of Transportation for non-interrupted flow along Queen Kaahumanu Highway.

2. Signalized intersection at Mamalahoa Highway and Kealakehe Parkway.

3. The Kealakehe Parkway extension between Queen Kaahumanu and Mamalahoa Highways should be constructed as a four-lane roadway. Depending on the number of intersections accessing the project, additional improvements such as the following may be necessary:

a. Signalize the intersections along Kealakehe Parkway when warranted.

b. Auxiliary lanes, primarily left turn storage lanes may be necessary along Kealakehe Parkway and the minor streets.

It is important to note that the feasibility of projects identified in this report has not been studied, and no recommendation regarding a specific project is implied. What is recommended is the need to consider projects of similar magnitude generally identified herein. Alternative actions should also be investigated for costs, benefits, and impacts. Major questions such as topography, costs, rights-of-way, environmental impacts, and other issues need to be fully investigated in the required and/or standard planning, design, and construction procedures.

APPENDIX A

LEVEL-OF-SERVICE DEFINITIONS FOR INTERSECTIONS AND HIGHWAYS

DEFINITION OF LEVEL-OF-SERVICE FOR SIGNALIZED INTERSECTIONS

Level of service for signalized intersections is defined in terms of *delay*. Delay is a measure of driver discomfort, frustration, fuel consumption, and lost travel time. Specifically, level-of-service criteria are stated in terms of the average stopped delay per vehicle for a 15-minute analysis period.

Level-of service A describes operations with very low delay, i.e., less than 5.0 sec per vehicle. This occurs when progression is extremely favorable, and most vehicles arrive during the green phase. Most vehicles do not stop at all. Short cycle lengths may also contribute to low delay.

Level-of-service B describes operations with delay in the range of 5.1 to 15.0 sec per vehicle. This generally occurs with good progression and/or short cycle lengths. More vehicles stop than for LOS A, causing higher levels of average delay.

Level-of-service C describes operations with delay in the range of 15.1 to 25.0 sec per vehicle. These higher delays may result from fair progression and/or longer cycle lengths. Individual cycle failures may begin to appear in this level. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.

Level-of-service D describes operations with delay in the range of 25.1 to 40.0 sec per vehicle. At level D, the influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, or a high v/c ratios (volume of cars to capacity of intersection). Many vehicles stop, and the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.

Level-of-service E describes operations with delay in the range of 40.1 to 60.0 sec per vehicle. This is considered to be the limit of acceptable delay. These high delay values generally indicate poor progression, long cycle length, and high v/c ratios. Individual cycle failures are frequent occurrences.

Level-of-service F describes operations with delay in excess of 60.0 sec per vehicle. This is considered to be unacceptable to most drivers. This condition often occurs with oversaturation, i.e., when arrival flow rates exceed the capacity of the intersection. It may also occur at high v/c ratios below 1.00 with many individual cycle failures. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.

REFERENCE: Highway Capacity Manual (Special Report 209, 1985)

DEFINITION OF LEVEL-OF-SERVICE
FOR
UNSIGNALIZED INTERSECTIONS

For unsignalized intersections, the traffic most impacted will be the minor or cross-street with the stop or yield control. The major roadway will have the right-of-way. The level-of-service is the amount of delay expected for the average vehicle desiring to cross or enter the major road. The following gives a general description of the measure.

The concept of levels of service is defined as a qualitative measure describing operational conditions within a traffic stream, and their perception by motorists and/or passengers. A level of service definition generally describes these conditions in terms of such factors as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and safety.

Six levels of service are defined for each type of facility for which analysis procedures are available. They are given letter designations, from A to F, with level-of-service A representing the best operating conditions and level-of-service F the worst.

Level-of-Service definitions--In general, the various levels of service are defined as follows for uninterrupted flow facilities:

Level-of-service A represents free flow. Individual users are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to maneuver within the traffic stream is extremely high. The general level of comfort and convenience provided to the motorist, passenger, or pedestrian is excellent.

Level-of-service B is in the range of stable flow, but the presence of other users in the traffic stream begins to be noticeable. Freedom to select desired speeds is relatively unaffected, but there is slight decline in the freedom to maneuver within the traffic stream from LOS A. The level of comfort and convenience provided is somewhat less than at LOS A, because the presence of others in the traffic stream begins to affect individual behavior.

Level-of-service C is in the range of stable flow, but marks the beginning of the range of flow in which the operation of individual users becomes significantly affected by interactions with others in the traffic stream. The selection of speed is now affected by the presence of others, and maneuvering within the traffic stream requires substantial vigilance on the part of the user. The general level of comfort and convenience declines noticeably at this level.

Level-of-service D represents high-density, but stable, flow. Speed and freedom to maneuver are severely restricted, and the driver or pedestrian experiences a generally poor level of comfort and convenience. Small increases in traffic flow will generally cause operational problems at this level.

Level-of-service E represents operating conditions at or near the capacity level. All speeds are reduced to a low, but relatively uniform value. Freedom to maneuver within the traffic stream is extremely difficult, and it is generally accomplished by forcing a vehicle or pedestrian to "give way" to accommodate such maneuver. Comfort and convenience levels are extremely poor, and driver or pedestrian frustration is generally high. Operations at this level are usually unstable, because small increases in flow or minor perturbations within the traffic stream will cause breakdowns.

Level-of-service F is used to define forced or breakdown flow. This condition exists wherever the amount of traffic approaching a point exceeds the amount which can traverse the point. Queues form behind such locations. Operations within the queue are characterized by stop-and-go wave, and they are extremely unstable. Vehicles may progress at reasonable speeds for several hundred feet or more, then be required to stop in a cyclic fashion. Level-of-service F is used to describe the operating conditions within the queue, as well as the point of the breakdown. It should be noted, however, that in many cases operating conditions of the vehicles or pedestrians discharged from the queue may be quite good. Nevertheless, it is the point at which arrival flow exceeds discharge flow which causes the queue to form, and level-of-service F is an appropriate designation for such points.

These definitions are general and conceptual in nature, and they apply primarily to uninterrupted flow. Levels of service for interrupted flow facilities vary widely in terms of both the user's perception of service quality and the operational variables used to describe them.

REFERENCE: Highway Capacity Manual (Special Report 209, 1985)

DEFINITION OF LEVEL-OF-SERVICE FOR TWO-LANE RURAL HIGHWAYS

Level of service for two-lane rural highways addresses both mobility and accessibility concerns. The primary measure of service quality is percent time delay, with speed and capacity utilization used as secondary measures.

Level-of service A describes the highest quality of traffic service where motorists are able to drive at their desired speed. Without strict enforcement, this highest quality would result in average speeds approaching 60 mph on two-lane highways. The passing frequency required to maintain these speeds has not reached a demanding level. Passing demand is well below passing capacity, and almost no platoons of three or more vehicles are observed. Drivers would be delayed no more than 30% of the time by slow-moving vehicles.

Level-of-service B describes the region of traffic flow wherein speeds of 55 mph or slightly higher are expected on level terrain. Passing demand needed to maintain desired speeds becomes significant and approximately equals the passing capacity at the lower boundary of level-of-service B. Drivers are delayed up to 45% of the time.

Level-of-service C describes conditions where further increases in flow results in noticeable increases in platoon formation, platoon size, and frequency of passing impediment. Average speed still exceeds 52 mph on level terrain, even though unrestricted passing demand exceeds passing capacity. At higher volume levels, chaining of platoons and significant reductions in passing capacity begin to occur. While traffic flow is stable, it is becoming susceptible to congestion due to turning traffic and slow moving vehicles. Percent time delays are up to 60%.

Level-of-service D describes unstable traffic flow as two opposing traffic streams essentially begin to operate separately at higher volume levels, as passing becomes extremely difficult. Passing demand is very high, while

passing capacity approaches zero. Mean platoon sizes of 5 to 10 vehicles are common, although speeds of 50 mph can still be maintained under ideal conditions. Turning vehicles and/or roadside distractions cause major shock-waves in the traffic stream. The percentage of time drivers are delayed approaches 75%.

Level-of-service E describes traffic flow conditions having a percent time delay of greater than 75 percent. Under ideal conditions, speeds will drop below 50 mph. Passing is virtually impossible and platooning becomes intense when slower vehicles or other interruptions are encountered.

Level-of-service F describes heavily congested flow with traffic demand exceeding capacity. Volumes are lower than capacity, and speeds are below capacity speed.

REFERENCE: Highway Capacity Manual (Special Report 209, 1985)

DEFINITION OF LEVEL-OF-SERVICE FOR MULTI-LANE HIGHWAYS

Level-of-service (LOS) criteria for multilane highways are defined in terms of *density*. Density is a measure which quantifies the proximity to other vehicles in the traffic stream. It expresses the degree of maneuverability within the traffic stream.

Level-of-service A describes completely free-flow conditions. The operation of vehicles is virtually unaffected by the presence of other vehicles, and operations are constrained only by the geometric features of the highway and driver preferences. Vehicles are spaced at an average of 440 ft, or 22 car-lengths, at a maximum density of 12 pc/mi/ln. The ability to maneuver within the traffic stream is high. Minor disruptions to flow are easily absorbed at this level without causing significant delays or queuing.

Level-of-service B is also indicative of free flow, although the presence of other vehicles begins to be noticeable. Average travel speeds are somewhat diminished from LOS A, but are still generally over 53 mph on sections with 70-mph design speed. Vehicles are spaced at an average of approximately 264 ft, or 13 car-lengths, at a maximum density of 20 pc/mi/ln. Minor disruptions are still easily absorbed at this level, although local deterioration in LOS will be more obvious.

Level-of-service C represents a range in which the influence of traffic density on operations becomes marked. The ability to maneuver within the traffic stream, and to select an operating speed is now clearly affected by the presence of other vehicles. Average travel speeds are reduced to about 50 mph on 70-mph design speed sections, and the average spacing of vehicles is reduced to approximately 175 ft, or 9 car-lengths, at a maximum density of 30 pc/mi/ln. Minor disruptions may be expected to cause serious local deterioration in service, and queues may form behind any significant traffic disruption. Severe or long-term disruptions may cause the facility to operate at LOS F.

Level-of-service D borders on unstable flow. Speeds and ability to maneuver are severely restricted because of traffic congestion. Average

travel speeds are approximately 40 mph on 70-mph design speed sections, while the average spacing of vehicles is 125 ft, or 6 car-lengths, at a maximum density of 42 pc/mi/ In. Only the most minor of disruptions can be absorbed without the formation of extensive queues and the deterioration of service to LOS F.

Level-of-service E represents operations at or near capacity, and is quite unstable. At capacity, vehicles are spaced at only 80 ft, or 4 car-lengths, at a maximum density of 67 pc/mi/ln. This is the minimum spacing at which uniform flow can be maintained, and effectively defines a traffic stream with no usable gaps. Thus, disruptions cannot be damped or dissipated, and any disruption, no matter how minor, will cause queues to form and service to deteriorate to LOS F. Average travel speeds at capacity are approximately 30 mph.

Level-of-service F represents forced or breakdown flow. It occurs at a point where vehicles arrive either at a rate greater than that at which they are discharged or at a point on a planned facility where forecasted demand exceeds the computed capacity. While operations at such points (and on immediately downstream sections) will appear to be at capacity or better, queues will form behind these breakdowns. Operations within queues are highly unstable, with vehicles experiencing short spurts of movement followed by stoppages. Average travel speeds within queues are generally under 30 mph, with densities higher than 67 pc/mi/ln. Note that the term "LOS F" may be used to characterize both the point of the breakdown and the operating conditions within the queue. It must be remembered, however, that it is the point of breakdown that causes the queue to form, and that operations within the queue are generally not related to defects along the highway segment over which the queue extends.

REFERENCE: Highway Capacity Manual (Special Report 209, 1985)

APPENDIX B

MANUAL TRAFFIC COUNT DATA

APPENDIX B

MANUAL TRAFFIC COUNT DATA

Date: January 17, 1990

Location: Palani Road and Ulua'oa Street

	Palani Road Northbound		Palani Road Southbound		Ulua'oa Street Eastbound	
Time (am)	LT	TH	TH	RT	LT	RT
7:15-7:30	4	57	125	15	11	10
7:30-7:45	4	68	147	36	14	10
7:45-8:00	4	51	173	39	13	23
8:00-8:15	7	59	111	32	16	13
8:15-8:30	4	59	131	33	16	9
8:30-8:45	3	67	83	11	17	6
Peak Hour 7:30-8:30						
Totals	**19**	**237**	**562**	**140**	**59**	**55**

Date: January 16, 1990

Location: Palani Road and Ulua'oa Street

	Palani Road Northbound		Palani Road Southbound		Ulua'oa Street Eastbound	
Time (pm)	LT	TH	TH	RT	LT	RT
4:00-4:15	6	112	102	9	8	6
4:15-4:30	1	115	77	7	8	1
4:30-4:45	7	122	83	10	15	3
4:45-5:00	9	130	73	8	16	2
5:00-5:15	8	118	77	11	18	3
5:15-5:30	8	128	65	17	12	2
Peak Hour 4:30-5:30						
Totals	**32**	**498**	**298**	**46**	**61**	**10**

MANUAL TRAFFIC COUNT DATA

Date: January 17, 1990

Location: Palani Road and Kealakaa Street

	Palani Road Northbound		Palani Road Southbound		Kealakaa Street Eastbound	
Time (am)	LT	TH	TH	RT	LT	RT
7:15-7:30	31	61	133	15	3	83
7:30-7:45	52	67	151	15	4	123
7:45-8:00	41	52	176	22	3	113
8:00-8:15	50	71	107	11	6	83
8:15-8:30	54	39	115	29	17	86
8:30-8:45	21	62	104	2	9	61
Peak Hour 7:30-8:30						
Totals	**197**	**229**	**549**	**77**	**30**	**405**

Date: January 16, 1990

Location: Palani Road and Kealakaa Street

	Palani Road Northbound		Palani Road Southbound		Kealakaa Street Eastbound	
Time (pm)	LT	TH	TH	RT	LT	RT
4:00-4:15	55	118	96	4	9	43
4:15-4:30	50	128	87	0	8	40
4:30-4:45	62	133	73	2	7	42
4:45-5:00	78	143	74	2	7	46
5:00-5:15	85	131	79	2	5	45
5:15-5:30	67	125	67	1	5	40
Peak Hour 4:15-5:15						
Totals	**275**	**535**	**313**	**6**	**27**	**173**

MANUAL TRAFFIC COUNT DATA

Date: January 17, 1990

Location: Queen Kaahumanu Highway and Kealakehe Parkway Road

	Queen Kaahumanu Highway Northbound		Queen Kaahumanu Highway Southbound		Kealakehe Parkway Road Eastbound	
Time (am)	LT	TH	TH	RT	LT	RT
7:30-7:45	26	128	100	9	4	9
7:45-8:00	17	114	139	13	7	12
8:00-8:15	26	101	109	11	6	9
8:15-8:30	26	111	97	15	5	12
8:30-8:45	23	121	107	17	6	17
8:45-9:00	17	106	99	10	8	19
Peak Hour 7:45-8:45						
Totals	**92**	**447**	**452**	**56**	**24**	**50**

Date: January 16, 1990

Location: Queen Kaahumanu Highway and Kealakehe Parkway Road

	Queen Kaahumanu Highway Northbound		Queen Kaahumanu Highway Southbound		Kealakehe Parkway Road Eastbound	
Time (pm)	LT	TH	TH	RT	LT	RT
3:00-3:15	29	114	150	6	10	23
3:15-3:30	24	150	176	9	9	22
3:30-3:45	23	132	186	26	8	22
3:45-4:00	32	117	214	17	9	27
4:00-4:15	21	106	235	23	12	22
4:15-4:30	30	116	165	10	9	27
Peak Hour 3:15-4:15						
Totals	**100**	**505**	**811**	**75**	**38**	**93**

MANUAL TRAFFIC COUNT DATA

Date: January 17, 1990

Location: Queen Kaahumanu Highway and Palani Road

	Queen Kaahumanu Highway						Palani Road					
	Northbound			Southbound			Eastbound			Westbound		
Time (am)	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
7:00-7:15	32	112	26	14	39	31	41	56	31	73	45	20
7:15-7:30	29	122	52	12	33	52	70	98	64	70	48	18
7:30-7:45	33	106	67	15	53	38	92	115	61	52	43	28
7:45-8:00	45	80	37	25	54	77	96	128	42	62	45	26
8:00-8:15	32	90	40	17	60	53	85	144	65	66	50	26
8:15-8:30	23	88	33	20	51	62	53	108	43	65	43	28
Peak Hour	**7:15-8:15**											
Totals	**139**	**398**	**196**	**69**	**200**	**220**	**343**	**485**	**232**	**250**	**186**	**98**

Date: January 16, 1990

Location: Queen Kaahumanu Highway and Palani Road

	Queen Kaahumanu Highway						Palani Road					
	Northbound			Southbound			Eastbound			Westbound		
Time (pm)	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
3:45-4:00	62	86	41	37	118	152	26	78	25	76	86	76
4:00-4:15	48	56	51	44	103	150	46	70	23	82	121	71
4:15-4:30	56	62	41	35	111	123	39	65	22	87	109	92
4:30-4:45	48	50	37	62	103	121	43	69	23	80	130	94
4:45-5:00	37	62	39	45	111	107	50	96	21	77	131	95
Peak Hour	**4:00-5:00**											
Totals	**189**	**230**	**168**	**186**	**428**	**501**	**178**	**300**	**89**	**326**	**491**	**352**

MANUAL TRAFFIC COUNT DATA

Date: May 16, 1990

Location: Mamalahoa Highway and Palani Road

	Mamalahoa Highway Southbound		Palani Road Northbound		Mamalahoa Highway Westbound	
Time (am)	LT	TH	TH	RT	LT	RT
6:30-6:45	10	93	37	7	16	6
6:45-7:00	10	94	48	8	17	7
7:00-7:15	11	120	47	5	11	14
7:15-7:30	14	126	38	16	21	11
7:30-7:45	25	152	47	24	21	8
7:45-8:00	16	136	38	24	39	16
8:00-8:15	5	110	63	8	24	9
8:15-8:30	5	106	58	6	11	9
8:30-8:45	6	78	41	5	13	7
Peak Hour 7:30-8:30						
Totals	**51**	**504**	**206**	**62**	**95**	**42**

Date: May 15, 1990

Location: Mamalahoa Highway and Palani Road

	Mamalahoa Highway Southbound		Palani Road Northbound		Mamalahoa Highway Eastbound	
Time (pm)	LT	TH	TH	RT	LT	RT
3:30-3:45	5	6	55	16	10	6
3:45-4:00	6	10	121	13	13	10
4:00-4:15	9	16	70	13	6	16
4:15-4:30	9	7	144	26	12	7
4:30-4:45	8	8	97	13	10	8
4:45-5:00	13	15	129	18	8	15
5:00-5:15	8	14	110	14	9	14
5:15-5:30	5	13	130	21	5	13
Peak Hour 4:15-5:15						
Totals	**38**	**265**	**480**	**71**	**39**	**44**

AIR QUALITY IMPACTS

AIR QUALITY STUDY
FOR THE PROPOSED
KEALAKEHE PLANNED COMMUNITY PROJECT

KAILUA-KONA, HAWAII

Prepared for:

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July 1990

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CONTENTS

FIGURES

TABLES

TABLES (cont.)

1.0 INTRODUCTION AND PROJECT DESCRIPTION

The State of Hawaii's Housing Finance and Development Corporation (HFDC) is proposing to develop a planned community project at Kealakehe, North Kona on Hawaii Island. As indicated on the project location map presented as Figure 1, the Kealakehe Planned Community Project is located approximately 3 miles north of Kailua-Kona and 4 miles south of Keahole Airport. It encompasses nearly 1000 acres of land on the western slope of Hualalai. Elements of the proposed project include approximately 5,000 housing units (with 60 percent to be sold as affordable units), a civic center, two schools, commercial/retail facilities, roadways, sewers, electric substations, a public golf course and other infrastructure and public facilities. Development of the proposed project will occur over a 20-year period of time with full build-out expected to be completed by about the year 2010.

The purpose of this study is to describe existing air quality in the project area and to assess the potential short-term and long-term direct and indirect air quality impacts that could result from construction and use of the proposed facilities as planned. Another purpose of this study is to examine potential impacts on the project from existing nearby air pollution sources. Measures to mitigate these impacts are suggested where possible and appropriate.

2.0 AMBIENT AIR QUALITY STANDARDS

Ambient concentrations of air pollution are regulated by both national and state ambient air quality standards (AAQS). National AAQS are specified in Section 40, Part 50 of the Code of Federal Regulations (CFR), while State of Hawaii AAQS are defined in

Chapter 11-59 of the Hawaii Administrative Rules. Table 1 summarizes both the national and the state AAQS that are specified in the cited documents. As indicated in the table, AAQS have been established for six air pollutants. These regulated air pollutants include: particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and lead. National AAQS are stated in terms of primary and secondary standards. National primary standards are designed to protect the public health with an "adequate margin of safety". National secondary standards, on the other hand, define levels of air quality necessary to protect the public welfare from "any known or anticipated adverse effects of a pollutant". Secondary public welfare impacts may include such effects as decreased visibility, diminished comfort levels, or other potential injury to the natural or man-made environment, e.g., soiling of materials, damage to vegetation or other economic damage. In contrast to the national AAQS, Hawaii State AAQS are given in terms of a single standard that is designed "to protect public health and welfare and to prevent the significant deterioration of air quality".

Each of the regulated air pollutants has the potential to create or exacerbate some form of adverse health effect or to produce environmental degradation when present in sufficiently high concentration for prolonged periods of time. The AAQS specify a maximum allowable concentration for a given air pollutant for one or more averaging times to prevent harmful effects. Averaging times vary from one hour to one year depending on the pollutant and type of exposure necessary to cause adverse effects. In the case of the short-term (i.e., 1- to 24-hour) AAQS, both national and state standards allow one exceedance per year.

State of Hawaii AAQS are in some cases considerably more stringent than comparable national AAQS. In particular, the State of Hawaii

1-hour AAQS for carbon monoxide is four times more stringent than the comparable national limit.

Under the provisions of the Federal Clean Air Act [1], the U.S. Environmental Protection Agency (EPA) is required to periodically review and re-evaluate national AAQS in light of research findings more recent than those which were available at the time the standards were originally set. Occasionally new standards are created as well. Most recently, the national standard for particulate matter has been revised to include specific limits for particulates 10 microns or less in diameter (PM-10) [2]. The State of Hawaii has not explicitly addressed the question of whether to set limits for this category of air pollutant, but national AAQS prevail where states have not set their own more stringent levels.

Hawaii AAQS for sulfur dioxide were relaxed in 1986 to make them essentially the same as national limits. It has been proposed in various forums that the state also relax its carbon monoxide standards to the national levels, but at present there are no indications that such a change is being considered.

3.0 REGIONAL AND LOCAL CLIMATOLOGY

Regional and local climatology significantly affect the air quality of a given location. Wind, temperature, atmospheric turbulence, mixing height and rainfall all influence air quality. Although the climate of Hawaii is relatively moderate throughout most of the state and most of the year, significant differences in these parameters may occur from one location to another. Most differences in regional and local climates within the state are caused by the mountainous topography.

Kealakehe, the site of the proposed project, is located near the midpoint of the western coast of the island of Hawaii. The topography of this island is dominated by the great volcanic masses of Mauna Loa (13,653 feet), Mauna Kea (13,796 feet), and of Hualalai, the Kohala Mountains and Kilauea. The island consists entirely of the slopes of these mountains and of the broad saddles between them. Mauna Loa and Kilauea, located on the southern half of the island, are still active volcanoes. The site of the proposed project occupies a portion of the lower slope of Hualalai extending from about the 50-foot level up to an elevation of about 750 feet.

Hawaii lies well within the belt of northeasterly trade winds generated by the semi-permanent Pacific high pressure cell to the north and east. Nearly the entire western coast of the island of Hawaii, however, is sheltered from the trade winds by high mountains, except when unusually strong trade winds sweep through the saddle between the Kohala Mountains and Mauna Kea and reach the areas to the lee. Due to wind shadow effects caused by the terrain, winds in the Kealakehe area are predominantly light and variable. Local winds such as land/sea breezes and/or upslope/ downslope winds tend to dominate the wind pattern for the area. During the daytime, winds typically move onshore because of seabreeze and/or upslope effects. At night, winds generally are land breezes and/or drainage winds which move downslope and out to sea. Calms occur about 29 percent of the time at nearby Keahole Point.

Air pollution emissions from motor vehicles, the formation of photochemical smog and smoke plume rise all depend in part on air

temperature. Colder temperatures tend to result in higher emissions of contaminants from automobiles but lower concentrations of photochemical smog and ground-level concentrations of air pollution from elevated plumes. In Hawaii, the annual and daily variation of temperature depends to a large degree on elevation above sea level, distance inland and exposure to the trade winds. Average temperatures at locations near sea level generally are warmer than those at higher elevations. Areas exposed to the trade winds tend to have the least temperature variation, while inland and leeward areas often have the most. The project site's leeward location results in a larger temperature profile compared to windward locations at the same elevation. At the Old Kona Airport located about 2 miles to the south, average daily minimum and maximum temperatures are 67°F and 83°F, respectively. The extreme minimum temperature on record at this location is 47°F, and the extreme maximum is 93°F. Temperatures at the project site are probably about 1 to 3 degrees F cooler on average compared to the airport and show a slightly larger diurnal variation due to the somewhat elevated and inland location.

Small scale, random motions in the atmosphere (turbulence) cause air pollutants to be dispersed as a function of distance or time from the point of emission. Turbulence is caused by both mechanical and thermal forces in the atmosphere. It is oftentimes measured and described in terms of Pasquill-Gifford stability class. Stability class 1 is the most turbulent and class 6 the least. Thus, air pollution dissipates the best during stability class 1 conditions and the worst when stability class 6 prevails. In suburban, coastal areas like Kealakehe, stability class 5 or 6 is generally the highest stability class that occurs, developing during clear, calm nighttime or early morning conditions. Stability classes 1 through 4 occur during the daytime, depending

mainly on the amount of cloud cover and incoming solar radiation and the onset and extent of the sea breeze.

Mixing height is defined as the height above the surface through which relatively vigorous vertical mixing occurs. Low mixing heights can result in high ground-level air pollution concentrations because contaminants emitted from or near the surface can become trapped within the mixing layer. In Hawaii, minimum mixing heights tend to be high because of mechanical mixing caused by the trade winds and because of the temperature moderating effect of the surrounding ocean. Low mixing heights may sometimes occur, however, at inland locations and even at times along coastal areas early in the morning following a clear, cool, windless night. Coastal areas may also experience low mixing levels during sea breeze conditions when cooler ocean air rushes in over warmer land. Although there is no mixing height data for the Kealakehe area, mixing heights elsewhere in the state typically are above 3000 feet (1000 meters). Mixing heights in the Kealakehe area probably tend to be somewhat lower due to the fact that light winds often prevail and also because sea breeze conditions often develop during the daytime.

Rainfall can have a beneficial effect on the air quality of an area in that it helps to suppress fugitive dust emissions, and it may also "washout" gaseous contaminants that are water soluble. Rainfall in Hawaii is highly variable depending on elevation and on location with respect to the trade wind. The Kealakehe area being a leeward location experiences a relatively dry climate. Some of the rainfall occurs in conjunction with winter storms, and some occurs during summer afternoons and evenings as a result of the onshore and upslope movement of moisture laden marine air. At the Old Kona Airport, average annual rainfall amounts to about 24

inches but may vary significantly from one year to the next. Average annual rainfall at the project site is estimated to amount to about 25 to 30 inches depending on elevation.

4.0 PRESENT AIR QUALITY

Present air quality in the project area is mostly affected by air pollutants from natural, industrial, agricultural and/or vehicular sources. Natural sources of air pollution emissions which may affect the project area but cannot be quantified very accurately include the ocean (sea spray), plants (aero-allergens), wind-blown dust, and volcanoes. Of these natural sources of air pollution, volcanoes are the most significant. Volcanic emissions periodically plague the project area. This is especially so since the latest eruption phase of the Kilauea Volcano began in 1983. Air pollution emissions from the Hawaiian volcanoes consist primarily of sulfur dioxide. After entering the atmosphere, these sulfur dioxide emissions are carried away by the wind and either washed out as acid rain or gradually transformed into particulate sulfates. Although emissions from Kilauea are vented on the other side of a mountain barrier more than 50 miles east of the project site, the prevailing wind patterns eventually carry the emissions into the Kona area. These emissions can be seen in the form of the volcanic haze (vog) which persistently hangs over the area. The American Lung Association is currently studying the character and concentrations of volcanic air pollution in the Kona area, but to date no results of the study are available.

The major industrial sources in the project vicinity include the Keahole Power Plant, operated by Hawaii Electric Light Company, and the Kailua Landfill, operated by the County of Hawaii. Air pollution emissions from Keahole Power Plant consist mostly of

sulfur dioxide and oxides of nitrogen. Emissions from the county landfill consist mainly of fugitive dust from heavy equipment operations and noxious fumes from underground fires, the latter of which has been the subject of numerous complaints from people residing and working nearby. Potential impacts on the proposed project from emissions emanating from the landfill are discussed in more detail later in this report.

Queen Kaahumanu Highway, which forms the west boundary of the project site, is the region's major arterial roadway. Some contamination from emissions exhausted by motor vehicles traversing Queen Kaahumanu Highway and other roadways nearby presently occurs, although elevated concentrations are likely confined to limited areas near intersections where and when traffic congestion occurs during poor dispersion conditions.

The State Department of Health operates a network of air quality monitoring stations at various locations around the state. Unfortunately, very little data are available for Hawaii Island, and even less are available for the Kona area specifically. As indicated in Table 2, the only existing monitoring data in the vicinity of the project site consist of sulfur dioxide and particulate measurements that were made about 12 miles to the south at Kealakekua during 1985 and 1986. During the two-year period, measurements of 24-hour average sulfur dioxide concentration at this location were consistently low with daily mean values ranging from less than 5 $\mu g/m^3$ up to 12 $\mu g/m^3$. No exceedances of the state/national 24-hour AAQS for sulfur dioxide were recorded. Twenty-four hour average particulate concentrations ranged from 4 to 28 $\mu g/m^3$; no violations of the state AAQS were measured during the 1985-86 monitoring period.

At this time, there are no reported measurements of lead, ozone, nitrogen dioxide or carbon monoxide in the project vicinity. These are primarily motor vehicle related air pollutants. Lead, ozone and nitrogen dioxide typically are regional scale problems; concentrations of these contaminants generally have not been found to exceed AAQS elsewhere in the state. Carbon monoxide air pollution, on the other hand, typically is a microscale problem caused by congested motor vehicular traffic. In traffic congested areas such as urban Honolulu, carbon monoxide concentrations have been found to occasionally exceed the state AAQS. Present concentrations of carbon monoxide in the project area are estimated later in this study based on mathematical modeling of motor vehicle emissions.

5.0 SHORT-TERM IMPACTS OF PROJECT

Short-term direct and indirect impacts on air quality could potentially occur due to project construction. For a project of this nature, there are two potential types of air pollution emissions which could directly result in short-term air quality impacts during the construction phases: (1) fugitive dust from vehicle movement and site excavation; and (2) exhaust emissions from on-site construction equipment. Indirectly, there could also be short-term impacts from slow-moving construction equipment traveling to and from the project site and from a temporary increase in local traffic caused by commuting construction workers.

Fugitive dust emissions may arise from the grading and dirt/rock-moving activities associated with site preparation once the area is cleared. The emission rate for fugitive dust emissions from construction activities is difficult to estimate accurately because

of its elusive nature and because the potential for its generation varies greatly depending upon the type of soil at the construction site, the amount and type of earth-disturbing activity taking place, the moisture content of exposed soil in work areas, and the wind speed. The EPA [3] has provided a rough estimate for uncontrolled fugitive dust emissions from construction activity of 1.2 tons per acre per month under conditions of "medium" activity, moderate soil silt content (30%), and precipitation/evaporation (P/E) index of 50. Uncontrolled fugitive dust emissions from project construction would probably be somewhere near this level or possibly lower due to the rocky nature of the soil in the area. In any case, State of Hawaii Air Pollution Control Regulations [4] stipulate that emissions of fugitive dust from construction activities cannot be visible beyond the property line. Thus, an effective dust control plan for the project construction phase is essential.

Adequate fugitive dust control can usually be accomplished by the establishment of a frequent watering program to keep bare-earth surfaces in work areas from becoming significant dust generators. In some cases, other control measures such as limiting the area that can be disturbed at any given time and/or using wind screens may be necessary. Control regulations also require that open-bodied trucks be covered at all times when in motion if they are transporting materials likely to give rise to airborne dust. Paving of parking areas and/or establishment of landscaping as early in the construction process as possible can also lower the potential for fugitive dust emissions.

On-site mobile and stationary construction equipment will also emit some air pollutants in the form of engine exhausts. The largest of this equipment is usually diesel-powered. Nitrogen oxides

emissions from diesel engines can be relatively high compared to gasoline-powered equipment, but the standard for nitrogen dioxide is set on an annual basis and is not likely to be violated by short-term construction equipment emissions. Carbon monoxide emissions from diesel engines, on the other hand, are low and should be relatively insignificant compared to vehicular emissions on nearby roadways.

Indirectly, slow-moving construction vehicles on roadways leading to and from the project site could obstruct the normal flow of traffic to such an extent that overall vehicular emissions are increased, but this impact can be mitigated by moving heavy construction equipment during periods of low traffic volume. Likewise, the schedules of commuting construction workers can be adjusted to avoid peak hours in the project vicinity. Thus, most potential short-term air quality impacts from project construction can be mitigated.

6.0 LONG-TERM IMPACTS OF PROJECT

6.1 Roadway Traffic

By serving as an attraction for increased motor vehicle traffic on nearby roadways, the proposed project is considered to be an indirect air pollution source. Motor vehicles with gasoline-powered engines are significant sources of carbon monoxide. They also emit nitrogen oxides, and those burning leaded gasoline contribute lead to the atmosphere. The use of leaded gasoline in new automobiles is now prohibited. As older vehicles continue to disappear from the numbers of those currently operating on the state's roadways, lead emissions are approaching zero. Nationally, so few vehicles now require leaded gasoline that the EPA is

proposing a total ban on leaded gasoline to take effect immediately. Even without such a ban, reported quarterly averages of lead in air samples collected in urban Honolulu have been near zero since early 1986. Thus, lead in the atmosphere is not considered to be a problem anywhere in the state.

Federal air pollution control regulations also call for increased efficiency in removing carbon monoxide and nitrogen oxides from the exhausts of new motor vehicles. By the year 1995 carbon monoxide emissions are expected to be about 30 percent less than the amounts now emitted due to the replacement of older vehicles with newer models. Further reductions in vehicular emissions have recently been proposed by the President for areas of the country which do not currently meet AAQS, mainly through the use of alternative fuels.

6.1.1 Ambient Air Quality

To evaluate the potential long-term, indirect ambient air quality impact of increased roadway traffic associated with a project such as this, computerized emission and atmospheric dispersion models can be used to estimate ambient carbon monoxide concentrations along roadways leading to and from the project. Carbon monoxide is selected for modeling because it is both the most stable and the most abundant of the pollutants generated by motor vehicles. Furthermore, carbon monoxide air pollution is generally considered to be a microscale problem, whereas nitrogen oxides air pollution most often is a regional issue that a single development has little control over. This is reflected in the fact that the AAQS for carbon monoxide are specified on a short-term basis (1-hour and 8-hour averaging times) while the AAQS for nitrogen dioxide is set on an annual basis.

For this project, three scenarios were selected for the carbon monoxide modeling study: year 1990 with present conditions, year 2010 without the project, and year 2010 assuming the project is built and complete. To begin the modeling study, critical receptor areas in the vicinity of the project site were identified for analysis. Generally speaking, roadway intersections are the primary concern because of traffic congestion and because of the increase in vehicular emissions associated with traffic cycling: decelerating, stopping, queuing and accelerating. For this study, the four key intersections identified in the traffic study [5] were also selected for air quality analysis. These include: Queen Kaahumanu Highway at Kealakehe Parkway, Queen Kaahumanu Highway at Palani Road, Mamalahoa Highway at Kealakehe Parkway, and Mamalahoa Highway at Palani Road. Modeling of the present scenario was performed assuming the existing roadway configurations (including the assumption that there is presently through traffic only at the location of the future intersection of Kealakehe Parkway and Mamalahoa Highway). Briefly, for the future air quality modeling scenarios, the following roadway configurations were assumed based on the project traffic study:

- With or without the project in the year 2010, Queen Kaahumanu Highway will be elevated and uninterrupted at Kealakehe Parkway, and Kealakehe Parkway will be connected to a frontage road system and signalized.

- With or without the project in the year 2010, Queen Kaahumanu Highway will be elevated and uninterrupted at Palani Road where a diamond-shaped interchange will provide on/off access. Palani Road will have four through lanes, exclusive turn lanes and signals at on/off ramps.

- With the project in the year 2010, Mamalahoa Highway at Kealakehe Parkway will form a T-intersection that is signalized. Mamalahoa Highway will be four lanes wide and have left and right turn lanes. Kealakehe Parkway will also be four lanes wide and have two left and one right turn lanes. Without the project, Mamalahoa Highway will be four lanes wide at this location with no intersection.

- With or without the project in the year 2010, Mamalahoa Highway at Palani Road will each be widened to four lanes and be signalized and fully channelized; Mamalahoa Highway will also have a left turn storage lane.

The traffic impact assessment report for the project referenced above describes the present and future conditions and configurations of these intersections in more detail.

The main objectives of the modeling study were to estimate both current and projected levels of worst-case 1-hour average carbon monoxide concentrations which could then be directly compared to the national and state AAQS. The traffic impact assessment report indicates that traffic volumes generally are or will be higher during the afternoon peak hour than during the morning peak period. Worst-case emission and meteorological dispersion conditions typically occur during the morning hours at many locations. However, due to possible effects from the queuing of vehicles at intersections, both morning and afternoon peak traffic hours were examined to ensure that worst-case concentrations were identified.

The EPA computer model MOBILE4 [6] was used to calculate vehicular carbon monoxide emissions for each of the years studied. One of the key inputs to MOBILE4 is vehicle mix. Based on recent vehicle

registration figures, the present and projected vehicle mix in the project area is estimated to be 91.9% light-duty gasoline-powered vehicles, 5% light-duty gasoline-powered trucks and vans, 0.5% heavy-duty gasoline-powered vehicles, 0.6% light-duty diesel-powered vehicles, 1% heavy-duty diesel-powered trucks and buses, and 1% motorcycles.

Other key inputs to the MOBILE4 emission model are the cold/hot start fractions. Motor vehicles operating in a cold- or hot-start mode emit excess air pollution. Typically, motor vehicles reach stabilized operating temperatures after about 4 miles of driving. For traffic operating within the immediate project area, it was assumed that during both the morning and the afternoon peak traffic hours about 25 percent of all vehicles would be operating in the cold-start mode and that about 5 percent would be operating in the hot-start mode. These operational mode values were estimated based on a report from the California Department of Transportation [7] and taking into consideration the likely origins of traffic in the project area. MOBILE4 idle emissions were adjusted to account for excess cold/hot-start emissions per a recent U.S. EPA memorandum [8].

Ambient temperatures of 59 and 68 degrees F were used for morning and afternoon peak-hour emission computations, respectively. These are conservative assumptions since morning/afternoon ambient temperatures will generally be warmer than this and emission estimates given by MOBILE4 are inversely proportional to the ambient temperature.

After computing vehicular carbon monoxide emissions through the use of MOBILE4, these data were then input to the latest version

of the computer model CALINE4 [9]. CALINE4 was developed by the California Transportation Department to simulate vehicular movement and atmospheric dispersion of vehicular emissions. It is designed to predict 1-hour average pollutant concentrations along roadways based on input traffic and emission data, roadway/receptor geometry and meteorological conditions.

Input peak-hour traffic data were obtained from the traffic study cited previously. The traffic volumes given in the traffic study for the future scenario include project traffic as well as traffic from other growth that is expected to occur in the area by the year 2010. Traffic queuing estimates were made based on the project traffic study, Transportation Research Board procedures [10], U.S. EPA guidelines [11], and traffic observations at the subject intersections.

Model roadways were set up to reflect actual roadway geometry, physical dimensions and operating characteristics. Model receptor sites were located within a few meters from the edge of the roadways near the intersections studied assuming sidewalks are or will be present. All receptor heights were placed at 1.5 meters above ground to simulate levels within the normal human breathing zone.

Input meteorological conditions for this study were defined to provide "worst-case" results. One of the key meteorological inputs is atmospheric stability category. For these analyses, atmospheric stability category 6 was assumed for morning scenarios and stability category 4 was assumed for afternoon cases. These are the most conservative stability categories that can be used for estimating pollutant dispersion at suburban or undeveloped

locations. A surface roughness length of 150 cm was assumed with a mixing height of 300 meters. Worst-case wind conditions were defined as a wind speed of 1 meter per second with a wind direction resulting in the highest predicted concentration.

Existing background concentrations of carbon monoxide in the project vicinity are believed to be at relatively low levels. Hence, background contributions of carbon monoxide from sources or distant roadways not directly considered in the analysis were accounted for by adding a background concentration of 0.1 ppm to all predicted concentrations for the 1990 scenarios. Due to the expected significant development that is predicted to occur in the Kona area within the next several years, a background value of 0.5 ppm was used for all 2010 scenarios.

Table 3 summarizes the final results of the modeling study in the form of the estimated worst-case 1-hour morning and afternoon ambient carbon monoxide concentrations. These results can be compared directly to the state and the national AAQS. Estimated worst-case carbon monoxide concentrations are presented in the table for three scenarios: year 1990 with existing traffic, year 2010 without project traffic and year 2010 with project traffic. The locations of these estimated worst-case 1-hour concentrations all occurred at or very near the indicated roadway intersections.

All morning peak hour concentrations estimated for the existing case were higher than the afternoon peak values except at the Queen Kaahumanu Highway/Kealakehe Parkway intersection. As indicated in the table, the estimated present (1990) worst-case 1-hour carbon monoxide concentration in the project area, 21.0 mg/m^3, occurred during the morning peak hour near the intersection of Queen

Kaahumanu Highway and Palani Road. This is one of the busiest intersections in the Kona area at the present time. Worst-case 1-hour values at the other locations in the project vicinity that were studied were less than 5 mg/m^3.

In the year 2010 without the proposed project, worst-case concentrations are predicted to be much reduced even with the increase in traffic that is predicted. A worst-case 1-hour concentration of 11.6 mg/m^3 was estimated to occur during the morning peak traffic hour near the Palani Road interchange at Queen Kaahumanu Highway, the same location and time as the highest concentration for the existing case. Values at the other locations studied for this scenario ranged between about 2 and 5 mg/m^3 during the morning peak hour. Afternoon peak-hour concentrations were about 10 to 15 percent lower than the morning worst-case values.

Predicted 1-hour worst-case concentrations for the 2010 with project scenario range from 3.6 mg/m^3 during the afternoon at Mamalahoa Highway and Palani Road to 13.0 mg/m^3 during the morning at Queen Kaahumanu Highway and Palani Road. Compared to the without project case, predicted concentrations are substantially higher near the Queen Kaahumanu Highway/Kealakehe Parkway and the Mamalahoa Highway/Kealakehe Parkway intersections due to the increased volumes of traffic the project will generate at these locations. Worst-case concentrations along Palani Road at Queen Kaahumanu Highway and at Mamalahoa Highway are predicted to be about the same or slightly lower than the without project scenario.

All estimated worst-case 1-hour carbon monoxide levels for all scenarios are within the national AAQS of 40 mg/m^3. It appears likely, however, that existing concentrations of carbon monoxide

CORRECTION

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All estimated worst-case 1-hour carbon monoxide levels for all scenarios are within the national AAQS of 40 mg/m^3. It appears likely, however, that existing concentrations of carbon monoxide

as well as future concentrations either without or with the project may exceed the State of Hawaii 1-hour AAQS of 10 mg/m^3 on occasion in the vicinity of Queen Kaahumanu Highway and Palani Road. In the future with project case, the state 1-hour standard may also occasionally be exceeded near the intersection of Queen Kaahumanu Highway frontage roads and Kealakehe Parkway.

Worst-case 8-hour carbon monoxide concentrations were estimated by multiplying the worst-case 1-hour values by a persistence factor of 0.5. This accounts for two factors: (1) traffic volumes averaged over eight hours are lower than peak 1-hour values, and (2) meteorological dispersion conditions are more variable (and hence more favorable) over an 8-hour period than they are for a single hour. Based on monitoring data, 1-hour to 8-hour persistence factors for most locations generally vary from 0.4 to 0.8 with 0.6 being the most typical. One recent study based on modeling [12] concluded that 1-hour to 8-hour persistence factors could typically be expected to range from 0.4 to 0.5. EPA guidelines [11] recommend using a value of 0.6 to 0.7 unless a locally derived persistence factor is available. Recent monitoring data for Honolulu reported by the Department of Health [13] suggests that this factor may range between about 0.35 and 0.55 depending on location and traffic variability. Considering the location of the project and the traffic pattern for the area, a 1-hour to 8-hour persistence factor of 0.5 is probably most appropriate for this application.

The resulting estimated worst-case 8-hour concentrations are indicated in Table 4. For the 1990 scenario, the estimated worst-case 8-hour carbon monoxide concentration was 10.5 mg/m^3 at the intersection of Queen Kaahumanu Highway and Palani Road. Other locations ranged from 0.8 mg/m^3 near Mamalahoa Highway at the

future Kealakehe Parkway intersection to 2.2 mg/m^3 near Queen Kaahumanu Highway at Kealakehe Parkway. The predicted maximum values for the year 2010 without and with project scenarios were 5.8 and 6.5 mg/m^3, respectively; both occurred at the Queen Kaahumanu Highway/Palani Road interchange. Other locations were in the 1 to 3 mg/m^3 range without the project and the 2 to 6 mg/m^3 with the project. Either with or without the project, the highest 8-hour concentrations in the year 2010 should be much lower than existing concentrations. Comparing the predicted values for the existing case to the AAQS, it appears that the state 8-hour standard may be exceeded in the vicinity of Queen Kaahumanu Highway and Palani Road and that the national 8-hour standard also could be exceeded once in a awhile near this intersection. Without or with the project in the year 2010, the state 8-hour AAQS may continue to be exceeded on occasion.

The results of this study reflect several assumptions that must be made concerning traffic movement and worst-case meteorological conditions. One such assumption concerning worst-case meteorological conditions is that a wind speed of 1 meter per second with a steady direction for 1 hour will occur. A steady wind of 1 meter per second blowing from a single direction for an hour is not very likely, and it may occur only once a year or less. With wind speeds of 2 meters per second, for example, computed carbon monoxide concentrations would be only about half the values given above.

6.1.2 Endangered Trees

Air pollution from automobiles can potentially damage vegetation if sufficiently high concentrations occur. This is of particular concern in the development of this project since a botanical survey

of the project site has revealed the existence of 19 trees that are currently on the federal list of endangered species. All of these trees are of the species Caesalpinia kavaiensis, locally called uhiuhi. As described in the project botanical report [14], the uhiuhi is a large shrub to medium-sized tree (up to 30 feet tall) with thick, rough, dark gray bark and dark blackish-brown heartwood. The leaves are subdivided into pale green leaflets, and the flowers occur at branch tips and are pinkish-purple to brick red. In the olden days when the trees were more abundant, the Hawaiians used the strong, dark, heavy wood for spears and fishing implements. Populations of the uhiuhi have been reduced greatly today with only a few plants known to exist around the state. Much of the decline was probably due to cattle and goat grazing and to the spread of fountain grass which inhibits regeneration and increases the chances of wildfire.

The 19 uhiuhi plants located on the Kealakehe project site occur mostly between 500 and 550 feet elevation, within the proposed residential area above the location where the high school will be located and below the existing Kealakehe House Lots. A few plants were also identified at about the 400-foot elevation near the location of the proposed church/day-care center and between 150 and 200 feet near or within the proposed golf course. The plants vary in height from about 8 to 25 feet.

Vegetation reacts with air pollution over a wide range of pollutant concentrations and environmental conditions. The ability of vegetation to withstand exposure to air pollutants depends on many factors including plant species, age, nutrient balance, soil conditions, temperature, humidity, and sunlight. Air pollutants may enter plant systems by either a primary or a secondary pathway. The primary pathway involves the diffusion of gases directly into

and out of plant leaves. Direct deposition of particulate matter may also occur on the outer surfaces of the leaves. The indirect pathway by which air pollutants interact with plants is through the root system. The deposition of air pollutants on soils and surface waters can cause alteration of the nutrient content of the soil in the vicinity of the plant, and thus change the soil condition causing secondary effects.

The effects of air pollution on plants range from subtle to catastrophic, depending on the pollutant, concentration level and duration of exposure. Visible symptoms include deviations from normal healthy appearance of the leaves, early leaf drop, and misshapen leaf structure. Subtle effects of air pollution involve reduced plant growth and alteration of physiological and biochemical processes, as well as changes in the reproductive cycle. The major air pollutants which are phytotoxic to plants are sulfur dioxide, nitrogen dioxide and ozone. Table 5 shows the levels of these air pollutants for short-term exposures that are estimated to cause about 5 percent injury to plants growing under sensitive conditions.

Sulfur dioxide emissions from motor vehicles are relatively insignificant, and ozone is not emitted directly. Nitrogen oxides are emitted mainly in the form of nitric oxide which may subsequently transform into the more corrosive species nitrogen dioxide after emission into the atmosphere. In clean atmospheres this transformation is slow, but in a polluted urban environment the conversion can be very rapid, especially during the daytime.

Present project plans call for the establishment of a 5-acre preservation area surrounding the cluster of eight uhiuhi trees

that exist near the proposed intersection of Kealakehe Street and the new project entrance road connecting with Palani Road. The botanist's report also recommends that small one-half acre plots be established around each of the remaining eleven plants outside the 5-acre preserve. Uhiuhi trees within the preserve area will have a buffer distance of about 150 feet to the nearest roadway. Most of the remaining plants will have larger buffer distances to the nearest roadways except for two trees along the proposed extension of Kealakehe Parkway. One of these two trees will be located about 75 feet from Kealakehe Parkway and the other within about 20 feet.

Potential air pollution impacts on the uhiuhi trees resulting from nitrogen oxides emissions associated with project motor vehicle traffic were estimated using the MOBILE4 emission model and the CALINE4 dispersion model. Both of these models were described and referenced in the previous section of this report in connection with the assessment of carbon monoxide impacts on air quality. The results of the nitrogen oxides modeling analysis show that the worst-case 1-hour nitrogen dioxide concentration impacting any of the uhiuhi trees as a result of emissions from project traffic should be less than 0.2 ppm (400 $\mu g/m^3$). As shown in Table 5, even sensitive species of plants can tolerate 1-hour exposures to nitrogen dioxide of up to 3 ppm (5700 $\mu g/m^3$) or more without significant injury. Both shorter and longer term exposures from project emissions can also be expected to be well below the injury thresholds indicated in the table. Thus, any injury to the uhiuhi plants located on the project site from project-related air pollution should be nil.

6.2 Electrical Demand

The proposed project would also cause indirect emissions from power generating facilities as a consequence of electrical power usage. Peak project power demand at full build-out is not expected to exceed 8.3 megawatts. Present generating capacity on the Big Island is 161 megawatts with most of this power provided by oil-burning generating units. Average annual electrical demand of the project when fully developed is not expected to exceed about 50 million kilowatt-hours (assuming 600 kilowatt-hours per month per housing unit plus an additional one million kilowatt-hours per month usage by the schools, church, daycare center, civic center and commercial facilities). This power demand will most probably be provided mainly by oil-fired turbine generating facilities located on the island. In order to meet the electrical power needs of the proposed project, power generating facilities will be required to burn more fuel, and hence more air pollution will be emitted at these facilities. Given in Table 6 are estimates of the indirect air pollution emissions that will result from the project electrical demand assuming all power is provided by burning more fuel oil at Hawaii's oil-fired power plants. Based on the ratio of peak project power demand to total present generating capacity on Hawaii, the project power demand will result in about a 5 percent increase in emissions from the electric utility if all project power is derived from fuel oil.

6.3 Solid Waste Disposal

Solid waste generated by the project when fully completed is expected to amount to less than 42 tons of refuse (about 7 truckloads) per day. Most if not all of this refuse will likely be hauled away and either landfilled or burned at another location. If all refuse is landfilled, the only air pollution emissions

associated with solid waste disposal (assuming problems similar to those which currently exist at the Kailua Landfill are avoided) will be due to exhaust fumes and fugitive dust from trucks and heavy equipment used to place the refuse in the landfill. If, on the other hand, all or part of the refuse is burned at a municipal incinerator, disposal of solid waste from the project will also result in emissions of particulate, carbon monoxide and other contaminants from the incineration facility. Table 7 gives emission factors for municipal refuse incinerators (without controls) in terms of pounds of air pollution per ton of refuse material charged. Thus, uncontrolled air pollutant emission rates in terms of pounds per year, for example, can be estimated by multiplying the emission factors given in the table by the number of tons per year of refuse that is burned. Use of emission filtration equipment will substantially reduce emissions of particulate.

7.0 IMPACTS OF KAILUA LANDFILL EMISSIONS ON PROJECT

In addition to assessing the impact of the project on the surrounding areas, the reverse problem of impacts of air pollution sources located in the surrounding area on the residents of the project is also of concern. For the Kealakehe Planned Community Project, the primary issue is the presence of the Kailua Landfill located adjacent to the project. Insofar as air quality is concerned, smoke and noxious fumes emanating from fires both above ground and underground present the greatest problem. For many years now, wastes have been transported to the landfill site and buried. As the waste within the landfill decomposes, landfill gas (LFG) is generated. LFG is typically comprised largely of methane, carbon dioxide, nitrogen and oxygen with a small fraction consisting of volatile organic compounds (VOC) and hydrogen sulfide. Spontaneous combustion may occur when the heat buildup from underground

bacterial activity ignites the LFG. Hot, humid conditions and the porous volcanic strata of landfills on Hawaii enhance composting conditions and hence the probability of spontaneous combustion. Presently, the County of Hawaii plans to close the Kailua Landfill by August 1991, which is before construction of the proposed project's first increment. The threat of surface fires, such as that which occurred in early May 1990 and caused the evacuation of nearby public facilities, will presumably be eliminated when the landfill is properly closed. Subsurface fires, however, could continue to occur even after the landfill is closed due to the spontaneous combustion of buried wastes.

For the past several years, nearby residents and workers have complained to county and to state Department of Health officials about noxious emissions from the landfill. The most persistent complaints have come from the police who work at the Kealakehe police station located adjacent to the landfill. On numerous occasions, the police have complained about odor, and several officers have complained of headaches, eye irritation and respiratory problems. The problem at the police station is generally the greatest during the night when offshore winds carry the fumes in this direction. There have also been complaints from Kealakehe School and from the residents of the Kealakehe neighborhood located upslope from the landfill. These areas are primarily affected during the daytime when onshore winds prevail.

At the request of the State Department of Health, a team of investigators from the EPA was dispatched to the Kailua Landfill during December of 1987. During a three-day period, samples of smoke emanating from the landfill were collected and analyzed. Although a final report of the study still has not been received by the local authorities, the draft report [15] concluded that

fumes from the facility may be a public nuisance but they do not pose a threat to public health. The draft report goes on to say, however, that "...since hazardous substances such as batteries, household chemical products (paints and pesticides) and other unknowns may be buried within the landfill, there is a potential for future hazardous releases if the burning continues unmitigated. Contaminants and concentrations will fluctuate, depending on the type of debris burning at that particular time."

The EPA study reported that the only contaminants consistently identified were toluene and benzene, which are common VOCs associated with decomposing municipal wastes. Other organic compounds commonly found in LFG samples include xylene, ethylbenzene and methylene chloride. Although there are no specific ambient air pollution standards pertaining to these substances, Threshold Limit Values (TLVs) set by the American Conference of Governmental Industrial Hygienists (ACGIH) for industrial workplaces are often used as guidelines [16]. The ACGIH TLVs generally are stated both in terms of a short-term exposure limit (TLV-STEL) and a time-weighted average (TLV-TWA). The TLV-STEL pertains to maximum allowable 15-minute average concentration, while the TLV-TWA specifies maximum allowable average concentrations for an 8-hour period (40 hours per week).

In lieu of national standards from the U.S. EPA, state and local governments are faced with the task of regulating ambient concentrations of air toxics. Although use of the TLVs directly in assessing potential impacts on public health is specifically discouraged by the ACGIH, at the present time more than 20 state and local governments use the TLVs either directly or indirectly as a basis for setting community standards in the absence of any better practical method [17]. The State of Hawaii so far has not

issued guidelines pertaining to allowable community air toxic concentrations. Until such guidelines are issued, community air toxic guidelines established by the Texas Air Control Board (TACB) may at least serve as a point of reference. TACB has developed both "acute" and "chronic" community air toxic guidelines based on the ACGIH TLVs. The TACB guideline for acute exposure is based on 1 percent of the TLV-STEL and pertains to a 30-minute averaging period, whereas the guideline for chronic exposure is derived as 0.1 percent of the TLV-TWA and applies to annual average exposure. Thus, community air pollution standards are usually set much lower than the ACGIH TLVs. This is because TLVs are designed to protect only healthy adults who work 40 hours per week. Community air toxic standards, on the other hand, must also safeguard children and other sensitive subpopulations and guard against continuous exposures. Compared to other states that have regulations controlling community air toxic concentrations, the TACB guidelines are in some cases more stringent and in others more permissive.

Table 8 shows the ACGIH TLVs and the TACB Community Air Toxic Guidelines for several of the substances that are known to be present in the LFG at Kailua Landfill. The EPA study found concentrations of benzene of about 12 to 25 mg/m^3 in the fumes at the point where they emerged from underground. This is based on only very limited sampling. More extensive data pertaining to benzene concentrations in LFG at mainland locations indicates that concentrations could range higher [18][19][20]. Based on the EPA testing, benzene concentrations as they emanate from the ground at the Kailua Landfill appear to be below the TLV-TWA of 30 mg/m^3 and thus should not threaten the health of landfill workers if this is so. Concentrations at offsite locations in the surrounding area will be diluted and dispersed by the wind by the time the emissions arrive at these locations. Based on screening-level dispersion calculations for worst-case conditions and the concentrations at

the landfill vents reported by EPA, it is estimated that offsite benzene concentrations should meet the TACB chronic exposure criteria.

Toluene in the fumes from smoldering vents was found to be present at a concentration of 68 mg/m^3. Again, this is based on only very limited sampling, and concentrations could range much higher. Nevertheless, the concentration reported at the Kailua Landfill is well below both the TLV-TWA and the TLV-STEL, and it is likely that even higher ranging concentrations will not exceed the ACGIH limits. The TACB guidelines for toluene could probably be achieved with a buffer distance of about 100 m (330 feet) or less.

Detectable concentrations of n-butyl mercaptan, hexane and ethyl benzene were also reported in the EPA study. Specific concentrations could not be determined with the available equipment, but it was estimated that n-butyl mercaptan and hexane concentrations were approximately in the 15 to 60 mg/m^3 range. At concentrations in this range, hexane emissions would not exceed either the TLV-TWA or the TACB Community Guidelines, but n-butyl mercaptan concentrations could potentially exceed the TLV-TWA at the landfill and also would likely exceed the TACB Community Guidelines for a distance of about 400 m (1300 ft). Since the EPA study is not very specific concerning the concentration at the source, it may be prudent to make further measurements before any definite conclusions are made or course of action is undertaken.

Aside from being a potential threat to the health of residents of the proposed project and other nearby areas, smoke and fumes from underground fires have created a nuisance odor problem for residents and workers in the Kealakehe area, particularly at the

local police station. The specific contaminant or contaminants causing the problem has not been identified. However, in addition to being toxic substances when present in sufficiently high concentrations, both benzene and toluene, which are known to be emitted at the landfill, are aromatic gases that have an odor threshold below the TLV-TWA. The odor thresholds for benzene and toluene in the general population are usually taken to be about 14 and 7.5 mg/m^3, respectively [21]. Sensitive individuals, however, may smell these substances at lower concentrations. The concentrations of benzene and toluene EPA measured at the landfill vents are above the odor thresholds, but dilution and dispersion of these constituents of the LFG should render them undetectable except perhaps immediately adjacent to the landfill vents. Hence, reports of odors a mile away or farther suggest that some other substance or substances are probably involved. As discussed above, the EPA study mentions only briefly that n-butyl mercaptan was detectable in the LFG, but the concentration could not be determined accurately. The estimated concentration was 15 to 60 mg/m^3. Butyl mercaptan is known to have a strong, skunk-like odor that can be detected even at very low concentrations. Worst-case dispersion calculations of LFG with concentrations of butyl mercaptan at the source of about 30 mg/m^3 indicate that the odor could likely be detected as far away as 1.5 miles on occasion. This agrees with the distance to some of the complaints that have been received.

Fumes from the landfill will be transported in the direction of the prevailing wind vector. As discussed in Section 3, winds in the Kealakehe area typically move onshore during the daytime and offshore at night. Daytime wind frequency data for the Old Kona Airport suggest that any locations in the northeast quadrant with respect to the landfill and within the distances discussed above could be adversely affected during the daytime. Based on the EPA testing at the landfill and on screening-level dispersion esti-

mates, the area where the proposed high school will be located as well as the proposed residential areas near the school will be far enough away so as to meet the TACB air toxic guidelines but could experience occasional odor problems. Nighttime winds move predominantly down slope from east to west and would carry the fumes over the proposed civic center area. Odor is already known to be a problem in this area, and the analysis presented above suggests that community guidelines for air toxics may also be exceeded for a few hundred feet downwind of the landfill even though the ACGIH TLVs would be met except inside the immediate landfill area.

The present study should be considered by no means an attempt to provide the final answers to the Kailua Landfill emissions question. This is a difficult problem with no simple solutions. The EPA study basically concluded that fumes from the Kailua Landfill did not present a threat to the health of nearby residents and that they represented little more than an odor nuisance. However, it appears that it may be prudent to at least obtain more and better information concerning the landfill fumes and/or the control of the fumes before developing further facilities in the adjacent areas. Some type of mitigative measures to at least reduce the odor problem will probably be necessary. Potential mitigative measures as suggested by EPA to reduce the problem of underground landfill fires include: boring holes to access hot spots and injecting fire retardant products such as foam or water; excavating of the hot spots and flushing with water; and smothering with a soil or geotextile cap. Maintaining the integrity of the soil cap and operating the landfill according to guidelines should also help to prevent fires from recurring. The shortage of suitable top soil on Hawaii, however, for use as a soil cap presents a problem that cannot be easily resolved. The present plan for the closure of the landfill has not been completed at this

time. Normally, if a landfill does not have a history of subsurface fire problems, 2-foot soil cap is specified. Since the Kailua Landfill does have a history of recurring subsurface fires, additional closure measures will likely be required. A proposal has been made by a private company to mine the landfill for recyclable materials, extinguish the underground fires and cover the landfill with soil.

8.0 SUMMARY OF IMPACTS AND MITIGATIVE CONSIDERATIONS

8.1 Impacts Summary

The major short-term air quality impact will be the potential emission of significant quantities of fugitive dust during project construction phases. Uncontrolled fugitive dust emissions from construction activities are estimated to amount to about 1.2 tons per acre per month. During construction phases, emissions from engine exhausts (primarily consisting of carbon monoxide and nitrogen oxides) will also occur both from on-site construction equipment and from vehicles used by construction workers and from trucks traveling to and from the project.

The primary long-term air pollution impact from the project will arise from the increased motor vehicle traffic associated with the project. Potential increased levels of carbon monoxide concentrations along roadways leading to and from the proposed development will be the primary concern. Based on mathematical modeling of projected vehicular traffic and on atmospheric dispersion estimates of vehicular emissions, it is predicted that with the proposed project carbon monoxide concentrations in the year 2010 along roadways in the project vicinity will be higher at some locations and lower at others compared to the without project case. With the

project, concentrations at the worst location (Queen Kaahumanu Highway and Palani Road) will be about the same or lower than existing levels. With or without the project, worst-case concentrations should comply within both the national 1-hour and 8-hour ambient air quality standards set by the U.S. Environmental Protection Agency. Presently, the U.S. EPA 8-hour standard for carbon monoxide may be exceeded occasionally near the intersection of Queen Kaahumanu Highway and Palani Road. The more stringent State of Hawaii ambient air quality standards for carbon monoxide may be exceeded at times during the current year and either with or without the project in the year 2010 near high-volume traffic locations within the study area. The state standards are set so low, however, they are probably exceeded at many intersections in the state that have even moderate traffic volumes. It is worth noting here that, although the national AAQS allow higher levels of carbon monoxide, the national standards were developed after extensive research with the objective of defining levels of air quality that would protect the public health with an adequate margin of safety.

Air pollution impacts on the endangered species of trees existing on the project site due to project-related automotive emissions should be nil. This conclusion is based on the fact that estimated maximum concentrations of nitrogen dioxide that will occur (less than 0.2 ppm) will be much less than the injury threshold levels for sensitive vegetation.

Some long-term impacts also could potentially occur due to indirect emissions from power generating facilities supplying the project with electricity and from the burning of waste materials generated by the project. Quantitative estimates of these impacts were not made, but it appears likely that any impacts will be relatively

small since project electrical power and solid waste disposal demands will be relatively modest (although not entirely insignificant) compared to the present county demands.

Potential impacts on the project from landfill emissions will be lessened but may not be eliminated with the closure of the landfill. Recurring subsurface fires could continue to persist even after landfill operations cease. The analysis of potential impacts on the project from emissions emanating from the Kailua Landfill suggests that further study of this problem is warranted before drawing any definite conclusions. The little data that are available indicate the concentrations of some air contaminants may presently exceed both occupational health and safety standards within the landfill and community guidelines outside the landfill for a distance of a few hundred feet. Nuisance odor problems may persist for several thousand feet downwind.

8.2 Mitigative Considerations

Strict compliance with State of Hawaii Air Pollution Control Regulations regarding establishment of a regular dust-watering program and covering of dirt-hauling trucks will be required to effectively mitigate fugitive dust emissions from construction activities. Twice daily watering is estimated to reduce dust emissions by up to 50 percent. Use of wind screens and/or limiting the area that is disturbed at any given time may be required in sensitive or dust-prone areas. Paving of parking areas and establishment of landscaping early in the construction schedule will also help to control dust. Increased vehicular emissions due to disruption of traffic by construction equipment and/or commuting construction workers can be alleviated by moving equipment and personnel to the site during off-peak traffic hours.

Options available to mitigate traffic-related air pollution are to improve roadways, reduce traffic or reduce individual vehicular emissions. Long-term projections of carbon monoxide emissions from vehicular traffic associated with the completed development are based on the traffic impact study findings. It has been assumed that the roadway improvements recommended in the traffic study will be implemented to move traffic efficiently through the project area and adjacent locations. Aside from improving roadways, air pollution impacts from vehicular emissions can be mitigated by reducing traffic through the use of mass transit and car pooling and/or by adjusting local school and business hours to begin and end during off-peak times. Due to the extended completion date for the project, it is conceivable that the efficiency of motor vehicle engines and/or emission control equipment will be improved or that vehicles will be developed which burn cleaner fuels before the project reaches full build-out. If this occurs, then impacts will be less than predicted. With regard to cleaner burning fuels, vehicles burning methanol or compressed natural gas or powered by electrical motors are some of the possibilities for technological development that are currently being contemplated. Lastly, even without technological breakthroughs, it is also possible that at some point in the future the state may decide to adopt either a motor vehicle inspection and maintenance program which would ensure that emission control devices are properly maintained, and thereby reduce emissions, or more restrictive emission control standards.

Air pollution impacts on endangered species of trees on the project site can be mitigated by locating roadways as far from the trees as practicable, although air pollution estimates indicate that this should be no problem even for trees adjacent to the proposed roadways.

Indirect emissions from project electrical demand could be reduced somewhat by utilizing solar energy design features to the maximum extent possible. This might include installing solar water heaters, designing homes and building space so that window positions maximize indoor light without unduly increasing indoor heat, and using landscaping where feasible to provide afternoon shade to cut down on the use of air conditioning. Use of wind power generating units, geothermal energy, ocean thermal energy conversion and/or other alternative energy sources by the utility instead of fuel-burning facilities also would lessen indirect emissions from project electrical demand.

Most probably solid waste from the project will be buried at a landfill, and any air pollution impacts will be minimal if the landfill is operated properly. If project refuse is burned instead at a municipal incinerator, air pollution impacts could be reduced substantially if the incinerator is fitted with pollution control equipment, i.e., electrostatic precipitators or fabric filters. Conservation and recycling programs also could reduce solid waste which would reduce any related air pollution emissions proportionately. Lastly, if the new H-Power garbage-to-energy facility located on Oahu proves successful, similar facilities on the other islands may be developed before project completion. Use of solid waste to generate power offsets emissions that would otherwise occur from fossil-fueled power plants.

Potential impacts <u>on</u> the project from emissions occurring as a result of underground fires at the Kailua Landfill can only be lessened by preventing or quickly extinguishing fires as they occur. The proposal to mine the landfill for recyclable materials,

extinguish the underground fires and cover the landfill with soil is probably the most comprehensive and effective solution. The alternative of closing and capping the landfill with soil may help to reduce the frequency of underground fires, but it may still be necessary to extinguish fires periodically with boring and fire fighting equipment.

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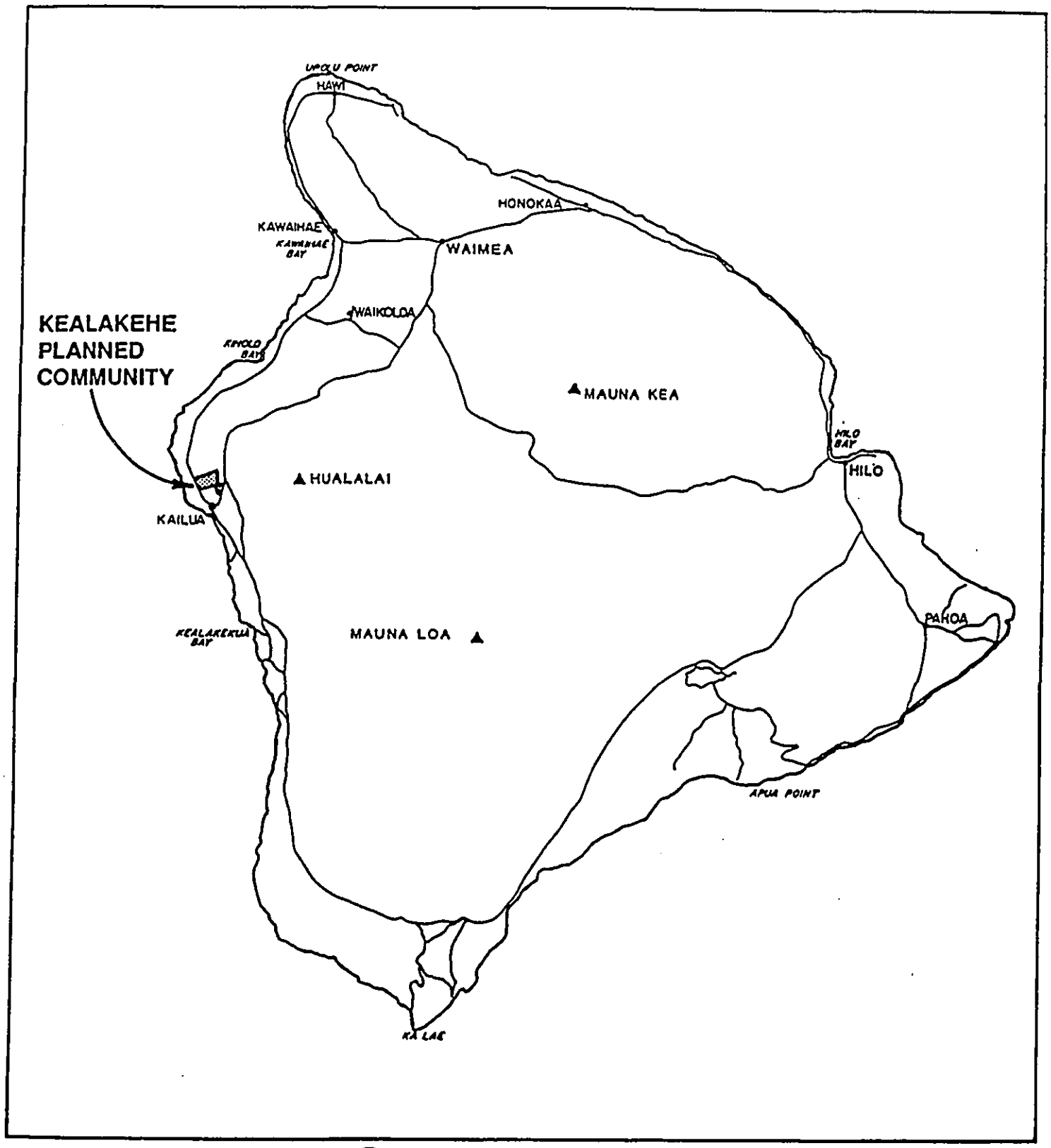

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MILES

NORTH

Prepared by: Belt Collins and Associates

Figure 1
ISLAND OF HAWAII

Table 1

SUMMARY OF STATE OF HAWAII AND NATIONAL
AMBIENT AIR QUALITY STANDARDS

Pollutant	Units	Averaging Time	Maximum Allowable Concentration		
			National Primary	National Secondary	State of Hawaii
Suspended Particulate Matter	$\mu g/m^3$	Annual	-	-	60[a]
		24 Hours	-	-	150[b]
Particulate Matter[c]	$\mu g/m^3$	Annual	50	50	-
		24 Hours	150[b]	150[b]	-
Sulfur Dioxide	$\mu g/m^3$	Annual	80	-	80
		24 Hours	365[b]	-	365[b]
		3 Hours	-	1300[b]	1300[b]
Nitrogen Dioxide	$\mu g/m^3$	Annual	100	100	70
Carbon Monoxide	mg/m^3	8 Hours	10[b]	-	5[b]
		1 Hour	40[b]	-	10[b]
Ozone	$\mu g/m^3$	1 Hour	235[b]	235[b]	100[b]
Lead	$\mu g/m^3$	Calendar Quarter	1.5	1.5	1.5

[a]Geometric mean

[b]Not to be exceeded more than once per year

[c]Particles less than or equal to 10 microns aerodynamic diameter

Table 2

ANNUAL SUMMARY OF AIR QUALITY MEASUREMENTS FOR MONITORING STATIONS NEAREST KEALAKEHE

Parameter / Location	1985	1986
Sulfur Dioxide / Kealakekua, Kona		
Period of Sampling (months)	7	8
No. of 24-Hr Samples	31	40
Range of 24-Hr Values (ug/m3)	<5-8	<5-12
Average Daily Value (ug/m3)	<5	<5
No. of State AAQS Exceedances	0	0
Particulate / Kealakekua, Kona		
Period of Sampling (months)	7	8
No. of 24-Hr Samples	34	40
Range of 24-Hr Values (ug/m3)	6-22	4-28
Average Daily Value (ug/m3)	12	16
No. of State AAQS Exceedances	0	0

Source: State of Hawaii Department of Health, "Hawaii Air Quality Data for the Period of January 1985 to December 1987"

Table 3

ESTIMATED WORST-CASE 1-HOUR CARBON MONOXIDE CONCENTRATIONS
ALONG ROADWAYS NEAR KEALAKEHE PLANNED COMMUNITY PROJECT
(milligrams per cubic meter)

Roadway Intersection	Year/Scenario: 1990/ Present AM	1990/ Present PM	2010/ Without Project AM	2010/ Without Project PM	2010/ With Project AM	2010/ With Project PM
Queen Kaahumanu Hwy at:						
Kealakehe Parkway	3.2	4.3	2.6	1.8	11.4	10.8
Palani Road	21.0	16.7	11.6	9.2	13.0	8.9
Mamalahoa Hwy at:						
Kealakehe Parkway	1.5[a]	0.8[a]	2.3[a]	1.6[a]	7.7	4.6
Palani Road	3.4	1.8	5.4	4.6	4.8	3.6

Hawaii State AAQS: 10
National AAQS: 40

[a]Assumes through traffic only.

Table 4

ESTIMATED WORST-CASE 8-HOUR CARBON MONOXIDE CONCENTRATIONS
ALONG ROADWAYS NEAR KEALAKEHE PLANNED COMMUNITY PROJECT
(milligrams per cubic meter)

Roadway Intersection	Year/Scenario 1990/ Present	2010/ Without Project	2010/ With Project
Queen Kaahumanu Hwy at:			
Kealakehe Parkway	2.2	1.3	5.7
Palani Road	10.5	5.8	6.5
Mamalahoa Hwy at:			
Kealakehe Parkway	0.8[a]	1.2[a]	3.8
Palani Road	1.7	2.7	2.4

Hawaii State AAQS: 5
National AAQS: 10

[a]Assumes through traffic only.

Table 5

AIR POLLUTANT CONCENTRATIONS FOR SHORT-TERM EXPOSURES THAT PRODUCE ABOUT 5% INJURY TO VEGETATION GROWN UNDER SENSITIVE CONDITIONS

Pollutant	Time (hours)	Concentration (ppm) Producing 5% Injury		
		Sensitive	Intermediate	Resistant
Ozone	0.5	0.20-0.35	0.30-0.55	>0.50
	1.0	0.10-0.25	0.20-0.35	>0.30
	2.0	0.07-0.20	0.15-0.30	>0.25
	4.0	0.05-0.15	0.12-0.26	>0.23
	8.0	0.03-0.12	0.10-0.22	>0.20
Sulfur dioxide	0.5	1.0-4.0	3.5-10	>9.0
	1.0	0.50-2.5	2.0-7.5	>7.0
	2.0	0.30-2.0	1.5-5.0	>4.5
	4.0	0.15-1.25	1.0-3.5	>3.0
	8.0	0.10-0.75	0.50-2.0	>1.5
Nitrogen dioxide	0.5	6.0-12	10-25	>20
	1.0	3.0-10	9.0-20	>18
	2.0	2.5-7.5	7.0-15	>13
	4.0	2.0-6.0	5.0-12	>10
	8.0	1.5-5.0	4.0-9.0	>8

Source: Arthur C. Stern, ed., *Air Pollution*, Third Edition, Volume II (New York: Academic Press, 1977)

Table 6

ESTIMATED INDIRECT AIR POLLUTION EMISSIONS
FROM KEALAKEHE PLANNED COMMUNITY PROJECT ELECTRICAL DEMAND[a]

Air Pollutant	Emission Rate (tons/year)
Particulate	9
Sulfur Dioxide	125
Carbon Monoxide	28
Volatile Organics	10
Nitrogen Oxides	121

[a]Based on U.S. EPA emission factors for utility gas turbines [3]. Assumes electrical demand of 50 million kw-hrs per year and low sulfur oil used to generate power.

Table 7

UNCONTROLLED AIR POLLUTION EMISSION FACTORS FOR MUNICIPAL REFUSE INCINERATORS (lb/ton)[a]

Air Pollutant	Emission Factor
Particulate	14[b]
Sulfur Oxides	2.5
Carbon Monoxide	35
Organics	1.5
Nitrogen Oxides	3

[a]Emission factors are given in terms of weight of material emitted per unit weight of refuse material charged.
[b]Assumes incinerator equipped with settling chamber and water spray.

Source: U.S. Environmental Protection Agency [3]

Table 8

THRESHOLD LIMIT VALUES AND COMMUNITY GUIDELINES FOR TOXIC SUBSTANCES KNOWN TO BE PRESENT IN KAILUA LANDFILL GASES
(milligrams per cubic meter)

Substance	TLV-STEL	TLV-TWA	Community Guideline[a]	
			Acute	Chronic
Benzene	-	30	-	0.03
Butyl mercapton	-	1.5	-	0.0015
Ethyl benzene	545	435	5.4	0.44
Hexane	-	180	-	0.18
Toluene	560	375	5.6	0.38

[a]Based on Texas Air Control Board Regulations. Acute refers to 30-minute exposure; chronic refers to annual average exposure.

MARKET ANALYSIS

KPMG Peat Marwick

Certified Public Accountants

Market Assessment
for
Kealakehe Planned Community

Kealakehe, North Kona, Hawaii

Prepared for

BELT COLLINS & ASSOCIATES

July 1990

KPMG Peat Marwick

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July 12, 1990

Mr. Tom Papandrew
Belt Collins & Associates
680 Ala Moana Boulevard, Suite 200
Honolulu, Hawaii 96813

Dear Mr. Papandrew:

KPMG Peat Marwick is pleased to present the attached report entitled "Market Assessment for Kealakehe Planned Community".

The report presents the market assessment for residential and golf course development at the Kealakehe site in North Kona, island of Hawaii, and is organized into six chapters as follows:

I. Introduction and Executive Summary
II. Economic and Demographic Trends
III. Housing Market Review
IV. Housing Supply, Demand and Need
V. Housing Market Assessment
VI. Golf Course Market Assessment

* * * * * * *

Thank you for the opportunity to work with you in the planning of this important public project.

Very truly yours,

KPMG Peat Marwick

BELT COLLINS & ASSOCIATES

Table of Contents

BELT COLLINS & ASSOCIATES

Table of Contents, Continued

BELT COLLINS & ASSOCIATES

Table of Contents, Continued

EXHIBITS

BELT COLLINS & ASSOCIATES

Table of Contents, Continued

I - INTRODUCTION AND EXECUTIVE SUMMARY

This chapter introduces the market assessment for development of the Kealakehe planned community. The project is described, as are the objectives and scope of assistance of KPMG Peat Marwick. Study conclusions are summarized at the end of the chapter.

PROJECT DESCRIPTION

The State of Hawaii owns a parcel of approximately 840 acres in the district of North Kona, on the island of Hawaii. The area is called Kealakehe, derived from its history as part of the ahupua'a of the same name. The borders of the property include the Queen Kaahumanu Highway, the Kealakehe landfill, Kealakehe Village and the Kailua quarry. The general location of the property is shown in Exhibit I-A.

The State has embarked on a new communities strategy to address affordable housing and urban development needs. Government agencies, led by the State Housing Finance Development Corporation (HFDC), are to take the lead role in site acquisition, land planning and infrastructure development, while private developers will build housing and other facilities. A new community is underway at Kapolei in Oahu's Ewa district, and a Maui project is to be developed at Lahaina. The Kealakehe property is being planned for a new community on the island of Hawaii.

The HFDC is considering development of the Kealakehe property as a residential community, primarily in order to meet existing and projected demand for affordable housing in the west Hawaii region. The development is conceived of as a mixed-use planned community which could include:

- Affordably-priced housing for rent and ownership
- Market-priced housing
- Public golf course
- Neighborhood shopping center
- Community, civic, recreation and public facilities uses

The HFDC retained Belt Collins & Associates (Belt Collins) to coordinate Kealakehe planning, including preparation of necessary environmental impact disclosure and development permit documents. Belt Collins in turn retained KPMG Peat Marwick to prepare a market assessment for housing and golf course uses at Kealakehe.

OBJECTIVES AND SCOPE OF ASSISTANCE

The objectives of KPMG Peat Marwick's assistance were to assist Belt Collins in preparing detailed land use development plans for the Kealakehe site by:

- Assessing the need for low and moderate income and market-priced housing in the west Hawaii region over a 20-year period, and estimating the amount of the needs associated with the respective markets that could be expected to be accommodated at Kealakehe.

EXHIBIT I-A

GENERAL LOCATION OF KEALAKEHE PLANNED COMMUNITY

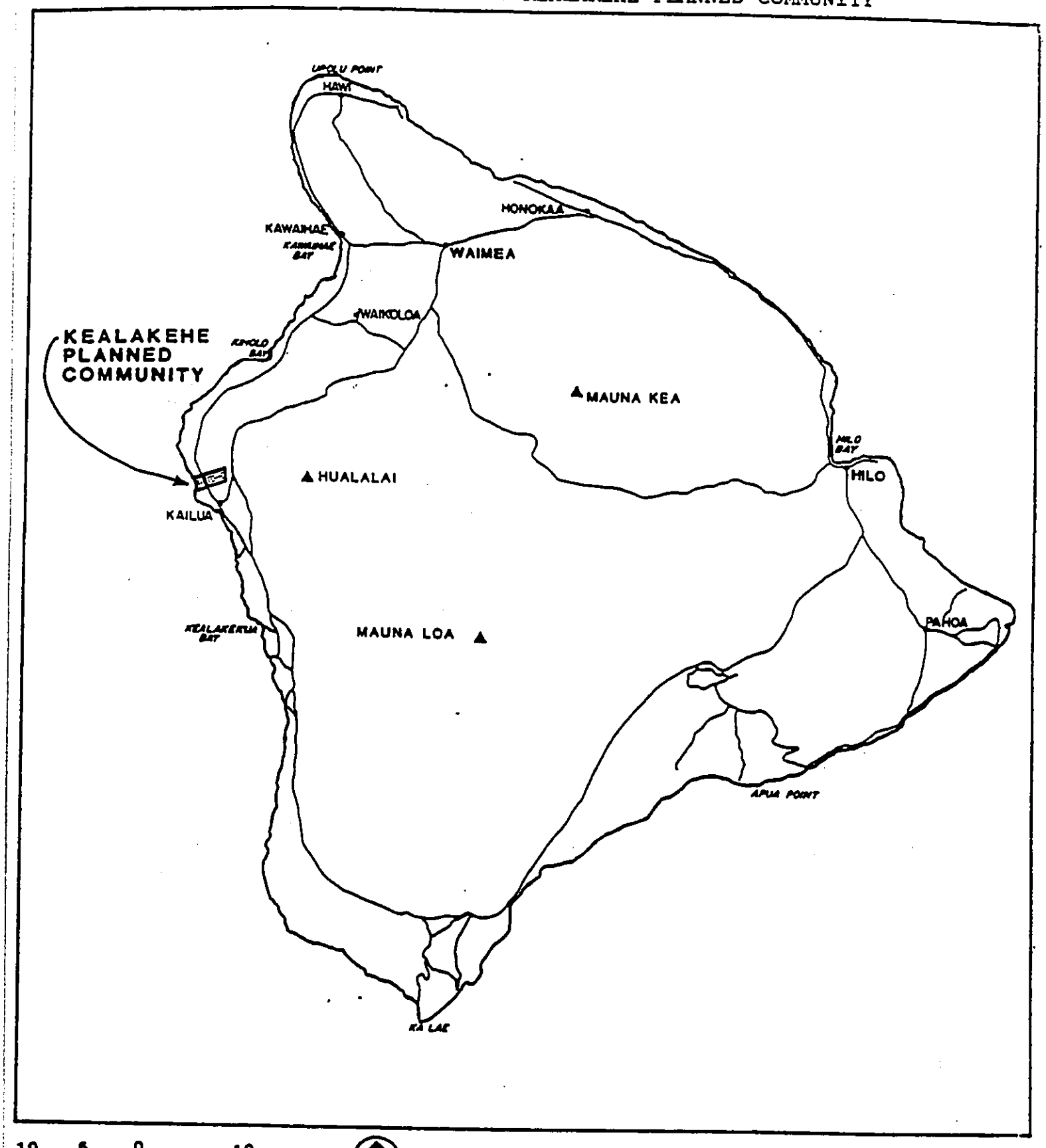

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Exhibit I-B

BELT COLLINS & ASSOCIATES

Summary of Market Support for
Kealakehe Planned Community Housing Development

1990 to 2010

Type of unit	Range of market support Low	High
Affordable:		
Ownership	1,800	2,100
Rental	690	1,160
Subtotal	2,490	3,260
Market units:	1,130	2,270
Total projected supportable units	3,620	5,530

- Evaluating the market potential for development of a municipal golf course at the project site.

To meet the objectives, the following scope of work was performed in two phases:

Phase I - Residential Market Assessment

- Project Orientation - Met with Belt Collins and representatives of the HFDC to:
  - Review the background, objectives, approach, work products and time table of the study.
  - Review the status of development planning for the site.
  - Obtain copies of prior reports and other sources of information.
- Site Visit - Visited and toured the Kealakehe site and its environs to evaluate its characteristics with respect to weather patterns, access, proximity to regional demand generators, highway frontage and other qualities.
- Island of Hawaii Economic and Demographic Trends - Using generally accepted public agency data as appropriate, described and projected trends on the island and in the west Hawaii region likely to affect housing demand during a 20-year anticipated project development period, including:
  - Population and employment growth
  - Household formations, characteristics and income patterns
- Island of Hawaii Housing Market Overview - Described recent and foreseeable trends in the residential market of the island and west Hawaii region, including:
  - Sales price levels and absorption rates
  - Rent levels and vacancies
  - Demolitions
  - Share of housing units reserved for visitor use
  - Planned new residential units and resident-oriented apartment units
- Project Housing Market Assessment - Assessed the anticipated market support for housing at Kealakehe in terms of:
  - Development concepts
  - Anticipated buyer markets
  - Anticipated renter target groups
  - Number of units supportable over a 20-year absorption period
  - Distribution between ownership and rental units
  - Supportable units by general price range, including:
    - Units affordable by low- and moderate-income households
    - Market-priced units

- Planning Assistance - Worked with Belt Collins in reviewing alternative development concepts.

- Informational Meetings - Participated in informational meetings and presentations.

Phase II - Non-Residential Land Use Market Assessment and Housing - Market Concept Refinement

- Identification of Complementary Non-Residential Uses - Assisted Belt Collins in identifying appropriate complementary non-residential uses for the Kealakehe site.

- Market Assessment for Golf Course Use - Analyzed market support for a municipal golf course, including:

  - Potential target markets
  - Development concepts
  - Amount of land or development product supportable
  - Development phasing

- Housing Market Concept Refinement - Reviewed the housing market assessment findings in terms of planned non-residential uses, including:

  - Housing development concepts
  - Adjustments relative to supportable units
  - Phasing and implementation

- Reporting - Summarized findings and conclusions in draft and final reports.

REPORT ORGANIZATION

This report is organized into six chapters, as follows:

I - Introduction
II - Economic and Demographic Trends
III - Housing Market Review
IV - Housing Supply, Demand and Need
V - Housing Market Assessment
VI - Golf Market Assessment

SUMMARY OF CONCLUSIONS

The major analysis and conclusions, presented in detail in the following chapters, are summarized in this section.

Economic and Demographic Trends

The Kealakehe planned community is expected to meet the critical housing need that now exists in the west Hawaii region, and to accommodate housing demand associated with expected rapid future population growth. Hawaii County's

population is projected to increase at an annual rate of 2.6% to 2010, compared with a statewide growth rate of 1.1%. Within the Kealakehe market area, population is anticipated to grow to more than 100,000 in 2010. The market area's growth is expected to be primarily driven by expansion in visitor facilities and related service employment.

Housing Market Review

New housing construction on the island of Hawaii has reached high levels in 1988 and 1989, but construction for the decade did not keep pace with the growth of population and households. The inventory of visitor units increased more rapidly than did units for resident households. Thus, signs of a tightening housing market appeared in the late 1980s, including a decline in homeownership, increasing resale prices, and higher rents.

Housing Supply, Demand and Need

More than 21,000 new housing units are planned within the Kealakehe market area. In addition, developers are mandated to provide a proportion of units affordable to low- and moderate-income households. Federal, state and county housing efforts are also aimed at serving affordable housing demand.

Almost 40,000 new homes are projected to be needed in the county between 1987 and 2010, in order to meet future housing demand; about 25,000 of these homes could be needed within the Kealakehe market area. In order to meet State Housing Functional Plan goals, about 6,000 additional ownership units and 4,600 rental units could be needed at prices affordable to low and moderate-income households within the Kealakehe market area.

Housing Market Assessment

The number of affordable housing units supportable at Kealakehe is estimated at from about 2,490 to 3,260 units through 2010. Along with market-priced units, support is expected for a total of from 3,620 to 5,530 units in the same period. Market support is summarized in Exhibit I-B.

Golf Course Market Assessment

An 18-hole municipal golf course is proposed as one element of the Kealakehe planning community. While substantial expansion of golf courses is planned on the island of Hawaii, most new courses are expected to cater to visitors, resort residents and private club members.

Demand for lower-priced daily fee play among island residents could increase strongly in the 1990 to 2010 period, providing market support for an additional municipal course. Projected golf play at Kealakehe is anticipated to reach similar levels to the comparable Hilo municipal course by 1995, and could reach sustainable capacity by 2000.

II - ECONOMIC AND DEMOGRAPHIC TRENDS

This chapter describes the economic and demographic trends likely to influence housing supply and demand on the island of Hawaii from 1990 to 2010, the expected development period for the Kealakehe planned community. Projected population growth is detailed for the state of Hawaii, county of Hawaii and districts constituting the Kealakehe market area. Regional economic conditions, notably projected growth of the visitor industry, are also described.

POPULATION TRENDS

This section indicates projected population trends for the state, county and the Kealakehe market area.

State and County Population

Population growth projected for the state of Hawaii and county of Hawaii by the State Department of Business and Economic Development (DBED) are shown in Exhibit II-A, which indicates:

- State population growth from about 1.1 million in 1988 to more than 1.4 million by 2010.
- Growth in county population from an estimated 117,500 in 1988 to more than 206,000 by 2010.
- County population projected to increase at more than twice the rate (2.6% annual compound growth) of the state as a whole (1.2% annual rate).

Kealakehe Market Area

The Kealakehe planned community is being designed to accommodate housing needs associated with growth in the west Hawaii region. For this reason, the project's market area consists of those locations now experiencing or likely to experience pressure for housing development if Kealakehe is not built. Based on general location, land availability, and current residences of west Hawaii resort workers, the Kealakehe market area has been defined to include the districts of:

- North Kohala
- South Kohala
- North Kona
- South Kona
- Hamakua

The Kealakehe market area is depicted in Exhibit II-B.

BELT COLLINS & ASSOCIATES

Historical and Projected Population
State of Hawaii and County of Hawaii

1988 to 2010

	1988	1990	1995	2000	2005	2010	Compound annual growth rate 1988 to 2010
State of Hawaii	1,098,200	1,137,200	1,225,200	1,285,100	1,350,800	1,435,500	1.2%
County of Hawaii	117,500	124,600	142,500	160,400	180,800	206,100	2.6

Source: State of Hawaii Department of Business and Economic Development, "Population and Economic Projections to 2010 (Series M-K)", November 1988.

Exhibit II-A

KEALAKEHE MARKET AREA

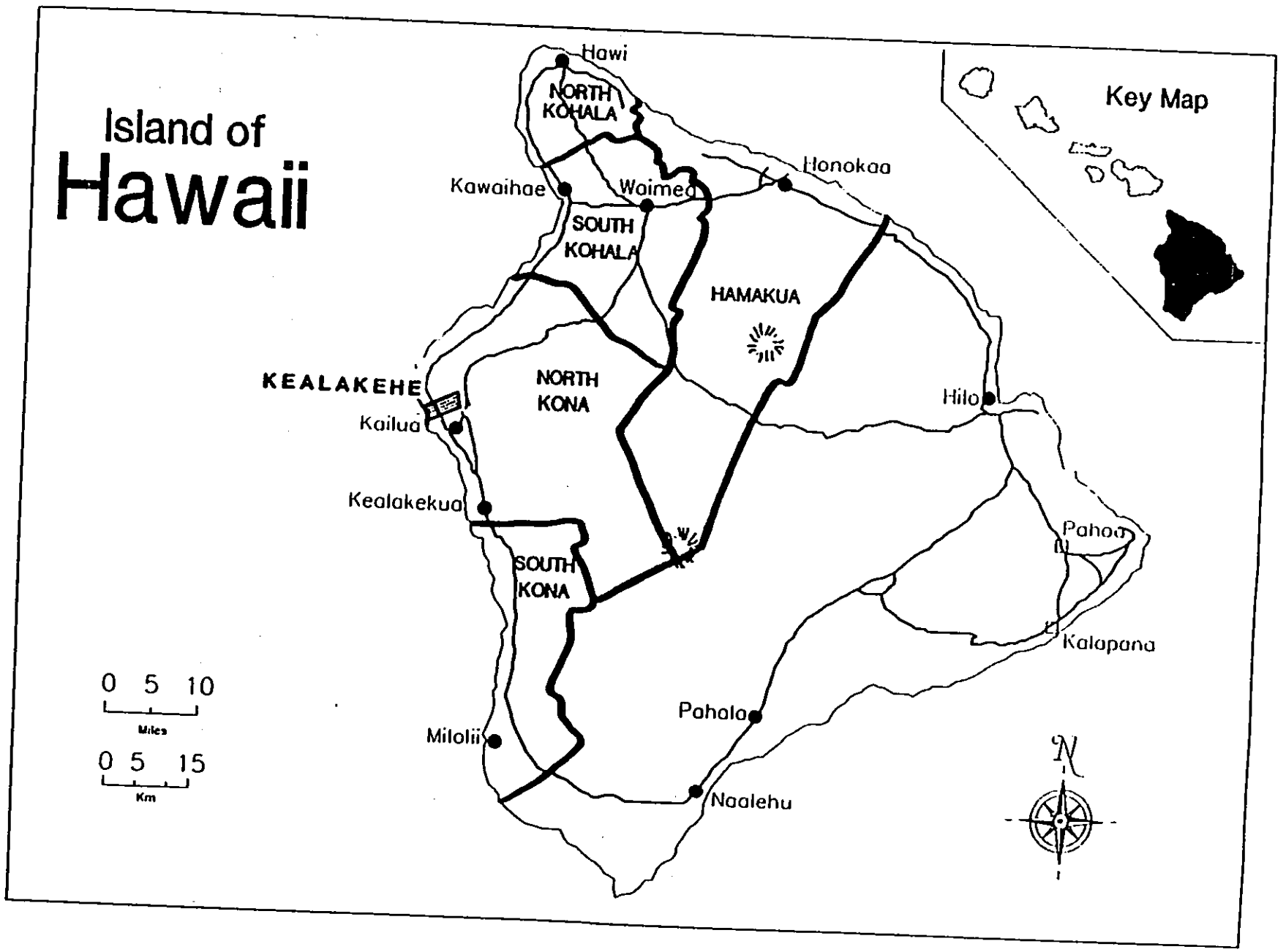

EXHIBIT II-8

Projected Population Growth
in Kealakehe Market Area

The county Hawaii General Plan presents a population distribution for districts within the county based on past growth patterns and assumptions about future employment growth. Application of these district shares to the county population projected by DBED are shown in Exhibit II-C. As indicated in the exhibit:

- Total population within the market area is projected to increase from about 46,000 in 1988 to about 108,000 in 2010.
- Projected growth for the Kealakehe market area, at a 3.9% annual rate, is significantly higher than for the county as a whole and almost three times the statewide rate.
- Within the market area, the districts of South Kohala and North Kona (where almost all new resort jobs are to be located) are projected to grow by even higher annual rates of 5% and 4% respectively.

ECONOMIC TRENDS

The economy of the island of Hawaii is based on agriculture, including sugar and diversified crops such as coffee and macadamia nuts, and tourism. High-technology research and development in agriculture, astronomy and energy are also emerging as new industries.

The visitor industry is expected tc be the primary source of economic growth during the development period for the Kealakehe project. This section describes plans for visitor industry development in west Hawaii and projects the resultant impacts on regional employment.

Projected Resort Hotel Development

Many new and expanded resort hotels are planned for development from 1989 to 2010. The potential schedule of new hotel units is presented in Exhibit II-D, arranged in terms of government development permissions received. As shown in the exhibit:

- The 540-unit Ritz Carlton Mauna Lani hotel is under construction.
- Nine resorts have all principal development approvals, including six with existing hotels. Additional hotel rooms at existing resorts could amount to almost 5,000 units.
- Three new resorts have received all principal development approvals, and could build out to about 2,600 rooms.
- Other resorts have been proposed in west Hawaii and in the Ka'u district, representing an additional 3,000 rooms.

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Historical and Projected Population
County of Hawaii and Kealakehe Market Area Districts

1988 to 2010

	Share of future population(1)	1988	1990	1995	2000	2005	2010	Growth rate 1988 to 2010
County of Hawaii (2)	100.0%	117,500	124,600	142,500	160,400	180,800	206,100	2.6%
District:								
North Kohala	3.1	3,700	3,900	4,400	5,000	5,600	6,300	2.5
South Kohala	11.1	7,900	8,800	11,600	15,300	20,100	26,500	5.6
North Kona	25.0	21,600	23,600	29,300	36,400	45,200	56,200	4.4
South Kona	6.3	7,500	7,900	8,900	10,100	11,400	12,900	2.5
Hamakaua (3)	3.1	5,300	5,300	5,400	5,500	5,600	5,700	0.3
Total Kealakehe market area		46,000	49,500	59,600	72,300	87,900	107,600	3.9%

(1) Expected share of county population in 2005, estimated by County Planning Department; in "Hawaii General Plan", August 1987; historical growth rates applied from 2005 to 2010.

(2) From Exhibit II-A.

(3) Growth rate adjusted to 1980-1988 historical rate to 2010.

Exhibit II-C

BELT COLLINS & ASSOCIATES

Proposed Hotel Development
On The Island of Hawaii

1989 to 2010

	Location	1989 to 1990	1991 to 1995	1996 to 2000	2001 to 2005	2006 to 2010	Total 1989 to 2010
Under construction:							
Ritz Carlton Mauna Lani	South Kohala	540	-	-	-	-	540
Subtotal		540	-	-	-	-	540
With all land approvals(1), within existing resort:							
Waikoloa Beach Resort	South Kohala	-	400	400	400	-	1,200
Mauna Lani Resort	South Kohala	-	-	600	-	-	600
Keauhou Resort	North Kona	-	-	500	500	700	1,700
Kona Village addition	North Kona	-	50	-	-	-	50
Hapuna Beach Hotel	South Kohala	-	350	-	-	-	350
Punalu'u	Ka'u	-	425	210	400	-	1,035
Subtotal		-	1,225	1,710	1,300	700	4,935
With all land approvals(1), within new resort:							
Kaupulehu	North Kona	-	950	-	-	-	950
Regent Beach Resort	North Kona	-	400	-	-	-	400
Kohanaiki	North Kona	-	400	350	500	-	1,250
Subtotal		-	1,750	350	500	-	2,600
Other proposed:							
O'oma II	North Kona	-	600	-	-	-	600
Mahukona Resort	North Kohala	-	500	500	500	-	1,500
Hawaiian Riviera	Ka'u	-	950	-	-	-	950
Subtotal		-	2,050	500	500	-	3,050
Total (2)		540	5,025	2,560	2,300	700	11,125

(1) County General Plan, County zoning and State Land Use Commission approvals in place.
(2) Numbers represent maximum units proposed, where more specific plans have not been announced.

Exhibit II-D

- The sum of planned resorts could represent more than 11,000 new hotel rooms, compared with the current inventory of less than 6,000 rooms.

- More than 80% of the hotel rooms proposed would be developed in the west Hawaii region.

Projected Resort Condominium Development

Development of condominium units in resort areas is expected to generate additional employment opportunities. Planned resort condominium units are depicted in Exhibit II-E, and indicate that:

- A total of 465 units are under construction or expected to start building in 1989.

- More than 7,350 additional units could be developed in existing resorts.

- About 1,300 condominium units are planned for new resorts with government approvals.

- Almost 1,800 additional condominium units are proposed.

- A total of more than 11,000 condominium units could be developed between 1989 and 2010. Most of the units -- more than 9,000 -- could be constructed in the west Hawaii region.

Relation of Proposed Visitor Unit Development to Economic Projections

The current inventory of visitor units, including resort condominium units used for visitor accommodations, is 8,171 units on the island of Hawaii. Economic projections of the DBED indicate that a similar number of visitor units could be absorbed as is now proposed; the figures below compare DBED projected visitor units to the total of existing and proposed visitor units:

Proposed and Projected Visitor Units
On The Island of Hawaii

1985 to 2010

Time period	Proposed(1)	Projected(2)
1990	8,900	10,100
1995	15,600	13,200
2000	19,900	16,400
2005	23,800	21,300
2010	24,900	27,100

(1) Exhibits II-D and II-E; resort condominiums estimated at 50% visitor use; includes existing visitor units.

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Proposed Resort Condominium Development
On The Island of Hawaii

1989 to 2010

	Location	1989 to 1990	1991 to 1995	1996 to 2000	2001 to 2005	2006 to 2010	Total 1989 to 2010(2)
Under construction:							
Villas at Keauhou	North Kona	58	-	-	-	-	58
The Bluffs at Hapuna Beach	South Kohala	67	-	-	-	-	67
Shores at Waikoloa II	South Kohala	172	-	-	-	-	172
Holua at Keauhou		-	400	-	-	-	400
Subtotal		297	400	-	-	-	697
With all land approvals (1), within existing resort:							
Waikoloa Beach Resort	South Kohala	168	540	800	800	165	2,473
South Kohala Resort	South Kohala	-	-	450	-	-	450
Mauna Lani Resort	South Kohala	-	500	500	600	-	1,600
The Bluffs at Hapuna Beach	South Kohala	-	150	-	-	-	150
Keauhou Resort	North Kona	-	250	350	213	-	813
Punalu'u	Ka'u	-	430	450	490	500	1,870
Subtotal		168	1,870	2,550	2,103	665	7,356
With all land approvals (1), within new resort:							
Kaupulehu	North Kona	-	200	200	200	-	600
Regent Beach Resort	North Kona	-	200	-	-	-	200
Kohanaiki	North Kona	-	150	275	75	-	500
Subtotal		-	550	475	275	-	1,300

Exhibit II-E

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Proposed Resort Condominium Development, Continued
On The Island of Hawaii

1989 to 2010

	Location	1989 to 1990	1991 to 1995	1996 to 2000	2001 to 2005	2006 to 2010	Total 1989 to 2010(2)
Other proposed:							
Kohala Makai	North Kohala	-	-	220	230	-	450
Kahua Makai	North Kohala	-	278	300	300	-	878
Kahua Shores	North Kohala	-	-	-	242	-	242
O'oma II	North Kona	-	200	-	-	-	200
Hawaiian Riviera	Ka'u	-	-	-	-	-	-
Subtotal		-	478	520	772	-	1,770
Total(2)		465	3,298	3,545	3,150	665	11,123

(1) County General Plan, County zoning and State Land Use Commission aprovals in place.
(2) Numbers represent maximum units proposed, where more specific plans have not been announced.

Exhibit II-E, Cont.

(2) DBED, "Population and Economic Projections for the State of Hawaii to 2010 (Series M-K), November 1988; includes existing visitor units.

Employment Impacts of Planned Visitor Unit Development

The projected employment impacts of planned resort development are shown in Exhibit II-F. The exhibit indicates that:

- More than 30,000 new jobs could be created from direct, indirect and induced visitor spending.

- More than 20,000 new positions could be located on the island of Hawaii.

The location within the county of the new employment will depend on many factors, such as transportation links and the availability of land for industrial use. However, since more than 75% of the new visitor units are planned for west Hawaii, that region is expected to be most heavily impacted by employment growth.

Exhibit II-G projects employment by major industry for Hawaii County in the 1985-2010 period. From 1990 to 2010, about 39,000 new jobs would be created, with the most rapid growth in those areas most closely related to tourism, such as services, construction and eating and drinking.

Projected resort development, as established in Exhibits II-D, II-E and II-F, would produce more visitor industry jobs than now projected by DBED in Exhibit II-G. If more rapid job growth does in fact occur, it is likely that population will rise above levels projected by DBED. Projections performed for the Hawaii General Plan indicate more rapid growth than estimated by DBED. According to county projections, island population in 2005 could range from 173,000 to 258,000, compared with the DBED projection of 180,800. The official state DBED projections are used in this analysis.

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Projected Additional Employment Resulting
From Proposed Visitor Unit Development

1989 to 2010

	1989 to 1990	1991 to 1995	1996 to 2000	2001 to 2005	2006 to 2010	Total
Proposed additional visitor units(1):						
Hotel rooms	540	5,025	2,560	2,300	700	11,125
Resort condominium units(2)	230	1,650	1,770	1,580	330	5,560
Total	770	6,675	4,330	3,880	1,030	16,685
Statewide employment:						
Direct(3):						
Hotel	590	5,530	2,820	2,530	770	12,240
Condominium	50	330	350	320	70	1,120
Resort commercial	150	1,380	710	630	190	3,060
Resort administration	-	30	20	20	-	70
Total	790	7,270	3,900	3,500	1,030	16,490
Indirect/induced(4):						
Hotel/resort	580	5,300	2,870	2,580	760	12,090
Commercial	90	830	430	380	110	1,840
Total	670	6,130	3,300	2,960	870	13,930

Exhibit II-F

BELT COLLINS & ASSOCIATES

Projected Additional Employment Resulting
From Proposed Visitor Unit Development, Continued

1989 to 2010

	1989 to 1990	1991 to 1995	1996 to 2000	2001 to 2005	2006 to 2010	Total
Island of Hawaii employment:						
Direct(5)	710	6,540	3,510	3,150	930	14,840
Indirect/induced(6)	270	2,450	1,320	1,180	350	5,570
Total	980	8,990	4,830	4,330	1,280	20,400

(1) From Exhibits II-D and II-E.

(2) 50% of condominium units allocated to visitor pool, based on experience of rural resorts in Hawaii.

(3) Direct employees equivalent to 1.1 per hotel unit, 0.2 per condominium unit, 0.25 resort commercial employees per direct hotel employee, 0.06 resort administration employees per direct hotel employee.

(4) Indirect/induced employees equivalent to 0.9 per direct hotel, condominium and resort administration employee, 0.6 per resort commercial employee; based on DBED input-ouput multipliers.

(5) Approximately 90% of all direct jobs estimated to be located on the island of Hawaii.

(6) Approximately 40% of indirect/induced jobs estimated to be located on the Island of Hawaii.

Exhibit II-F, Cont.

BELT COLLINS & ASSOCIATES

Projected Population and Employment by Industry
Hawaii County

1985 to 2010

	1985	1990	1995	2000	2005	2010	Growth rate 1985 to 2010
Resident population	109,500	124,600	142,500	160,400	180,800	206,100	2.7%
De facto population(1)	116,100	134,400	158,600	183,000	211,000	243,000	3.0
Civilian jobs:	42,400	50,800	59,300	68,200	78,300	89,800	3.0
Wage and salary jobs	37,700	43,100	50,800	59,000	68,600	79,500	3.0
Agriculture	3,500	3,700	3,800	3,900	4,000	4,100	0.6
Manufacturing	2,800	2,700	2,800	2,800	2,900	2,900	0.1
Construction	1,300	1,600	1,900	2,200	2,500	2,900	3.3
Tranportation, comm., utilities	2,100	2,600	3,000	3,400	3,900	4,500	3.1
Trade	6,400	7,300	8,500	9,900	11,500	13,300	3.0
Eating and drinking	2,700	3,800	5,000	6,300	8,000	9,900	5.3
Banking, financing	1,500	1,700	1,900	2,200	2,600	3,000	2.8
Services	8,800	11,600	14,600	17,700	21,200	25,300	4.3
Hotels	4,000	5,200	6,300	7,400	8,700	10,200	3.8
Other services	4,900	6,500	8,300	10,200	12,400	15,100	4.6
Government	6,800	8,100	9,300	10,600	12,000	13,600	2.8
State/Local	6,300	7,500	8,700	9,900	11,400	13,000	2.9
Federal	700	600	700	700	700	700	0.0
Self-employed	6,700	7,700	8,500	9,700	9,700	10,200	1.7

(1) Includes visitors.

Source: DBED, "Population and Economic Projections for the State of Hawaii to 2010 (Series M-K)", November 1988.

Exhibit II-G

III - HOUSING MARKET REVIEW

This chapter summarizes housing market trends on the island of Hawaii and in the Kealakehe market area. Changes in the housing inventory are discussed relating to housing units authorized by building permit and completed. Growth in the inventory of resident and non-resident housing units is described, as well as change in the extent of owner-occupancy among resident households. Housing pricing and affordability as measured by resale prices and observed rents are also discussed.

HOUSING INVENTORY TRENDS

This section describes changes in the housing unit inventory.

Units Authorized by Permit

Home construction has risen steadily in the past three years after relatively low production from 1981 to 1986. Exhibit III-A details housing units authorized by building permit in Hawaii County from 1980 through 1989. As shown in the exhibit:

- The 1989 calendar year marked a new high in unit authorizations, with more than 3,000 units permitted.
- The 1980-1989 average of 1,570 units also reflects the 1982-1986 period when from about 1,000 to 1,200 homes were permitted each year.
- About 80% of all units permitted, on average, have been single-family units.

Housing Unit Completions

From 1980 to 1987, a total of about 10,450 housing units were authorized by building permit. However, many of the permitted homes were not actually completed. Exhibit III-B indicates changes in housing supply by district on the island of Hawaii, and shows that about 8,100 units were completed in the 1980-1987 period. As also shown in the exhibit:

- The Puna district has had the most rapid growth in housing inventory, averaging 6.6% annual increase in the period.
- The housing inventory in Hamakua shows almost no increase from 1980 to 1987, reflecting removal from service of surplus plantation housing units.
- The housing stock in South Kohala and North Kona grew at a more rapid rate than for Hawaii County as a whole, but housing unit growth in the entire market area (3.1% per year) was only slightly higher than the countywide rate of 3% per year.

Exhibit III-A

BELT COLLINS & ASSOCIATES

Units Authorized by Building Permit
County of Hawaii

1980 to 1989

Year	Single-family units	Multifamily units(1)	Total units
1980	1,192	739	1,931
1981	1,033	285	1,318
1982	809	245	1,054
1983	880	96	976
1984	910	181	1,091
1985	988	190	1,178
1986	1,129	39	1,168
1987	1,367	361	1,728
1988	1,715	474	2,189
1989	2,562	455	3,017
Average	1,260	310	1,570

(1) Duplexes counted as multifamily units.

Source: Bank of Hawaii, "Construction in Hawaii 1989", and First Hawaiian Bank, "Economic Indicators", September 1989; 1989 data from County of Hawaii.

Exhibit III-8

BELT COLLINS & ASSOCIATES

Housing Inventory by District
Hawaii County

1980 to 1987

District	Total housing units 1980	Total housing units 1987	Change 1980 to 1987	Annual growth rate 1980 to 1987
Kealakehe market area:				
North Kohala	1,122	1,263	141	1.7%
South Kohala	2,218	2,938	720	4.1
North Kona	7,540	9,717	2,177	3.7
South Kona	1,722	2,097	375	2.9
Hamakua	1,741	1,804	63	0.5
Market area subtotal	14,343	17,819	3,476	3.1
Other:				
North Hilo	581	639	58	1.4
South Hilo	14,301	16,220	1,919	1.8
Puna	4,126	6,463	2,337	6.6
Ka'u	1,441	1,733	292	2.7
Other island subtotal	20,449	25,055	4,606	2.9
Total	34,792	42,874	8,082	3.0%

Sources: Hawaii County Planning Department, Hawaii General Plan; 1987 counts estimated by Planning Department from unpublished sources as of December 5, 1989.

Change in Resident Housing Unit Inventory

The island's housing inventory also includes units not occupied by residents, such as vacation homes and resort condominium units intended for part-time residents or visitor rentals. Historic and projected nonresident housing units are shown in Exhibit III-C, and indicate that:

- Units identified in the visitor unit inventory increased from about 600 in 1980 to more than 2,100 in 1987 -- an annual increase of 19%.

- Based on comparison with Exhibit III-B, more than 18% of the increase in overall housing inventory from 1980 to 1987 consisted of visitor units.

- Market support for visitor condominium units is projected to grow with accelerated resort development and expansion in the number of both first-time and repeat visitors. Visitor condominium units could increase by 10% annually to 2000, and by 7% annually to 2010, adding as many as 8,000 new units to the visitor condominium inventory.

Owner Occupancy Trends

The extent of owner occupancy -- the percentage of resident households living in homes they own -- is considered to be an important indicator of housing affordability. Increasing owner occupancy is an explicit goal of state housing programs, in that the State Housing Functional Plan targets attainment of a 60% statewide owner occupancy rate.

Hawaii County has historically had a high rate of homeownership; in 1980, owner-occupied units represented 59% of island households. However, homeownership on the island has declined in the 1980s, as shown in Exhibit III-D:

- As shown previously in Exhibit III-B, total housing stock grew at an annual rate of 3.0% from 1980 to 1987.

- Resident units (total inventory, less visitor units) increased from 33,594 to 40,772 in 1987, a rate of 2.8% per year.

- While owner-occupied units increased at 1.0% per year, the proportion of owner households declined from about 60% to 49%.

Relation of Population and Housing Inventory Growth

In the 1980-1987 period, population in the county of Hawaii has increased more rapidly than the housing inventory. The stock of resident units grew at annual rate of 2.8% during the period, compared to estimated annual population growth of 3.1%.

HOUSING AFFORDABILITY TRENDS

The affordability of rental and for-sale housing within the Kealakehe market area is described in this section.

Exhibit III-C

BELT COLLINS & ASSOCIATES

Historical and Projected
Nonresident Housing Units
County of Hawaii

1980 to 2010

Year	Nonresident housing units	Annual growth from prior period
1980(1)	621	-%
1985	2,279	29.7
1987	2,102	(4.0)
1990(2)	2,400	4.5
1995(3)	5,440	17.8
2000	7,600	6.9
2005	8,900	3.2
2010	10,320	3.0

(1) Condominium units in rental pools or intended for transient occupancy based on February survey data from Hawaii Visitors bureau.

(2) Estimated from 1988 inventory and 50% of units projected to be completed by 1990 from Exhibit II-E.

(3) Estimated based on projected visitor market support.

Exhibit III-D

BELT COLLINS & ASSOCIATES

Owner Occupancy in Hawaii County

1980 to 1988

	1980	1985	1987	1988	Compound annual growth 1980 to 1988
Population:					
Resident population	92,000	101,100	114,400	117,500	3.1%
Persons per household(1)	3.09	3.08	3.02	3.00	(0.4)
Households	29,806	32,825	37,881	39,167	3.5
Owner-occupied units:					
Total units	17,731	18,773	18,704	19,187	1.0
Percentage owner households	59.5	57.2	49.4	49.0	(2.4%)

(1) Estimated for 1988.

Prices of Existing Homes

Single-family residence average prices have risen steadily in the Kealakehe market area between 1986 and 1989, increasing at an average annual rate of 25% for the period. Resale trends are shown in Exhibit III-E, with key trends as follows:

- The average single-family resale price was almost $214,000 in 1989, significantly higher than 1988's average of about $160,000.
- About 90% of sales in 1988 and 1989 occurred in South Kohala or North Kona. The other three, more rural districts had few resales.
- Resale prices in the Kealakehe market area remained higher than for Hawaii County as a whole, with 1989 market area prices averaging 27% higher than countywide.

Condominium resale prices also rose steadily in the market area, increasing by an average annual rate of 29% from 1986 to 1989. Resale trends are shown in Exhibit III-F, and highlighted as follows:

- Almost 90% of the condominium resales on the island occurred within the South Kohala, North Kona and South Kona districts of the Kealakehe market area. Thus, market area and countywide average prices had a relatively constant relationship.
- Resale prices levelled off in the first nine months of 1989, with the average price of about $202,000 declining slightly from the 1988 average of $215,000.

Residential Lot Prices

Many island residents prefer to acquire vacant residential lots and build custom homes. Thus, lot prices are an important indicator of housing affordability. Current sales prices for North Kona lots of less than one acre are shown in Exhibit III-G. As shown in the exhibit:

- The average lot sold for more than $187,000 in the first three months of 1990, a figure well out of reach of most moderate-income households.
- While prices were highest in the visitor-oriented Keauhou area, average per-square foot prices elsewhere ranged from about $9.50 to about $16.50.

Affordability of Resale Housing

Housing prices are most meaningful in relation to household incomes among Hawaii County residents. Exhibit III-H portrays housing affordability based on the 1990 distribution of household incomes as estimated by the U.S. Department of Housing and Urban Development.

The HUD distribution divides households into "deciles", ten income brackets each representing 10% of all households. Thus, the D-1 decile includes the lowest 10% of households by income level, the D-2 decile those between the tenth and twentieth percentile, as so forth.

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Resale Trends for Single-Family Residences
County of Hawaii and Kealakehe Market Area

1986 to 1989

Sales price range	Number of sales: North Kohala	South Kohala	North Kona	South Kona	Hamakua	Market area: Sales	Market area: Percent of sales	County: Sales	County: Percent of sales
1988 sales:									
Less than $ 60,000	1	4	24	-	-	29	5%	63	7%
$ 60,000 to 79,999	3	3	21	1	7	35	6	131	14
80,000 to 99,999	3	5	28	1	5	42	7	167	18
100,000 to 119,999	1	5	51	2	1	60	10	96	10
120,000 to 149,999	3	35	113	6	2	159	28	190	21
150,000 to 174,999	2	26	71	2	-	101	17	108	12
75,000 to 199,999	-	22	31	-	-	54	9	62	7
200,000 or more	1	34	63	-	-	98	17	109	12
Total sales	14	134	402	13	15	578	100%	926	100%
1989 year to date sales(1):									
Less than $ 60,000	-	-	1	1	-	2	1	24	4
$ 60,000 to 79,999	1	-	4	-	1	6	2	60	9
80,000 to 99,999	1	2	11	-	2	16	4	89	14
100,000 to 119,999	3	4	17	-	1	25	6	71	11
120,000 to 149,999	4	13	56	1	2	76	20	109	17
150,000 to 174,999	1	16	59	2	1	79	21	87	14
175,000 to 199,999	-	13	44	2	-	59	15	64	10
200,000 or more	-	45	74	2	1	122	32	129	20
Total sales	10	93	266	8	8	385	100%	633	100%

(Continued)

BELT COLLINS & ASSOCIATES

Resale Trends for Single-Family Residences
County of Hawaii and Kealakehe Market Area, Continued

1986 to 1989

	Market area	County	Market area of % county
Average sales price:			
1986	$ 114,302	$ 93,561	122%
1987	145,765	110,641	132
1988	159,980	135,300	118
1989	213,875	168,972	127

Source: Multiple Listing Service, Hawaii, Inc.

Exhibit III-E, Cont.

BELT COLLINS & ASSOCIATES

Resale Trends for Condominiums
County of Hawaii and Kealakehe Market Area

1986 to 1989

Sales price range	Number of sales: North Kohala	South Kohala	North Kona	South Kona	Hamakua	Market area: Sales	Market area: Percent of sales	County: Sales	County: Percent of sales
1988 sales:									
Less than $ 60,000	-	6	85	7	-	98	16%	127	19%
$ 60,000 to 79,999	-	4	45	1	-	50	8	70	10
80,000 to 99,999	-	19	60	-	-	79	13	95	14
100,000 to 119,999	-	26	52	-	-	78	13	82	12
120,000 to 149,999	-	13	46	-	-	59	10	66	10
150,000 to 174,999	-	1	26	-	-	27	5	27	4
175,000 to 199,999	-	-	19	-	-	19	3	19	3
200,000 or more	-	134	52	1	-	187	31	190	28
Total sales		203	385	9		597	100%	676	100%
1989 year to date sales(1):									
Less than $ 60,000	-	3	32	10	-	45	9	59	10
$ 60,000 to 79,999	-	8	56	-	-	64	13	89	16
80,000 to 99,999	-	7	46	-	-	53	10	61	11
100,000 to 119,999	-	16	53	-	-	69	14	75	13
120,000 to 149,999	-	13	79	-	-	92	18	94	17
150,000 to 174,999	-	4	43	-	-	47	9	49	9
175,000 to 199,999	-	-	20	-	-	20	4	20	4
200,000 or more	-	70	47	-	-	117	23	118	21
Total sales	-	121	376	10	-	507	100%	565	100%

(Continued)

Exhibit III-F

BELT COLLINS & ASSOCIATES

Resale Trends for Condominiums
County of Hawaii and Kealakehe Market Area, Continued

1986 to 1989

	Market area	County	Market area of % county
Average sales price:			
1986	$ 99,542	$ 90,918	109%
1987	126,069	121,227	104
1988	214,895	204,033	105
1989	202,481	189,874	107

(1) No condominium sales in North Kohala and Hamakua districts.

Source: Multiple Listing Service Hawaii, Inc.

Exhibit III-F, Cont.

Exhibit III-G

BELT COLLINS & ASSOCIATES

Vacant Residential Lot Sales
in North Kona District

January 1990 to March 1990

Tax map section	Principal residential areas	Weighted average Lot size (square foot)	Weighted average Sales price Total	Weighted average Sales price Per square foot
7 - 2	Kaloko, Kona Ocean View	9,550	$ 155,000	$ 16.23
7 - 3	Kona Highlands, Kalaoa, Kona Palisades	12,770	113,500	10.08
7 - 4	Queen Liliuokalani Village, Paniolo Country	9,070	84,700	9.56
7 - 5	Kailua-Kona, Kona Heights, Kona Hillcrest	16,250	170,000	12.85
7 - 6	Holualoa, Alii Kai	10,630	153,000	15.80
7 - 7	Komohana, Kona Sea View	13,210	202,600	16.34
7 - 8	Keauhou	16,720	370,100	22.82
	Average	12,600	$ 178,414	$ 14.69

Source: Multiple Listing Service Hawaii, Inc.

BELT COLLINS & ASSOCIATES

Housing Affordability for Hawaii County Residents
by Income Decile

	1990 resident income decile									
	Very Low/Low				Low/moderate		Moderate	Market		
	D-1	D-2	D-3	D-4	D-5	D-6	D-7	D-8	D-9	D-9.5
1988 maximum annual income(1)	$ 9,000	14,000	19,000	23,700	28,800	33,500	40,200	49,100	64,400	83,300
1990 estimated income(2)	10,000	15,600	21,100	25,600	32,000	38,400	44,800	54,600	71,600	92,600
Monthly maximum income	833	1,300	1,758	2,133	2,667	3,200	3,733	4,550	5,967	7,717
Maximum monthly mortgage principal and interest(3)	150	304	455	579	755	931	1,107	1,377	1,844	2,422
At 10% interest:										
Maximum mortgage amount	17,100	34,600	51,900	66,000	86,000	106,100	126,100	156,900	210,100	275,900
Maximum home purchase price at (4):										
5% down	18,000	36,000	55,000	69,000	91,000	112,000	133,000	165,000	221,000	290,000
10% down	19,000	38,000	58,000	73,000	96,000	118,000	140,000	174,000	233,000	307,000
20% down	21,000	43,000	65,000	83,000	108,000	133,000	158,000	196,000	263,000	345,000
At 9% interest:										
Maximum mortgage amount	18,600	37,800	56,600	72,000	93,800	115,700	137,600	171,100	229,200	300,900
Maximum home purchase price at(4):										
5% down	20,000	40,000	60,000	76,000	99,000	122,000	145,000	180,000	241,000	317,000
10% down	21,000	42,000	63,000	80,000	104,000	129,000	153,000	190,000	255,000	334,000
20% down	23,000	47,000	71,000	90,000	117,000	145,000	172,000	214,000	287,000	376,000

(1) U.S. Department of Housing and Urban Development.

(2) Certain deciles estimated based on 1988 distribution and 1990 median income of $32,000.

(3) 33% of monthly income, less $125 for real property taxes and insurance.

(4) Maximum home purchase price: mortgage principal and interest at specified interest rate, plus down payment; rounded to nearest $1,000.

Exhibit III-H

The exhibit further displays the maximum home price affordable by the highest income in the decile under conventional mortgage financing loan interest rates and downpayment terms. Mortgage interest rates of 9% and 10% are shown.

The decile distribution has housing program, as well as statistical, significance. For housing planning purposes, the deciles are commonly consolidated into four groups:

- The very low/low income group consists of households in the first four deciles, the lowest 40% of the population based on household income.
  - This group includes households earning less than 80% of median income.
  - With a 10% downpayment, maximum home prices for this group are $73,000 to $80,000 depending on the mortgage interest rate.
- The low/moderate income group consists of households in the fifth and sixth decile.
  - This group includes households earning from 80% to 120% of median income.
  - Maximum home prices for the moderate income gap group are $118,000 to $129,000 with a 10% downpayment, varying with the mortgage interest rate.
- The moderate income group consists of households in the seventh decile, earning between 120% and 140% of median income.
- The market group consists of households earning more than 140% of median income.

Review of housing resale trends in the west Hawaii region relative to the purchasing power of resident households indicates some erosion in affordability in 1988 and 1989, especially in regard to single-family homes. Resale prices by affordability group are summarized in Exhibit III-I, with a more typical 20% downpayment assumption used:

- Very low and low income households could afford to purchase at most about one in ten (11%) of the single-family homes sold during 1988. The number of affordable units fell to 3% in 1989.
- Low/moderate income households could afford about one in four (28%) of the single-family homes sold in 1988; by 1989, affordable resales declined to 13% of the total.
- Moderate income households, who could have afforded up to 56% of the single-family homes sold in 1988, could have afforded up to 33% of homes sold in 1989.

Loss of purchasing power in condominium units was not so pronounced in 1988 and 1989, as also shown in Exhibit III-I. However, many resold condominium units are smaller units, are located within resort areas, or are otherwise not desirable to resident households.

BELT COLLINS & ASSOCIATES

Home Resale Prices by Affordability Group
Kealakehe Market Area

1988 to 1989

Income group(1)	Affordable home price(2)	Single-family home sales below maximum price 1988	1989	Condominium unit sales below maximum price 1988	1989
Very low/low income: Up to 80% of median income	$ 80,000	11%	3%	24%	22%
Low/Moderate: 80% to 120% of median income	120,000	28	13	50	46
Moderate: 120% to 140% of median income	150,000	56	33	60	64

(1) From Exhibit III-G.
(2) From Exhibit III-G; rounded, using 20% downpayment.

Exhibit III-1

Exhibit III-J

BELT COLLINS & ASSOCIATES

Advertised Apartment Rents
in West Hawaii Region

August 1986 to April 1990

Survey period	Average rent	Compound annual increase
August 1986	$658	-%
August 1989	810	7.2
April 1990	909	18.3

Source: Hawaii County Office of Housing and Community Development, periodic rent surveys; 1989 and 1990 data from newspaper rental unit advertisements.

Rental Housing Trends

The market for rental housing has tightened significantly in the past several years, due to new jobs and population growth in the west Hawaii region. Among the indicators of diminished rental housing supply are the following:

- Vacancy rates for year-round housing units, which reached 20% in North Kona and South Kohala in the 1980 Census, have declined. A HUD survey in 1987 found an islandwide rental vacancy rate of 6%, with virtually no vacancies in west Hawaii. Additional rental housing has since been constructed in the region.

- Rents on advertised housing units have risen steadily from 1986 to 1990, as shown in Exhibit III-J. Rents were determined from units advertised in the West Hawaii Today regional newspaper. This sample covered about 50 units. Surveyed rents increased at an 18% annual rate in the period ending with April 1990.

- The limited supply of multifamily units consists mainly of rentals in the $700 to $900 monthly range, as shown in Exhibit III-K.

Exhibit III-K

BELT COLLINS & ASSOCIATES

Monthly Rental Rates for
Market Area Multifamily Units

1990

Development	Location	Average unit size		Average rental size	
		One bedroom	Two bedroom	One bedroom	Two bedroom
Kona Bali Kai	Alii Drive	620	1,035	$ 600	$ 1,000
Kona Palms	Alii Drive	825	1,040	700	850
Royal Kahili	Alii Drive	N/A	900	750	900
White Sands	Alii Drive	N/A	1,000	N/A	1,000
Kona Mansions	Kuakini Highway	600	900	550	750
The Villages	Waikoloa Village	700	800	700	900
Waikoloa Hills	Waikoloa Village	700	860	800	950
Fairway Terrace	Waikoloa Village	525	925	890	975
Average		662	933	$ 713	$ 916

N/A Not applicable.

IV - HOUSING SUPPLY, DEMAND AND NEED

This chapter estimates future housing supply and demand in the Kealakehe market area. Planned housing development in the region is detailed, including market, private affordable and government-sponsored projects. Future housing demand is estimated based on current housing inventory, trends in household patterns and expected growth of regional population. Projected housing need in the county and the Kealakehe market area are also summarized.

PLANNED HOUSING DEVELOPMENT

This section details planned housing development in the Kealakehe market area.

Resident Market Housing Projects

Market housing in the region is generally planned to be developed in one of the following types of projects:

- Master-planned communities, large acreages under unified ownership in which a variety of housing products could be developed over an extended time period.
- Resort-oriented communities, consisting of multifamily and single-family properties oriented toward visitors, second-home buyers and full-time residents.
- Agricultural or estate lots, in which lots of 1 acre or more in size are sold for eventual home development.
- Residential lots, where smaller lots are sold for eventual home development or building house/lot packages.
- Subdivisions or multifamily projects, including other housing products marketed to residents.

In resort areas such as west Hawaii, visitor and second-home housing demand is a major force in the market. Resort-oriented communities in particular contain relatively few full-time residents. Thus, growth in the number of resort-oriented communities in the region is not further discussed in this section. Visitor and second-home buyers represent a major market for agricultural or estate lots as well. However, these projects are subsequently discussed because they also serve the resident market.

Exhibit IV-A identifies planned market housing projects in the region. As shown in the exhibit, more than 21,000 potential resident market units are being planned. As also shown in the exhibit:

- At least eight large tracts are proposed for residential communities that could include as many as 16,400 units. However:

Exhibit IV-A

BELT COLLINS & ASSOCIATES

Planned Resident Market Housing Projects
in West Hawaii Region

1989 to 2000

Project		Number units by location: North Kohala	South Kohala	North Kona	Total
Master-planned communities, development underway:					
Waikoloa Village	To 1990	-	150	-	
	1991 to 1995	-	1,800	-	
	1996 to 2000	-	1,500	-	
	Subtotal	-	3,450	-	3,450
Master-planned communities, with government approvals:					
Y-O Ltd.		-	-	1,433	1,433
Master-planned communities, requiring government approvals:					
Parker Ranch 2020		-	800	-	
Signal Puako		-	2,700	-	
Puako Mauka		-	2,000	-	
	Subtotal	-	5,500	-	5,500
Master-planned communities, in conceptual stage:					
Lanihau		-	-	3,000	
Kohala Ranch		3,050	-	-	
Queen Liliuokalani Trust		-	-	N/A	
	Subtotal	3,050	-	3,000	6,050
Agricultural lot or estate projects:					
Kohala-by-the-Sea		73	-	-	
Maliu Ridge		170	-	-	
Waiwailani		85	-	-	
Kapaanui		170	-	-	
Kahua Makai		N/A	-	-	
Puu Lani Ranch		-	-	45	
Waiki'i Ranch		-	-	207	
Mokuloa		-	68	-	
Estates at Waimea		-	44	-	
	Subtotal	498	112	252	862

(Continued)

BELT COLLINS & ASSOCIATES

Planned Resident Market Housing Projects
in West Hawaii Region, Continued

1989 to 2000

Project	Number units by location: North Kohala	South Kohala	North Kona	Total
Residential lot projects, with governmental approvals:				
Ainakea	165	-	-	
South Kohala View Estates	-	46	-	
Subtotal	165	46	-	211
Other housing projects, with government approvals:				
Taiyo Fudasan	-	-	300	
Kona Coast Associates	-	-	950	
Gamlon	-	-	500	
Alii Village	-	-	368	
Kaulana at Kona	-	-	276	
Subtotal	-	-	2,394	2,394
Other housing projects, requiring government approvals:				
Pualani	-	-	546	
Kona Woods	-	-	110	
Pu'uhonua	-	-	479	
Subtotal	-	-	1,135	1,135
Total units planned	3,713	9,108	8,214	21,035

- Only one project, Waikoloa Village, has advanced in its development program to offer product today.

- One other project has necessary government approvals.

- More than 11,500 of the planned units are still in conceptual design or government approvals processing. Years of infrastructure development will be required before housing is developed.

- More than 800 agricultural and estate lots are planned for the region, in addition to large lots to be developed at Waikoloa Village and Kohala Ranch.

- More than 3,700 units are planned within smaller projects. About one-third, or 1,100 units, require additional government approvals.

Private Affordable Housing Projects

State and county agencies have anticipated future needs by establishing affordable housing development requirements as a condition of development approval. Conditions normally take one of several forms:

- In the case of resorts and other employment-generating projects, a requirement that a certain number of affordable housing units be provided for employees.

- In the case of projects with a residential component, a requirement that a percentage of units developed be priced to be affordable by households in specific income brackets.

- As alternatives, developers are mandated to meet affordable housing needs through donation of land or money to allow government or non-profit development of affordable housing.

Establishment of affordable housing requirements encourages developers to utilize available government programs to reduce costs. However, meeting requirements is not predicated on government assistance.

Exhibit IV-B indicates the affordable housing commitments mandated in the region. As shown in the exhibit:

- The amount of affordable units required will be related to the ultimate project build-out. Since most commitments are expressed as a percentage of total residential units built, scaling back the resort or residential development program would reduce the number of affordable units as well.

- About 7,000 affordable units could be required, if all projects are built out to the maximum numbers planned.

Exhibit IV-B

BELT COLLINS & ASSOCIATES

Hawaii County Affordable Housing
Commitments by Target Group

Project/developer	Planned market housing units	Target groups for affordable units: Below 80% of median	80% to 120%	120% to 140%	Total(3)	Comments
Resort projects:						
South Kohala Resort	550	-	-	-	-	$2,043,000 cash payment accepted.
Waikoloa Beach	3,400	-	-	-	-	Providing land; 32 units built.
Keauhou	1,300	-	-	-	170	Not yet established.
Mauna Lani	3,000	-	-	-	-	
Kona Village	-	-	-	-	-	$100,000 cash payment accepted.
Punalu'u	1,870	-	-	-	-	Subject to future study.
Kaupulehu	600	122	237	359	718	
Regent Beach	200	254	494	749	1,497	
Kohanaiki	500	161	312	473	945	
Subtotal(1)	11,420	537	1,043	1,581	3,330	
Residential projects:						
Gamlon(2)	500	-	-	-	50	
Y-O Ltd.(2)	1,433	-	-	-	143	
Ainakea(2)	165	-	-	-	10	5.7 acres donated in additon.
Colony Associates	70	-	-	-	-	$175,000 cash payment accepted.
Kohala Ranch	3,050	305	610	915	1,830	
Keauhou Investment	310	-	-	-	31	
Signal Puako	2,700	-	810	810	1,620	
Subtotal(1)	8,228	305	1,420	1,725	3,684	
Total affordable units(1)		842	2,463	3,306	7,014	

(1) Requirements by target group do not add to total, as some are not specified by target group.

(2) Pricing of affordable units not specified.

(3) Total with maximum project buildout; affordable units could be located on- or off-site; subject to further negotiation under specific agreements.

Sources: County of Hawaii, Office of Housing and Community Development, and State of Hawaii, Housing Finance and development Corporation.

As also indicated by the exhibit, a relatively small number of affordable units have been built to date. Affordable units have been constructed at Waikoloa Village and at Ainakea, and the La'ilani project was developed by Mauna Lani Resort. A total of 257 affordable units have been built as a result of land use requirements.

Exhibit IV-B also summarizes the affordable housing commitments, in terms of the market group mandated to be served. As the exhibit indicates:

- Most of the almost 7,000 affordable units mandated are targeted to specific income groups.
- Relatively few of the units, about 800, are mandated to be affordable by households earning less than 80% of the area median income.
- Less than half of the mandated units are reserved for those earning less than 120% of median income.

Unlike the more than 21,000 planned units identified in Exhibit IV-A, private affordable units do not necessarily represent an increase in housing supply. Instead, the land use requirements could contribute to a redistribution of housing product toward a greater percentage of lower-priced units.

The extent to which the existing affordable housing commitments actually deliver affordable units depends on a number of factors, including:

- Availability of government housing assistance
- Availability of infrastructure to service new residential communities
- Success in marketing lower-priced homeownership units and leasing affordable rentals
- Degree to which developers seek to maximize unit counts in project build-out
- Flexibility in negotiating satisfaction of commitments

Government agencies could perform a supportive and expediting role through such means as:

- Providing serviced land or developing public facilities
- Efficiently staging land so that it is available for development at appropriate times
- Assisting builders in realizing cost savings
- Providing home buyer and renter assistance
- Reducing affordable housing investment risk

In each of these areas, ongoing development of a government-sponsored, master-planned community at Kealakehe could provide a crucial bridge between housing need and existing affordable housing commitments.

Planned Government-Sponsored Housing Projects

Exhibit IV-C shows the affordable housing projects in planning or development by government housing agencies on the island of Hawaii. About 3,500 units are in the planning stages; as also shown by the exhibit:

- The county's Office of Housing and Community Development (OHCD) is planning almost 2,000 units.
  - However, all but about 100 of the units are planned for after 1992.
  - The county's major project in the region is planned for a 300-acre site at Waikoloa Village, where more than 1,700 units could be developed.
- The Department of Hawaiian Home Lands has an ambitious program to lease homestead lands to eligible native Hawaiians. Two homestead areas in the west Hawaii region, at Waimea and Kawaihae, could accommodate additional housing, although industrial, commercial and agricultural leases are also anticipated.
- Smaller projects are planned by the OHCD, Hawaii Housing Authority and Department of Health to accommodate special needs, as for the handicapped and those requiring group living facilities.
- In addition to the Kealakehe project, the HFDC has plans for about 500 affordable units on the island. Three projects are planned in west Hawaii, although most units would not be built until after 1992.

PROJECTED HOUSING DEMAND

This section projects future demand for housing in the Kealakehe market area, based on anticipated population, household patterns and market trends.

Factors Affecting Projected Housing Demand

The amount of units required to meet future housing demand is affected by a number of factors, including:

- Projected population growth
- Trends in household size
- Current resident housing inventory
- Loss of existing units
- Targeted numbers of vacant available units

Projections of persons per housing unit and targeted vacancy rates introduce the greatest variability in housing demand projections.

Exhibit IV-C

BELT COLLINS & ASSOCIATES

Planned Affordable Housing Projects
in the County of Hawaii

1990 to 1992

Project	Location	Unit completion date 1990	1991	1992	Future	Total
Housing Finance Development Corporation:(1)						
Homeownership:						
Milolii	South Kona	44	-	-	-	44
Piihonua Meadows	Hilo	37	-	-	-	37
Hale Nama Olama	Hilo	-	-	41	-	41
Lalamilo	South Kona	31	-	-	-	31
Kealakehe	North Kona	28	10	-	-	38
Upper Lalamilo	South Kohala	-	-	50	250	300
Other:						
HCC model homes	Hilo	1	1	1	2	5
Total		141	11	92	252	496
Department of Hawaiian Home Lands:						
Homeownership:						
Lot development(2)	Homestead areas	-	454	-	523	977
Hawaii Housing Authority:						
Special needs housing:						
Emergency shelter	Hilo	-	4	-	-	4
Teacher housing	South Kohala	2	-	-	-	2
Total		2	4	-	-	6
Department of Health:						
Special needs housing:						
SDMI units(3)	Various	-	2	-	-	2
County of Hawaii:						
Homeownership:						
Waikoloa	North Kona	-	-	-	1,200	1,200
Kona	North Kona	-	-	12	-	12
Ainakea	North Kohala	10	-	-	-	10
Hilo	Hilo	-	-	8	-	8
Total		10	-	20	1,200	1,230

BELT COLLINS & ASSOCIATES

Planned Affordable Housing Projects
in the County of Hawaii, Continued

1990 to 1992

Project	Location	Unit completion date 1990	1991	1992	Future	Total
Affordable rentals:						
Waikoloa	North Kona	-	-	-	525	525
Elderly rentals:						
Waimea	South Kohala	25	-	-	-	25
Kona	Undetermined	25	-	-	-	25
Ainakea	North Kohala	21	-	-	-	21
Hilo	Hilo	-	-	25	-	25
Honokaa	Hamakua	-	-	-	50	50
Papaaloa	North Hilo	-	-	-	25	25
Pahala	Ka'u	-	-	-	10	10
Puna	Puna	-	-	-	25	25
Total		71	-	25	110	206
Handicapped rentals:						
Hale Ulu Hoi	Hilo	18	-	-	-	18
Total planned units		242	471	137	2,610	3,460

(1) Many projects could be developed with a combination of County, HFDC and Federal Assistance.

(2) Lots may be leased without subdivision improvements.

(3) New or renovated housing for severely disabled-mentally impaired.

The number of persons per housing unit has been declining for both the state and for Hawaii County during the 1970s and 1980s. Even smaller households are expected in the future, with more single-person households, split families, and elderly-headed households. Estimates of household size trends since 1980 are presented below:

Household Size Estimates
State of Hawaii and Hawaii County

1980 to 1987

	State	County
1980(1)	3.15	3.09
1985(2)	3.06	3.08
1987(3)	3.02	2.98

(1) U.S. Bureau of Census, "1980 Census of Population and Housing".

(2) U.S. Bureau of Census, "Estimates of Households, for Counties, July 1, 1985".

(3) State estimates, from U.S. Bureau of Census, "current Population Reports, Population Estimates and Projections"; County estimates from U.S. Department of Housing and Urban Development, "Comprehensive Housing Market Analysis Hawaii County Housing Market Area".

As noted in Chapter III, housing vacancy rates have varied greatly in Hawaii County in the 1980s. A 5% vacancy rate is considered optimal by HUD in order to provide some market choice to consumers.

Projected Housing Demand for the County of Hawaii

Exhibit IV-D projects the number of additional housing units required to shelter the population of Hawaii County through 2010. These projections use the following assumptions:

- Population is as estimated under the State of Hawaii's Series M-K projections for the county.
- Persons per housing unit are estimated at 2.8 in 1990, trending down to 2.7 persons per unit by 2010.
- Future loss of housing units is estimated at demolition rates observed from 1980 to 1988.

Exhibit IV-D

BELT COLLINS & ASSOCIATES

Projected Housing Demand
County of Hawaii

1987 to 2010

	1990	1995	2000	2005	2010
Housing demand:					
Population(1)	124,600	142,500	160,400	180,800	206,100
Persons per housing unit(2)	2.8	2.8	2.75	2.75	2.7
Total units required, rounded	44,500	50,900	58,300	65,700	76,300
Housing supply:					
1988 housing stock(3)	42,900	40,320	40,100	39,880	39,660
Projected demolitions for period(4)	225	225	225	225	225
Nonresident unit inventory(5)	2,354	-	-	-	-
Remaining resident units, rounded	40,320	40,100	39,880	39,660	39,440
Excess of demand over supply	4,180	10,800	18,420	26,040	36,860
Additional vacancy factor	4%	4%	4%	4%	4%
Additional units to meet vacancy factor, rounded(6)	1,780	2,040	2,330	2,630	3,050
Cumulative total resident units needed, rounded	6,000	12,800	20,800	28,700	39,900
Total resident units needed per year for period	3,000	1,360	1,600	1,580	2,240
Average annual resident units needed					1,730

(1) From Exhibit II-A.
(2) Projected by Hawaii County Planning Department.
(3) Bank of Hawaii, Construction in Hawaii 1989.
(4) Based on 1980-1988 data.
(5) DBED, "Housing Unit Estimates for Hawaii, 1970-1988".
(6) 1988 vacancy rate estimated at 1%.

- Demand is estimated assuming a 5% vacancy rate to provide consumer choice.

- No allowance is made for existing pent-up demand for affordable rental or homeownership units.

The year 1988 is used as a baseline to estimate the existing housing inventory. As shown in the exhibit, additional housing unit demand is projected to amount to:

- A total of 4,200 housing units for the island as a whole by 1990, less resident units constructed in the 1988-1990 period. Resident housing unit completions would have to amount to more than 2,100 units annually.

- An additional 6,800 units from 1991 to 1995, representing unit completions at a rate of almost 1,400 units per year.

- An additional 8,000 units from 1996 to 2000, and 7,900 units from 2001 to 2005, representing annual completion of more than 1,600 resident units.

- An additional 11,200 units from 2006 to 2010, representing annual completion of more than 2,200 resident units.

An overall total of 39,900 units would be required over the period, less resident homes completed from 1988 to 1990. This would represent an average of more than 1,700 additional resident units completed each year.

Projected Housing Demand in Kealakehe Market Area

More than half of the future housing demand on the island of Hawaii will be associated with population growth in the Kealakehe market area. As shown in Exhibit IV-E, 25,540 additional housing units could be needed in the region by 2010 based on population growth indicated above in Exhibit II-C. Market demand, as shown in Exhibit IV-E, would be as follows:

- North Kohala demand of about 50 units per year.
- South Kohala demand of about 310 units annually.
- North Kona demand of about 570 units per year.
- South Kona demand of about 120 units annually.
- Hamakua demand of about 20 units per year.

Total market area demand could require addition of 1,070 units per year from 1987 to 2010.

AFFORDABLE HOUSING NEED

This section summarizes housing need for the county of Hawaii and the Kealakehe market area through 2010. Goals are established for affordable homeownership and rental units for the island and market area.

BELT COLLINS & ASSOCIATES

Projected Cumulative Housing Demand by District
Kealakehe Market Area

1988 to 2010

	Estimated 1987 resident housing units(1)	Additional housing units 1990	1995	2000	2005	2010	Units per year
North Kohala	1,263	190	370	630	850	1,160	50
South Kohala	2,769	500	1,540	3,020	4,830	7,440	310
North Kona	7,965	800	2,920	5,800	9,130	13,680	570
South Kona	2,097	840	1,210	1,720	2,210	2,870	120
Hamakua	1,804	160	200	280	310	390	20
Existing units	15,898						
Total market area demand		2,490	6,240	11,450	17,330	25,540	1,070

(1) Total housing inventory from Hawaii County Planning Department land use inventory, excluding visitor units.

Exhibit IV-E

Affordable Homeownership Unit Targets

Historically, the extent of homeownership has been related to household income level. This is shown for the state as a whole for 1980 in Exhibit IV-F, which indicates:

- There is a direct relationship between income and ownership. While less than 25% of households earning under $10,000 in 1979 were homeowners, more than 80% of those earning more than $35,000 owned their homes.

- Although homeownership is less widespread in lower income brackets, many lower-income households are owners. This reflects many elderly-headed households, where lower present incomes do not reflect long-term ownership of homes purchased at far lower price levels than currently prevail.

- A sizeable minority of households with incomes seemingly sufficient to qualify for homeownership still rent. In 1979, almost half -- 45% -- of households earning from $20,000 to $25,000 annually were renting. This reflects a shortage of moderately-priced housing, and also a possible lack of units suitable for families at moderate prices.

Exhibit IV-G presents similar information on the income distribution of owners and renters in Hawaii County in 1980. Overall homeownership in the county was higher than for the entire state, due primarily to greater numbers of lower-income and moderate-income owners.

The current ability of Hawaii County resident households to afford homeownership units, relative to their income, was described previously in Exhibit III-H. A similar distribution of the population into deciles is used to estimate affordable homeownership unit goals in Exhibit IV-H, as follows:

- The State Housing Functional Plan goal of 60% homeownership among resident households is used as the target.

- A distribution of owners by income decile is shown to indicate the probable distribution by 2010 if ownership follows the declining trend shown for Hawaii County in the 1980-1987 period. With this distribution, owner occupancy declines to 38% of resident households in 2010.

- The 60% overall homeownership rate is applied to the income distribution of households, in order to establish what proportion of each 10% of households -- each decile -- would have to attain homeownership in order to reach the 60% overall homeownership goal.

- The difference of homeowners in each decile represents additional homeownership units needed. These are distributed to the Kealakehe market area and other areas of the county on the basis of projected location of households shown in Exhibits IV-D and IV-E.

BELT COLLINS & ASSOCIATES

Household Tenure by Income for
State of Hawaii, 1980

Income in 1979	Owners	Renters	Percent owners	Total	Percent of total median income		Percent paying 35% or more of income for rent
					Minimum	Maximum	
Less than $ 5,000	$ 5,713	18,689	23.4%	24,402	-%	24.4%	96.7%
5,001 to 9,999	10,035	29,664	25.3	39,699	24.4	48.8	70.3
10,000 to 12,499	6,746	15,904	29.8	22,650	48.8	61.1	50.5
12,500 to 14,999	6,443	12,588	33.9	19,031	61.1	73.3	37.1
15,000 to 19,999	15,352	22,359	40.7	37,711	73.3	97.7	31.4
20,000 to 24,999	19,078	15,863	54.6	34,941	97.7	122.1	19.3
25,000 to 34,999	35,653	16,729	68.1	52,382	122.1	171.0	9.4
35,000 to 49,999	32,226	7,366	81.4	39,592	171.0	244.2	3.4
50,000 +	20,670	2,974	87.4	23,644	244.2%	-%	1.1%
Totals	151,916	142,136	51.7%	294,052			
Median income	$ 28,263	13,853		20,473			

Source: 1980 Census of Population and Housing.

Exhibit IV-F

BELT COLLINS & ASSOCIATES

Household Tenure by Income for
Hawaii County, 1980

Income in 1979	Owners	Renters	Percent owners	Total	Percent of total median income Minimum	Maximum	Percent paying 35% or more of income for rent
Less than $ 5,000	1,162	2,222	34.3%	3,384	-%	26.1%	44.6%
5,001 to 9,999	1,843	2,591	41.6	4,434	26.1	52.3	24.0
10,000 to 14,000	2,357	1,995	54.2	4,352	52.3	78.4	14.8
15,000 to 19,000	2,156	2,263	48.8	4,419	78.4	104.5	9.7
20,000 +	8,326	2,759	75.1	11,085	104.5%	-%	3.5%
Total	15,844	11,830	57.3%	27,674			
Median income				$ 19,131			

Source: Census of Population and Housing, STF 3-A file for Hawaii County.

U.S. Department of Housing & Urban Development, "Estimated median family income for fiscal year 1988."

Exhibit IV-G

BELT COLLINS & ASSOCIATES

Affordable Homeownership Unit Targets
with Projected Trend
Hawaii County

1990 to 2010

	2010 resident income deciles (in 1990 dollars)										
	Very low/low				Low/moderate		Moder-ate	Market			Total average
	D-1	D-2	D-3	D-4	D-5	D-6	D-7	D-8	D-9	D-9.5	
Maximum annual income(1)	$10,000	15,600	21,100	25,600	32,000	38,400	44,800	54,600	71,600	92,600	32,000
Number of households(2)	7,600	7,600	7,600	7,600	7,600	7,600	7,600	7,600	7,600	3,800	76,000
Projected renters by decile, 2010(3)	90%	85%	85%	85%	80%	75%	55%	30%	20%	10%	61.0%
Number of households in decile:											
Renter	6,800	6,500	6,500	6,500	6,100	5,700	4,200	2,300	1,500	400	46,900
Owner	800	1,100	1,100	1,100	1,500	1,900	3,400	5,300	6,100	3,400	29,100
Percentage owners to meet 60% goal	10.0%	15.0%	30.0%	45.0%	60.0%	70.0%	75.0%	80.0%	80.0%	90.0%	
Additional owners	-	-	1,200	2,300	3,100	3,400	2,300	800	-	-	13,100
Kealakehe market area	-	-	720	1,380	1,860	2,040	1,380	480	-	-	7,860
Rest of island	-	-	480	920	1,240	1,360	920	320	-	-	5,240

(1) From Exhibit III-H.

(2) Based on projected households in 2010, from Exhibit IV-D.

(3) Estimated from 1980 Census data; adjusted for change in homeownership patterns in county from 1980 to 1988 and projected to 2010.

Exhibit IV-H

- Additional homeownership units projected to be required are:
  - A total of 13,100 units for Hawaii County as a whole.
  - Approximately 7,860 units within the Kealakehe market area.
  - About 800 of those units would be required for households earning more than 140% of median income, leaving a total of 12,300 ownership units required for households earning less than 140% of median income.

The needed pricing of affordable units to accommodate additional homeowners, based on their ability to pay, is shown in Exhibit IV-I. Maximum unit pricing based on the general housing need groups, is shown below:

Required Affordable Homeownership Units
by General Income Category

Category	Percent median income	Units required		Maximum unit price(1)
		County	Market area	
Very low/low income	80%	3,500	2,100	$ 80,000
Low/moderate	120%	6,500	3,900	127,000
Moderate and market	120%-140%	2,300	1,380	150,000
Total		12,300	7,380	

(1) Based on 9% mortgage interest rate and 10% down payment.

Affordable Rental Unit Targets

The need for affordable rental units is estimated from historical patterns of ability to pay for rental housing, applied to a population of households assumed to be composed of 60% homeowners. Affordable rental unit targets are shown in Exhibit IV-J, and calculated as follows:

- A similar distribution of households by income and tenure is used as with the homeownership unit targets, although it is calculated from percentage of renters in each income decile.
- Based on percentage of households paying more than 35% of income for rent in 1980, as shown in Exhibit IV-G for Hawaii County, the projected number of renters in need is estimated for 2010 for the county as a whole and for the Kealakehe market area. Projections by income group are shown below.

BELT COLLINS & ASSOCIATES

Affordable Homeownership Unit Targets
by Unit Price Range with Projected Trend
Hawaii County

1989 to 2010

	2010 resident income deciles (in 1990 dollars)										
	Very low/low			Low/Moderate			Moder-ate	Market			Total average
	D-1	D-2	D-3	D-4	D-5	D-6	D-7	D-8	D-9	D-9.5	
To meet 60% homeownership goal:											
Additional owners	-	-	1,200	2,300	3,100	3,400	2,300	800	-	-	13,100
Kealakehe market area	-	-	720	1,380	1,860	2,040	1,380	480	-	-	7,860
Rest of island	-	-	480	920	1,240	1,360	920	320	-	-	5,240
Maximum home purchase price at 9% interest and:											
5% down			60,000	76,000	99,000	122,000	145,000	180,000			
10% down			63,000	80,000	104,000	129,000	153,000	190,000			
20% down			71,000	90,000	117,000	145,000	172,000	214,000			
Maximum home purchase price at 10% interest and:											
5% down			55,000	69,000	91,000	112,000	133,000	165,000			
10% down			58,000	73,000	96,000	118,000	140,000	174,000			
20% down			65,000	83,000	100,000	133,000	158,000	196,000			

Exhibit IV-I

BELT COLLINS & ASSOCIATES

Affordable Rental Unit Targets
Hawaii County

1989 to 2010

	2010 resident income deciles (in 1990 dollars)										Total average
	Very low/low				Low/moderate		Moder-ate	Market			
	D-1	D-2	D-3	D-4	D-5	D-6	D-7	D-8	D-9	D-9.5	
Maximum annual income(1)	$ 10,000	15,600	21,100	25,600	32,000	38,400	44,800	54,600	71,600	92,600	32,000
Number of households(2)	7,600	7,600	7,600	7,600	7,600	7,600	7,600	7,600	7,600	3,800	76,000
Projected renters by decile 2010, with 60% ownership(3)	90.0%	85.0%	70.0%	55.0%	40.0%	30.0%	25.0%	20.0%	20.0%	10.0%	40.0%
Renter households	6,800	6,500	5,300	4,200	3,000	2,300	1,900	1,500	1,500	400	33,800
Percentage renters in need(4)	45.0%	45.0%	25.0%	10.0%	10.0%	7.5%	7.5%	5.0%	5.0%	3.5%	
Number of renters	3,100	2,900	1,300	400	300	200	100	100	100	-	8,500
Kealakehe market area	1,860	1,740	780	240	180	120	60	60	60	-	5,100
Rest of island	1,240	1,160	520	160	120	80	40	40	40	-	3,400

(1) Maximum income in 1988 from U.S. Department of Housing and Urban Development, adjusted with 1989 median.

(2) Based on projected households in 2010, from Exhibit IV-F.

(3) Estimated from 1980 Census data; adjusted for change in homeownership patters in county from 1980 to 1987 and projected to 2010.

(4) Based on percentage of renters paying more than 35% of income for housing from Exhibit IV-1.

Exhibit IV-J

Projected Renters in Need
by Income Group

Category	Percent median income	County total	Market area	Maximum monthly rent(1)
Very low/low income	80%	7,700	4,080	$ 535- 618
Low/moderate	120%	500	270	855- 938
Moderate and market	120%-140%	100	50	1,025-1,108
Total		8,300	4,400	

(1) Based on maximum rent equivalent to 30% of monthly gross income less utility expense allowance as established by HUD.

V - KEALAKEHE HOUSING MARKET ASSESSMENT

This chapter assesses support for affordable and market-priced housing at the Kealakehe planned community. The number of homes of each type supportable at the site is estimated on the basis of projected demand in the market area and anticipated market conditions. Market support is also presented by five-year time interval for the project development period from 1990 to 2010 and for affordable homeownership and rental units, and market units.

Home sales and rental projects under development in the region comparable to the Kealakehe projects are also reviewed. Based on the comparable projects, recommendations are made for development phasing and unit characteristics.

SUPPORTABLE HOUSING UNITS

This section identifies the number of affordable and market-priced housing units potentially supported at Kealakehe. Market support is further segmented into homeownership and rental units, and is estimated by five-year interval through the project development period.

Supportable Affordable Units at Kealakehe

Islandwide and market area projected housing demand was estimated in Chapter IV. Estimates of required affordable ownership and rental units from Chapter IV are used to identify supportable units at Kealakehe, with one adjustment:

- Required additional homeownership units include those needed for households in the 120% to 160% of median income category. More widespread homeownership in this group would be required to reach the 60% ownership goal of the State Housing Functional Plan..

- The HFDC development program targets new community development toward households earning less than 120% of median income. Therefore affordable unit demand is limited to units available for those earning less than 120% of median income.

Supportable affordable units are shown in Exhibit V-A, and estimated as follows:

- Affordable ownership and rental unit demand groups were projected for the market area in Exhibits IV-H and IV-J, respectively. Because affordable rental and ownership demand were independently projected based on affordability criteria, some households could be both potential renters or homeowners.

- Capture rates, expressing the percentage of total demand that could be accommodated at Kealakehe, are estimated for each income and tenure group:

  - The Kealakehe project is estimated to capture from about 30% to 35% of affordable homeownership demand in the market area. Capture rates rise with income, reflecting the increasing ability of households to purchase homes with higher incomes.

Exhibit V-A

BELT COLLINS & ASSOCIATES

Affordable Housing Market Support
for Kealakehe Planned Community

1990 to 2010

	County total	Market area total	Projected Kealakehe site capture rates Low	High	Planned units Low	High
Affordable unit demand:						
Ownership units(1):						
Low/moderate income	10,000	6,000	30%	35%	1,800	2,100
Subtotal	10,000	6,000	30	35	1,800	2,100
Rental units(2):						
Very low/low income	7,700	4,620	15	25	690	1,160
Subtotal	7,700	4,620	15	25	690	1,160
Total demand(3)	17,700	10,620	23%	31%	2,490	3,260

(1) Projected renter households earning less than 120% of area median income as shown in Exhibit IV-H.

(2) Projected renter households earnings less than 80% of median income and paying excessive rent as shown in Exhibit IV-J.

(3) Total is greater than need group due to some renters being part of both potential owner and renter demand groups.

- The Kealakehe project is estimated to capture from about 15% to 25% of affordable rental unit demand in the market area. Capture rates also rise with renter income. Renter capture rates are expected to be lower than homeowner rates due to:
  - The preponderance of low income renters
  - The difficulty of producing heavily subsidized low-rent housing in quantity
  - The fact that many of the already planned affordable projects on the island, as shown previously in Exhibit IV-B, are targeted at households earning less than 80% of median income.

As shown in Exhibit V-A, affordable housing unit support at Kealakehe is estimated at from about 2,490 to about 3,260 units through the year 2010.

Supportable Market Units at Kealakehe

The Kealakehe planned community is intended to address a broad range of housing needs, including those which can be met with market-priced units. Market housing demand is estimated based on:

- Overall market area demand of 25,540 units, as shown previously in Exhibit IV-E.
- From overall market area demand, affordable unit demand to be accommodated at Kealakehe is subtracted. A mid-range number of 2,875 affordable units is applied from Exhibit V-A.
- Remaining market area demand is projected to be 22,665 units through the year 2010.

It is estimated that the Kealakehe community could capture from 5% to 10% of market housing unit demand from 1990 to 2010. The Kealakehe share of new market units could represent from 1,130 to 2,270 units.

Total Market Support for Housing Development at Kealakehe

Total market support consists of supportable affordable and market-priced units at Kealakehe. Based on the findings of this chapter, supportable units range from 3,620 to 5,530 units, as shown below:

Summary of Market Support for
Kealakehe Planned Community Housing Development
1990 to 2010

Type of unit	Range of market support Low	High
Affordable:		
Ownership	1,800	2,100
Rental	690	1,160
Subtotal	2,490	3,260
Market units:	1,130	2,270
Total projected supportable units	3,620	5,530

Exhibit V-B

BELT COLLINS & ASSOCIATES

Cumulative Market Support for
Kealakehe Planned Community by Time Period

1990 to 2010

Type of unit	1990	1995	2000	2005	2010	Total
Affordable ownership units:						
Cumulative demand(1)	600	1,720	3,300	4,500	6,000	6,000
Market support:						
Low	180	520	990	1,350	1,800	1,800
High	210	600	1,160	1,580	2,100	2,100
Affordable rental units:						
Cumulative demand(2)	460	1,320	2,540	3,470	4,620	4,620
Market support:						
Low	70	200	380	520	690	690
High	120	330	640	870	1,160	1,160
Subtotal affordable units:						
Low	250	720	1,370	1,870	2,490	2,490
High	330	930	1,800	2,450	3,260	3,260
Market units:						
Cumulative demand(3)	2,200	5,415	9,865	15,170	22,665	22,665
Market support:						
Low	110	270	490	760	1,130	1,130
High	220	540	990	1,520	2,270	2,270
Total supportable units:						
Low	360	990	1,860	2,630	3,620	3,620
High	550	1,470	2,790	3,970	5,530	5,530

(1) From Exhibit IV-H.

(2) From Exhibit IV-J.

(3) Cumulative market area demand, from Exhibit IV-E, less mid-range of affordable development at Kealakehe.

Supportable Units by Time Period

Cumulative market support for Kealakehe housing units over the development period is shown in Exhibit V-B. As noted in the exhibit:

- The market is projected to support from 250 to 330 affordable units and from 110 to 220 market units in 1990.
- Cumulative support could increase to from about 1,860 to about 2,790 units by 2000.
- Market support could further grow to the 3,620-unit to 5,530-unit range by 2010.

Market support segmented by five-year time period is shown in Exhibit V-C. This exhibit indicates that:

- In general, market support will increase over the twenty-year development period, in line with regional growth.
- Annual absorption in the 1990 to 1995 period could reach 200 to 290 units at average capture rates.
- The highest degree of potential market absorption, after initial development, could occur in the 2005 to 2010 period, when from 200 to 310 units could be absorbed annually.
- Annual absorption over the entire development period could range from 170 to 260 units, depending upon the size of the development program.

RESIDENTIAL DEVELOPMENT CHARACTERISTICS

This section identifies significant site factors affecting development characteristics of the Kealakehe site. Comparable ownership and rental projects in the Kealakehe market area are reviewed, and recommendations are presented for housing characteristics and development phasing.

Site Factors

The characteristics of the Kealakehe property and development plan could influence the types, mix and pricing of planned housing units. The following could be particularly significant:

- Project areas planned for housing may need buffering or separation from nearby uses with negative impacts such as Queen Kaahumanu Highway and the Kealakehe landfill. Planned major roads through the project may also require buffering. Provision of open space might necessitate somewhat higher densities or smaller residential lots.
- The planned golf course could represent a major buffer, open space and visual amenity.

Exhibit V-C

BELT COLLINS & ASSOCIATES

Incremental Market Support for
Kealakehe Planned Community by Time Period

1990 to 2010

Type of unit	1990	1995	2000	2005	2010	Total
Affordable ownership units:						
Low	180	340	470	360	450	1,800
High	210	390	560	420	520	2,100
Affordable rental units:						
Low	70	130	180	140	170	690
High	120	210	310	230	290	1,160
Market units:						
Low	110	160	220	270	370	1,130
High	220	320	450	530	750	2,270
Total supportable units:						
Low	360	630	870	770	990	3,620
High	550	920	1,320	1,180	1,560	5,530
Units per year(1):						
Low	-	200	170	150	200	170
High	-	290	260	240	310	260

(1) Based on initial development in 1990.

- The property generally slopes upward from about 50 feet above sea level at the Queen Kaahumanu Highway property line to about 1000 feet at the eastern property line. Higher portions of the property feature excellent ocean and coastal views and a cooler climate with greater rainfall.

- Kealakehe would be a master-planned development, with parks, schools and other community facilities conveniently located in relation to residential neighborhoods.

- Regional development trends and county policies embodied in the draft "K to K Plan", indicate that Kealakehe will be located within the future Kailua-Kona regional center, with nearby employment, shopping and government service facilities.

Comparable Housing Projects Review

This section reviews recently opened rental and sales projects that could be comparable to homes to be developed at Kealakehe. Project characteristics, unit types and amenities are described, as well as pricing and unit sizes. Characteristics of project buyers and renters are summarized.

Comparable Home Sales Projects

Three home sales projects in the Kealakehe market area were selected for review, based on:

- Location
- Sales price affordability to moderate income buyers
- Potential similarity to Kealakehe development concept
- Current or recent sales program

The comparable projects, each located in Kailua-Kona, are:

- The Kamani Trees condominium subdivision
- The Pines at Kailua-Kona planned unit development
- Kuakini Makai subdivision

Project characteristics are summarized in Exhibit V-D. As shown in the exhibit:

- Lot size - Kuakini Makai provides individual lots at a minimum of 10,000 square feet area, which represents typical county residential zoning and a preferred size for home buyers. The Kamani Trees and Pines developments feature much smaller lot sizes, ranging from 3,100 to 6,400 square feet. Strong sales indicate that smaller lot sizes have become more acceptable acceptable to buyers of lower-priced homes. Lot sizes indicate the greatest differentiation among the comparable projects.

- Density - With smaller lot sizes, the Kamani Trees and Pines projects achieve single-family unit densities greater than 6 units per acre. The more conventional subdivision pattern at Kuakini Makai yields less than 4 units per acre.

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Comparable Kealakehe Market Area
Home Sales Project Characteristics

	Kamani Trees	Pines	Kuakini Makai
Developer	James P. Schuler & Associates	Taiyo Hawaii, Ltd.	Maryl Development
Location	Kealoha Street, Kailua-Kona	Nani Kailua Drive, Kialua-Kona	Kailua-Kona
Status	Phase I sold and under construction	Two of four planned increments built and sold	First of two planned increments built and sold
Land ownership	Fee simple	Fee simple	Fee simple
Unit type	Detached single-family	Zero lot line single-family	Detached single-family
Units	137	189	34 - increment I 99 - total units
Density (units/acre)	6	6.3	3.5
Lot size (square feet)	5,000 (average)	3,200 (average)	10,000 (minimum)
Common amenities	None	Landscaped, maintained common areas, private park	Ocean views, lots graded and landscaped
Pricing	$121,900 - 131,900 (2/2 units) $138,900 - 146,900 (3/2 units) $160,000 (3/2.5 units)	$117,500 - 142,000 (Phase I) $125,500 - 155,000 (Phase II)	$144,900 (Phase I) $179,000 - 215,000 (Phase II)
Unit distribution			
1 bedroom	30%	-%	-%
2 bedroom	60	80	50
3 bedroom	10	20	50
Unit size:			
1 bedroom	800 - 860	-	-
2 bedroom	1,000	1,070 - 1,180(1)	1,272
3 bedroom	1,225	1,350(1)	1,376
Common area maintenance	$15 - $18/month	$97 - $117/month	Nome

(1) Including lanai, excluding garage area.

Source: Interviews with developers, real estate brokers and property managers.

Exhibit V-D

- Common amenities - The projects provide few, if any, common facilities. Most amenities take the form of upgrading within the units.

- Maintenance fees - Common area maintenance fees are assessed at both the Kamani Trees and Pines projects. While Kamani Trees monthly fees are relatively low at $15 to $18, Pines buyers would pay from $97 to $117, which covers landscaping and maintenance of sidewalks, streets and other improvements in front yards.

- Number of bedrooms - Two-bedroom units represent half or more of the homes in each of the projects, with three-bedroom units accounting for the remainder.

- Unit size - There is substantial variation in unit size, ranging from 800 to almost 1,300 square feet for two-bedroom units, and from 1,000 to almost 1,400 square feet for three-bedroom units.

- Pricing - Units currently in sales at the Kamani Trees project are the least expensive, with two-bedroom prices ranging from $121,900 to $131,900. Pricing for new increments at the Pines and Kuakini Makai have risen substantially from earlier sales, and were projected to start at $125,500 and $179,000, respectively.

Exhibit V-E summarizes home buyer market segments at the three Kealakehe market area projects. As shown in the exhibit:

- Buyer origins - Households already living in the region represent about half or more of buyers in the three developments. Buyers from the U.S. Mainland, including investors familiar with the region or those looking for a part-time seasonal home, have proven to be an important source of demand.

- Family type - Couples and families with young children have accounted for about half of all sales at the three projects. Retirees, including many second-home buyers, have been numerous as well.

- Owner occupancy - Owner-occupants are 70% to 80% of original sales at the Kamani Trees and Pines projects. Investor participation was greater at the more expensive Kuakini Makai development.

Homeownership Unit Recommendations

The comparable projects review may indicate a number of areas in which Kealakehe homeownership units could find important market niches and provide competitive sales inventory. While each of the comparable projects is priced beyond the reach of most if not all moderate-income buyers, successful elements could be incorporated in the HFDC development program. The following should be considered:

- All three comparable projects have sold well, and have surplus buyers for available inventory. While this is related to west Hawaii's economic growth and affordable mortgage rates, it also suggests strong market support for homes on the lower stratum of market prices, in these cases between $117,000 and $144,900 for units sold in early phases of the comparable projects.

Exhibit V-E

BELT COLLINS & ASSOCIATES

Comparable Kealakehe Market Area
Home Sales Project Buyer Profiles

	Kamani Trees	Pines	Kuakini Makai
Units sold	75	91	34
Buyer origin:			
West Hawaii	65%	50% - 60%	40%
Other Hawaii	30	10 - 20	-
Mainland	5	20 - 30	60
Foreign	-	- - -	-
Total	100%	100%	100%
Family type:			
Singles	10	10	-
Couples	50	30	30
Young families	10	20	35
Retirees	30	40	35
Total	100%	100%	100%
Investment type:			
Owner-occupant	80	70	25
Second home	10	15	25
Investor	10	15	50
Total	100%	100%	100%

Source: Interviews with developers and real estate brokers.

- Strong sales at The Pines and The Kamani Trees indicates that smaller-lot, higher density single-family projects can be attractive to moderate-income buyers. These projects, featuring lots smaller than 5,000 square feet and overall project densities of about 6 units per gross acre, could allow for reductions in land and facilities costs.

- Common amenities have proven less important to the single-family unit buyer than opportunities to upgrade within the home. However, common amenities could prove significant to the developer, in establishing a tone for the community and enhancing sales in the later years of the development program. Thus, inclusion of common amenities should be considered more in terms of overall community marketing and in rental housing development.

- Projects in sales have attracted a clientele among couples and retirees or part-time residents. They have been less successful, however, in accommodating families with children. In order to better address family needs, larger units or a greater number of three-bedroom units would be required.

- Appropriate site design could accommodate slightly larger units within the same general density range, if individual lots smaller than 4,000 square feet were employed. If this option is pursued, standardized design of unit frontages and common maintenance through an association could be used to maintain an overall positive image and high-quality appearance.

- While market units within an HFDC-planned community are usually thought of as being those priced above affordable levels, other types of units could be considered for the market-price consumers as well. For example, lower-priced, smaller condominium units could be marketed without HFDC's "buy back" restriction. Potential price appreciation in these units could assist a mobile population of younger people to accumulate equity for a purchase of a future market unit.

Comparable Rental Projects

Three rental projects in the Kealakehe market area were selected for review, based on:

- Location
- Potential similarity to Kealakehe development concept
- Current or recent leasing program

The comparable projects are:

- The Villages at Waikoloa apartments
- The Fairway Terrace at Waikoloa condominium project
- The La'ilani garden apartments at Kealakehe Village

These projects cover a broad range of the regional rental market and can be strongly distinguished from one another:

- The Villages was constructed to accommodate Waikoloa area resort workers. It is a moderately-priced market rental project with few amenities.

- Fairway Terrace is designed to attract upscale professionals seeking rental units. The project is constructed for eventual sale as condominium units, and contains numerous amenities and common facilities.

- The La'ilani development was built by Mauna Lani Resort for sale to, and management under, the State HFDC. Rents are subsidized under a state rent supplement program for qualifying tenants, and other tenants pay market rents which are somewhat below rents at the other projects.

The comparable rental projects' characteristics are summarized in Exhibit V-F, as follows:

- Unit type - Each project is of low-rise configuration with one to two stories.

- Density - The projects attain net densities of 11 to 16 units per acre.

- Common amenities - Both Waikoloa Village rental developments offer golf course frontage and golf course views which are reflected in higher rents for these units. In addition:

  - The Villages has two swimming pools and a recreation area.

  - Fairway Terrace has extensive amenities, including a pool, community recreation center and upgraded appliances in each unit including microwave ovens.

  - La'ilani provides outdoor features such as a boat parking area, tot lots, athletic courts and a pavilion.

- Number of bedrooms - Two-bedroom units represent more than two-thirds of units at all three projects. The Villages was designed as 100% two-bedroom units, although reconfiguration with internal lock outs has allowed less than 10% of the units to be converted to one-bedroom units. The La'ilani project is the sole development to include three-bedroom units, amounting to 12% of the total inventory.

- Unit size - Two-bedroom unit sizes range from 682 to 960 square feet. Units at the Villages are the largest of the three projects. One-bedroom units range from an average of 509 to 800 square feet. Three-bedroom units at La'ilani contain 930 square feet.

- Pricing - Rents are lowest at La'ilani, ranging from $460 to $785 per month; in addition, qualifying tenants receive state rental assistance payments averaging $168 per month. Fairway Terrace rents are about 10% higher than at the Villages. Rents at the Waikoloa projects range from $600 to $935, depending upon number of bedrooms, furnishings, floor and frontage.

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Comparable Kealakehe Market Area
Home Sales Project Characteristics

	The Villages	Fairway Terrace	La'ilani
Developer	Villages at Waikoloa, Inc.	TFK Development and Allison Investment Corporation	Mauna Lani Resort
Location	Lua Kula Street Waikoloa Village	Lua Kula Street Waikoloa Village	Kealakehe Village
Status	Constructed in leaseup	Constructed in leaseup	Fully leased
Unit type	Garden apartment four-plex	Eight-plex	Garden apartment
Units	216	200	200
Density (units/acre)	13.8	11.7	12.9
Common amenities	Two pools Recreation area Golf frontage	Pool, recreation center; appliance upgrades; microwave	Laundry area, pavilion, tot lots, athletic courts
Rents(1):			
1 bedroom	$600 - 700	$675 - 775	$460
2 bedroom	795 - 925	890 - 935	660
3 bedroom	-	-	785
Unit distribution			
1 bedroom	10%	32%	16%
2 bedroom	90	68	72
3 bedroom	-	-	12
Total	100%	100%	100%

Exhibit V-F

BELT COLLINS & ASSOCIATES

Comparable Kealakehe Market Area
Home Sales Project Characteristics, Continued

	The Villages	Fairway Terrace	La'ilani
Average unit size (Square feet):			
1 bedroom	800	524	509
2 bedroom	960	924	682
3 bedroom	-	-	930
Units rented/sold:	140	32	199
Renter/owner origin:			
West Hawaii	50%	30%	80%
Other Hawaii	20	20	20
Mainland	20	25	-
International	10	25	-
Total	100%	100%	100%
Family type:			
Singles	30%	40%	20% - 25%
Couples	30	25	5 - 10
Young families	30	25	50 - 60
Retirees	10	10	5 - 10
Total	100%	100%	100%

(1) Rents not counting $175 monthly rent supplement to qualifying La'ilani tenants.

Source: Interviews with developers, real estate brokers and property managers.

Exhibit V-F, Cont.

- Renter origins - A majority of the renters at the three projects previously lived in the west Hawaii area. From 30% to 50% of Waikoloa renters came from outside of the state.

- Renter family type - Each of the projects has achieved a different renter profile. La'ilani caters heavily to families, with more than 70% of renter households having children. The Villages population includes many couples and singles and some families, while Fairway Terrace has attracted more singles and couples.

Rental Unit Recommendations

The comparable projects review indicates a number of areas in which Kealakehe rental units could fill important market niches. The following should be considered:

- Garden apartments, townhouse and four-plex structures in one to two story configuration appear to offer the best fit with development trends in the west Hawaii region. Density of 12 to 15 units per gross acre could be attained.

- Availability of common facilities appear more important in rental than in homeownership projects. Provision should be made for recreation and community needs on rental project sites.

- The use of internal "lock out" configurations within three- and four-bedroom units should be considered, so that the larger units can be used either for larger families, or for smaller families with additional rental units for singles or couples. This configuration would require units with at least two bathrooms.

- Strong demand appears to exist for rental projects priced between La'ilani (at $460 to $785) and The Villages at Waikoloa (at $600 to $925).

- Larger, three-bedroom two-bath units suitable for families could fill an important niche. If configured for reduction to smaller units through lockouts, these larger units could also be adaptable for singles and couples.

- Smaller units appear acceptable to renters in recent lease up trends. One-bedroom units could be developed in the 450-550 square foot range, with two-bedroom units sized from 650 to 800 square feet. Three-bedroom units could range from 750 to 900 square feet.

- As regional population increases, demand could emerge for some specialized rental housing products, as for the independent elderly, older people requiring some form of medical or assisted living services, or group homes. Provision should be made for these higher-density facilities in project areas near commercial and community facilities.

Development Phasing

The Kealakehe planned community would be built over a period of about 20 years, with all housing units completed by about 2010. The mix of housing developed -- affordable ownership units, affordable rental units and market units -- should be relatively flexible in order to respond to market needs and opportunities. A general phasing scheme is presented to assist in project planning.

Key phasing considerations are as follows:

- Housing development could proceed at higher levels to 1995, in order to accommodate growth in a period of strong employment expansion and to service pent up demand.

- Market units could be phased in early in the Kealakehe development program, so as to establish the community as an attractive location and to provide future move up opportunities.

A potential phasing schedule is presented in Exhibit V-G, for a 4,000-unit project including about 1,400 affordable ownership and about 1,000 affordable rental units and about 1,600 market units. As shown in the exhibit:

- Recommended phasing differs somewhat from projected absorption as shown previously in Exhibit V-C. Absorption estimates were based on average capture rates. Recommended phasing produces absorption at the same average capture rate over the 20-year period, but with varying (rather than constant) capture rates in each of the four five-year intervals constituting the 20-year development program.

- Overall development would be highest in the first five years at 250 units per year, stabilize at about 175 units each year for the next ten years, and be completed with about 200 units in each of the last five years.

- Affordable ownership housing production would decline as a proportion of total development after the first five years, and would range from 40 to 90 units annually.

- Affordable rental units would represent about 60 units per year through 1995, but would decline for the 1996-2005 period, when other rental projects are expected to be developed.

- Market units would range from 60 to 100 units per year, with the highest production levels in the first and final five-year periods.

Ownership Unit Pricing

Prices of ownership units at the Kealakehe planned community could be influenced by a number of factors, including:

- Potential home buyer affordability
- Ability to recapture development costs
- Provision of first-time and move-up buyer opportunities
- Competitive supply

Exhibit V-G

BELT COLLINS & ASSOCIATES

Recommended Annual Production of
Kealakehe Housing Units
by Time Period

1990 to 2010

Type of unit	1990 to 1995	1996 to 2000	2001 to 2005	2006 to 2010	Average	Total
Affordable housing:						
Ownership units	90	90	70	40	70	1,400
Rental units	60	30	40	70	50	1,000
Market housing:						
Market units	100	60	60	90	80	1,600
	250	175	175	200	200	4,000

Since Kealakehe is planned as part of the State of Hawaii's new communities initiative, pricing is established to meet criteria of affordability for low- and moderate-income buyers. Based on the affordable homeownership unit targets shown previously in Exhibits IV-H and IV-I, the recommended project build-out shown in Exhibit V-G, and affordability criteria presented in Exhibit III-H, the following pricing considerations are presented:

- A total of 1,400 affordable homeownership units could be supported, with:
  - About 50% of units priced below $100,000 in 1990 dollars.
  - About 50% of units priced between $100,000 and $130,000 in 1990 dollars.
- A total of 1,600 market units, with the proportion of ownership and rental units determined by market needs and opportunities over the course of the development program. Market ownership unit pricing should take into account the following considerations:
  - Meeting State Housing Functional Plan homeownership goals would require production of additional units priced between $120,000 and $150,000 for households earning between 120% and 140% of median income.
  - Additional homeownership opportunities will also be needed for families earning from 140% to 160% of median income, with unit prices targeted for from $150,000 to $200,000.
  - The Kealakehe development program might provide a number of premium development sites with golf course frontage. Based on typical golf frontage premiums in other communities, a limited number of units in the $250,000 to $350,000 range could be provided.

VI - GOLF COURSE MARKET ASSESSMENT

An 18-hole municipal golf course is proposed as one element of the Kealakehe planned community. This chapter assesses potential market support for the course. Existing golf courses in the market area and on the island of Hawaii are reviewed in terms of size, facilities, fees and play levels. Planned golf courses are also discussed. Finally, future play levels at the Kealakehe municipal course are projected.

EXISTING GOLF COURSES ON THE ISLAND OF HAWAII

This section describes golf courses in operation on the island.

Location of Golf Courses

There are twelve golf courses currently operated on the island of Hawaii. Existing courses are summarized in Exhibit VI-A, which indicates:

- Seven of the courses are located in resort areas.
- The remaining five courses are located away from resort areas and cater primarily to island residents and club members.

Resort Golf Courses

Visitors are the predominant users of resort courses on the island of Hawaii, although "off-property" golfers are accommodated on a daily fee basis. In general, the resort courses charge differently for play by non-guests, as shown for resort courses on all islands in Exhibit VI-B:

- Total green and cart fees at resort courses average $60 per 18-hole round for "on-property" guests, $85 for visitors staying off-property and $56 for Hawaii residents. Resident "kamaaina" rates are extended to resident-visitors from other islands, as well as residents of the island of Hawaii.
- On the island of Hawaii, total fees average $74 for Hawaii residents, well above the average on-property guest fee of $53. Off-property visitors pay an average of $85.

Resort courses in Hawaii are widely used, with highest use levels at more established, larger resorts. Utilization is shown in Exhibit VI-C, which indicates play levels at an average of 144 rounds per day.

Non-resort Golf Courses

The island of Hawaii has five golf courses situated outside of resort areas, as shown previously in Exhibit VI-A. The Hilo Municipal course is operated by the County of Hawaii, while the other courses are privately owned but permit daily fee play. Non-resort golf course use patterns differ markedly from those of resort courses, and are summarized in Exhibit VI-D:

Exhibit VI-A

BELT COLLINS & ASSOCIATES

Golf Courses on the Island of Hawaii

1989

Course	Location	Number of holes
Resort courses:		
Waikoloa Beach Golf Club	Waikoloa Beach	18
Waikoloa Kings Course	Waikoloa Beach	18
Waikoloa Village Golf Club	Waikoloa Village	18
Kona Country Club	Keauhou	27
Mauna Kea Beach Hotel Golf Course	Mauna Kea	18
Francis I'i Brown	Manua Lani	18
Sea Mountain Golf Course	Punalu'u	18
Subtotal		135
Off-resort courses:		
Naniloa Country Club	Hilo	9
Hilo Municipal Golf Course	Hilo	18
Volcano Golf and Country Club	Volcano	18
Discovery Harbour Golf Course	Naalehu	18
Hamakua Country Club	Honokaa	9
Subtotal		72
Total golf holes in operation		207

Exhibit VI-B

BELT COLLINS & ASSOCIATES

Total Green and Cart Fees
at Selected Resort Golf Courses in Hawaii

1989

	Resort guests	Non-resort guests	Hawaii residents
Oahu:			
Sheraton Makaha Resort and Country Club(1)	$ 45	95	55
Turtle Bay Golf Course(2)	65	80/ 90	40/ 45
Oahu average	55	91	49
Maui:			
Wailea Blue and Orange Courses			
Peak season (December-April)	45	90	45(3)
Low season (May-November)	30	60	30(3)
Royal Kaanapali - North and South Courses	74	74	74
Kapalua Golf Club - Bay Course and Village Course	55	85	40
Maui average	56	78	51
Kauai:			
Princeville Golf Club:			
Peak season (December-March)	53	68	48(4)
Low season (April-November)	48	63	43(4)
Kiahuna Golf Club	52(5)	58	34
Kiele Golf Course	105	125	55
Kauai Lagoons Golf Course	85	105	45
Kauai average	74	89	45
Hawaii:			
Mauna Kea Beach Golf Course	55	90	90
Mauna Lani:			
Peak season (December-March)	50	100	100
Low season (April-November)	50	70	70
Waikoloa Beach Resort and Golf Club			
Peak season (January-March)	55	90	45
Low season (April-December)	55	90	45

BELT COLLINS & ASSOCIATES

Total Green and Cart Fees
at Selected Resort Golf Courses in Hawaii, Continued

1989

	Resort guests	Non-resort guests	Hawaii residents
Kona Country Club			
Peak season (January-March)	53	75	75
Peak season (April-December)	47	70	70
Hawaii average	53	85	74
All islands:			
Range	30-105	60-125	30-100
Average	$ 60	85	56

(1) Guests from other Sheraton hotels pay $85.

(2) Higher rates are charged for weekend by non-resort guests and Hawaii residents.

(3) Rate offered only to Maui residents.

(4) Hawaii residents who do not live on Kauai pay $58 in peak season and $53 in low season.

(5) Rates paid by guests of Poipu area hotels.

Source: Compiled from discussions with course representatives and published information.

Exhibit VI-C

BELT COLLINS & ASSOCIATES

Average Daily Rounds of Golf
at Selected Resort Courses

1988

	Daily rounds of golf		
	Average	Desired	Maximum
Oahu:			
Makaha	152	200	200(1)
Turtle Bay	178	250	320
Maui:			
Wailea:			
Blue Course	135	216	216(1)
Orange Course	135	216	216(1)
Royal Kaanapali:			
North Course	173	N/A	250
South Course	123	N/A	250
Kapalua Golf Club:			
Bay Course	190	230	280
Village Course	137	210	240
Kauai:			
Princeville Golf Club(2)	178	200 - 235(3)	235
Kiahuna Golf Club	123	250	300
Hawaii:			
Mauna Lani - Francis I'i Brown Golf Course	129	200	250
Mauna Kea Beach Golf Course	148	230	265
Waikoloa Beach Resort Golf Course	118	180 - 200	230
Keauhou Golf Course(2)	187	250	350
Average (rounded)(4)	144	250	350

N/A Not available.

(1) Maximum level of play is the same as desired level.

(2) Utilizing all 27 holes available in 1987.

(3) Desired level of play is 200 rounds per holes in the winter and 235 per 18 holes in summer months due to greater number of daylight hours.

(4) Excluding Princeville Golf Club and Keauhou Golf Course.

Source: Based on interviews with golf professionals or representatives of the respective courses.

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Utilization and Fees at Non-Resort Golf Courses
on the Island of Hawaii

	Naniloa Country Club	Hilo Municipal Golf Course(1)	Volcano Golf and Country Club	Discovery Harbor Golf Course	Hamakua Country Club
Average daily rounds of play	60	275	N/A	10	20
Daily fees for residents per round:					
Green fees	$ N/A	6.00	21.00-24.00	10.00	10.00
Cart rental	7.00-14.00	14.50	9.00-10.00	14.00	-
Daily fees for visitors per round:					
Green fees	N/A	6.00	35.00	10.00	10.00
Cart rental	7.00-14.00	14.50	9.00-10.00	14.00	-
Market mix:					
Local and members	80%	95%	95%	100%	100%
Visitors	20	5	5	-	-

(1) Also offers senior citizen discount rate.

Source: Interviews of golf professionals, directors of golf and club managers.

Exhibit VI-D

- The Hilo Municipal course is the most heavily used on the island, with 275 average rounds per day. However, the other non-resort courses have relatively low use levels, below 60 rounds per day.

- Fees are far lower than for resort courses. As shown in Exhibit VI-B, average resident fees on island resort courses are $74, compared with Hilo Municipal's charge of $20.50. Several non-resort courses offer further discounts, as for senior citizens and members of golfing clubs.

- Non-resort courses cater primarily to residents, who make up from 80% to 100% of total rounds played.

While non-resort courses charge far less for play than resort courses, few offer comparable facilities. Exhibit VI-E summarizes facilities at non-resort courses:

- Two of the five courses -- Naniloa and the Hamakua Country Club in Honokaa -- do not have a clubhouse.

- Only Hilo Municipal has a teaching professional.

- Two of the courses have limited 9-hole layouts.

Planned Golf Courses

Expansion in the number and capacity of island golf courses is anticipated with the growth of west Hawaii resorts. Planned and proposed golf courses on the island are shown in Exhibit VI-F, which indicates:

- While Waikoloa Beach Resort has just opened a second course, the other two existing South Kohala area resorts have announced plans for second 18-hole courses to be built in the next few years.

- The Kona Country Club at Keauhou Resort plans to add nine holes to bring its capacity to 36 holes.

- Ten other courses are proposed in conjunction with planned resort development.

- Six other courses are proposed, most in the context of a master-planned resident community. Development plans for these courses are now somewhat indefinite, but are unlikely to offer play at low municipal rates.

MUNICIPAL GOLF COURSE MARKET ASSESSMENT

This section estimates potential market support for a municipal golf course at the Kealakehe planned community.

Market Position

The preceding section points to the existence of parallel golf markets on the island of Hawaii, including:

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Facilities at Non-Resort Golf Courses
on the Island of Hawaii

	Naniloa Country Club	Hilo Municipal Golf Course(1)	Volcano Golf and Country Club	Discovery Harbor Golf Course	Hamakua Country Club
Number of holes	9	18	18	18	9
Property size (acres)	65	130	N/A	N/A	19
Facilities:					
Clubhouse	-	X	X	X	-
Restaurant	-	X	X	-	-
Lounge/bar	-	X	X	-	X
Pro shop	X	X	X	-	-
Locker room	-	X	X	-	-
Driving range	X	-	X	X	-
Practice green	X	X	X	X	
Resident golf pro	-	X	-	-	-

Source: Interviews of golf professionals, directors of golf and club managers.

Exhibit VI-E

Exhibit VI-F

BELT COLLINS & ASSOCIATES

Planned and Proposed Golf Courses
on the Island of Hawaii

1989

Course	Location	Number of holes
Planned:		
Mauna Kea Resort - second course (1991-1992)	Mauna Kea	18
Mauna Lani - second course (1991-1992)	Mauna Lani	18
Waikoloa Highlands course	Waikoloa Village	18
TSA residential community course	Kaloko	18
Oneloa	Puna	36
Subtotal		108
Proposed:		
Additional resort course	Waikoloa Beach	36
Hapuna Beach Resort - mauka course	Mauna Kea	18
Planned resort courses	Kaupulehu	36
Regent Beach Resort Course	Regent Beach	18
Planned resort course	Awake'e	18
Planned resort course	Kohanaiki	18
Kona Country Club expansion	Keauhou	9
Hawaiian Palace resort course	Hawaiian Riviera	18
Ka'u Aina resort courses	Hawaiian Riviera	36
Royal Vista Golf and Country Club	North Kona	27
Kohala Ranch	North Kohala	18
Signal Puako	South Kohala	36
Subtotal		288
Total Planned and proposed golf holes		396

- A resort golf market oriented toward visitors, offering a variety of high-quality facilities at relatively high use fees ranging from about $50 to $75 per round.

- A local golf market oriented toward residents, providing fewer facilities and substantially lower fees ranging from $6 to $24 per round.

The planned course at Kealakehe is intended to primarily cater to residents, although regional visitors could represent a secondary source of demand. As a municipally-operated course, fees could be expected to be similar to the daily average of $20.50 at the Hilo Municipal Course. For this reason, Hilo Municipal is selected as the most comparable facility for demand projections.

Proposed Development Concept

Demand for golf at Kealakehe is estimated based on the following development concept:

- The course would be designed to cater primarily to Hawaii residents, although nonresidents could play the course at the same daily fees.

- The fee structure could yield somewhat lower average fees by residents through special discounts for senior citizens, golfing clubs, monthly or seasonal passes or other adjustments.

- The course would offer an 18-hole layout, designed to maximize adjacent residential lot frontage.

- The course would offer facilities comparable or superior to Hilo Municipal, with a clubhouse, pro shop, practice facilities, locker space and a resident teaching professional.

Projected Demand for Golf at Kealakehe

Play levels projected for the Kealakehe municipal course are based on the following assumptions:

- Resident demand within the Kealakehe market area would be similar to that now experienced in the Hilo Municipal course's primary market area of North Hilo, South Hilo and Puna.

- Golf participation is expected to increase from 1988 to 2010, in line with national trends. A 1% annual compound rate of increase in resident play is projected.

- Play by visitors could be expected to represent about 15% of total demand, since many visitors would stay in accommodations lacking golf, and Kealakehe would be well located to capture visitor play.

Projected demand is shown in Exhibit VI-G, based on the above assumptions and resident population projections for the Kealakehe market area. As shown in the exhibit:

Exhibit VI-G

BELT COLLINS & ASSOCIATES

Projected Demand for Golf at
Kealakehe Municipal Course

(average rounds per day)

	1990	1995	2000	2005	2010
Resident demand:					
Daily rounds per 1000 residents(1)	3.1	3.3	3.5	3.7	3.9
Market area resident population, projected(2)	49,500	59,600	72,300	87,900	107,600
Projected daily rounds by residents	150	200	250	330	420
Visitor demand:					
Projected daily rounds by visitors(3)	30	40	50	60	80
Projected total demand	180	240	300	390	500

(1) Based on average daily play at Hilo Municipal and average annual growth of 1% in participation rate.

(2) As shown in Exhibit II-C.

(3) At 15% of total play.

- By 1995, total demand could reach 240 rounds per day, representing potential play levels equivalent to 90% of those at the Hilo Municipal course.

- Demand could exceed 300 rounds by 2000. Unless additional courses were developed in other market area locations, the Kealakehe course could reach capacity by 2000.

PUBLIC REVENUES AND COSTS

KEALAKEHE MASTER PLAN
PUBLIC REVENUES AND COSTS
For the Years 1992 - 2011

File Name: REVFINAL.WK1
Date: 09/10/90
Time: 12:00 AM

	Schedule	YEAR 1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	
Church/Child Care Development GET												
Site Improvement/Acre						200,000						2
Acres						3						
Church/Child Care Development						600,000						6
GET Rate						4%						
Church/Child Care Site Devevelopment GET						24,000						2
Construction Cost/Sq.Ft.						100						
Sq.Ft.						17,820						1
Construction Cost						1,782,000						1,78
GET Rate						4%						
Construction GET						71,280						7
Church/Child Care Development GET						95,280						9
Schedule A-2: Operations General Excise Tax Revenue												
Golf Course Operations GET					43,200	45,120	47,040	48,960	50,880	52,800	54,720	5
Commercial Center Operations GET					0	0	462,000	646,800	831,600	1,016,400	1,201,200	1,38
Total Operations GET					43,200	45,120	509,040	695,760	882,480	1,069,200	1,255,920	1,44
Golf Course Operations GET												
Average Revenue/Round					20	20	20	20	20	20	20	
Rounds Per Year					54,000	56,400	58,800	61,200	63,600	66,000	68,400	7
Operating Revenue					1,080,000	1,128,000	1,176,000	1,224,000	1,272,000	1,320,000	1,368,000	1,41
GET Rate					4%	4%	4%	4%	4%	4%	4%	
Golf Course Operations GET					43,200	45,120	47,040	48,960	50,880	52,800	54,720	5
Commercial Center Operations GET												
Sales/Sq.Ft.							231	231	231	231	231	
Sq.Ft.							50,000	70,000	90,000	110,000	130,000	15
Operating Revenue							11,550,000	16,170,000	20,790,000	25,410,000	30,030,000	34,65
GET Rate							4%	4%	4%	4%	4%	
Commercial Center Operations GET							462,000	646,800	831,600	1,016,400	1,201,200	1,38

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	TOTAL
			200,000										
			3										
			600,000										
			4%										1,200,000
			24,000										48,000
			100										
			17,820										
			1,782,000										
			4%										3,564,000
			71,280										142,560
			95,280										190,560
50,880	52,800	54,720	56,640	58,560	60,480	62,400	64,320	66,240	68,160	70,080	72,000	0	921,600
331,600	1,016,400	1,201,200	1,386,000	1,570,800	1,755,600	1,940,400	2,125,200	2,310,000	2,402,400	2,402,400	2,402,400	2,402,400	24,855,600
382,480	1,069,200	1,255,920	1,442,640	1,629,360	1,816,080	2,002,800	2,189,520	2,376,240	2,470,560	2,472,480	2,474,400	2,402,400	25,777,200
20	20	20	20	20	20	20	20	20	20	20	20		
63,800	66,000	68,400	70,800	73,200	75,600	78,000	80,400	82,800	85,200	87,600	90,000		1,152,000
272,000	1,320,000	1,368,000	1,416,000	1,464,000	1,512,000	1,560,000	1,608,000	1,656,000	1,704,000	1,752,000	1,800,000		23,040,000
4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%		
50,880	52,800	54,720	56,640	58,560	60,480	62,400	64,320	66,240	68,160	70,080	72,000		921,600
231	231	231	231	231	231	231	231	231	231	231	231	231	
90,000	110,000	130,000	150,000	170,000	190,000	210,000	230,000	250,000	260,000	260,000	260,000	260,000	2,690,000
790,000	25,410,000	30,030,000	34,650,000	39,270,000	43,890,000	48,510,000	53,130,000	57,750,000	60,060,000	60,060,000	60,060,000	60,060,000	621,390,000
4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	
331,600	1,016,400	1,201,200	1,386,000	1,570,800	1,755,600	1,940,400	2,125,200	2,310,000	2,402,400	2,402,400	2,402,400	2,402,400	24,855,600

KEALAKEHE MASTER PLAN
PUBLIC REVENUES AND COSTS
For the Years 1992 - 2011

File Name: REVFINAL.WK1
Date: 09/10/90
Time: 12:00 AM

Schedule A-3: Personal Consumption General Excise Tax Revenue	YEAR 1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Construction Personal Consumption GET	348,516	348,516	348,516	348,516	348,516	348,516	348,516	348,516	348,516	348,516
Golf Course Personal Consumption GET	0	0	0	12,062	12,062	12,062	12,062	12,062	12,062	12,062
Restaurant Personal Consumption GET	0	0	0	1,150	1,150	1,150	1,150	1,150	1,150	1,150
Commercial Center Personal Consumption GET	0	0	0	0	0	6,722	10,332	13,942	17,552	21,162
Schools Personal Consumption GET	0	0	0	0	23,328	25,272	26,730	28,674	31,590	33,534
Services Personal Consumption GET	0	0	0	0	0	1,590	3,180	4,770	6,360	7,950
Total Personal Consumption GET	348,516	348,516	348,516	361,728	385,056	395,312	401,970	409,114	417,230	424,374
Construction Personal Consumption GET										
Average Income	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000
Payroll Deduction Rate	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Payroll Deduction	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800
Net Payroll	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200
Personal Consumption Rate	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
Personal Consumption Expenditure	11,520	11,520	11,520	11,520	11,520	11,520	11,520	11,520	11,520	11,520
GET Rate	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
Average GET	461	461	461	461	461	461	461	461	461	461
Direct, Indirect & Induced Jobs	756	756	756	756	756	756	756	756	756	756
Construction Personal Consumption GET	348,516	348,516	348,516	348,516	348,516	348,516	348,516	348,516	348,516	348,516
Golf Course Personal Consumption GET										
Average Income				17,000	17,000	17,000	17,000	17,000	17,000	17,000
Payroll Deduction Rate				20%	20%	20%	20%	20%	20%	20%
Payroll Deduction				3,400	3,400	3,400	3,400	3,400	3,400	3,400
Net Payroll				13,600	13,600	13,600	13,600	13,600	13,600	13,600
Personal Consumption Rate				60%	60%	60%	60%	60%	60%	60%
Personal Consumption Expenditure				8,160	8,160	8,160	8,160	8,160	8,160	8,160
GET Rate				4%	4%	4%	4%	4%	4%	4%
Average GET				326	326	326	326	326	326	326
Direct, Indirect & Induced Jobs				37	37	37	37	37	37	37
Golf Course Personal Consumption GET				12,062	12,062	12,062	12,062	12,062	12,062	12,062
Golf Course Restaurant Personal Consumption GET										
Average Income				12,000	12,000	12,000	12,000	12,000	12,000	12,000
Payroll Deduction Rate				20%	20%	20%	20%	20%	20%	20%
Payroll Deduction				2,400	2,400	2,400	2,400	2,400	2,400	2,400
Net Payroll				9,600	9,600	9,600	9,600	9,600	9,600	9,600
Personal Consumption Rate				60%	60%	60%	60%	60%	60%	60%
Personal Consumption Expenditure				5,760	5,760	5,760	5,760	5,760	5,760	5,760
GET Rate				4%	4%	4%	4%	4%	4%	4%
Average GET				230	230	230	230	230	230	230
Direct, Indirect & Induced Jobs				5	5	5	5	5	5	5
Golf Course Restaurant Personal Consumption GET				1,150	1,150	1,150	1,150	1,150	1,150	1,150
Golf Course & Restaurant Personal Consumption GET				13,212	13,212	13,212	13,212	13,212	13,212	13,212

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	TOTAL
348,516	348,516	348,516	348,516	348,516	348,516	348,516	348,516	348,516	348,516	348,516	348,516	348,516	6,970,320
12,062	12,062	12,062	12,062	12,062	12,062	12,062	12,062	12,062	12,062	12,062	12,062	12,062	205,054
1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	19,550
13,942	17,552	21,162	24,772	28,382	31,992	44,479	45,399	46,319	50,229	50,229	50,229	50,229	491,969
28,674	31,590	33,534	34,020	34,020	34,020	34,020	34,020	34,020	34,020	34,020	34,020	34,020	509,328
4,770	6,360	7,950	9,540	11,130	12,720	14,310	15,900	17,490	19,080	20,670	23,055	23,055	190,800
409,114	417,230	424,374	430,060	435,260	440,460	454,537	457,047	459,557	465,057	466,647	469,032	469,032	8,387,021
24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	
20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	
4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800	
19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	
60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	
11,520	11,520	11,520	11,520	11,520	11,520	11,520	11,520	11,520	11,520	11,520	11,520	11,520	
4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	
461	461	461	461	461	461	461	461	461	461	461	461	461	
756	756	756	756	756	756	756	756	756	756	756	756	756	
348,516	348,516	348,516	348,516	348,516	348,516	348,516	348,516	348,516	348,516	348,516	348,516	348,516	6,970,320
17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	289,000
20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	
3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	57,800
13,600	13,600	13,600	13,600	13,600	13,600	13,600	13,600	13,600	13,600	13,600	13,600	13,600	231,200
60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	
8,160	8,160	8,160	8,160	8,160	8,160	8,160	8,160	8,160	8,160	8,160	8,160	8,160	138,720
4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	
326	326	326	326	326	326	326	326	326	326	326	326	326	
37	37	37	37	37	37	37	37	37	37	37	37	37	
12,062	12,062	12,062	12,062	12,062	12,062	12,062	12,062	12,062	12,062	12,062	12,062	12,062	205,054
12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	204,000
20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	
2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	40,800
9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	163,200
60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	
5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	97,920
4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	
230	230	230	230	230	230	230	230	230	230	230	230	230	
5	5	5	5	5	5	5	5	5	5	5	5	5	
1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	1,150	19,550
13,212	13,212	13,212	13,212	13,212	13,212	13,212	13,212	13,212	13,212	13,212	13,212	13,212	224,604

KEALAKEHE MASTER PLAN
PUBLIC REVENUES AND COSTS
For the Years 1992 - 2011

File Name: REVFINAL.WK1
Date: 09/10/90
Time: 12:00 AM

	Schedule	YEAR 1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Commercial Center Personal Consumption GET											
Average Income (Retail)							14,000	14,000	14,000	14,000	14,000
Payroll Deduction Rate							20%	20%	20%	20%	20%
Payroll Deduction							2,800	2,800	2,800	2,800	2,800
Net Payroll							11,200	11,200	11,200	11,200	11,200
Personal Consumption Rate							60%	60%	60%	60%	60%
Personal Consumption Expenditure							6,720	6,720	6,720	6,720	6,720
GET Rate							4%	4%	4%	4%	4%
Average GET							269	269	269	269	269
Direct, Indirect & Induced Jobs							10	20	30	40	50
Retail Consumption GET							2,690	5,380	8,070	10,760	13,450
Average Income (Restaurant)							12,000	12,000	12,000	12,000	12,000
Payroll Deduction Rate							20%	20%	20%	20%	20%
Payroll Deduction							2,400	2,400	2,400	2,400	2,400
Net Payroll							9,600	9,600	9,600	9,600	9,600
Personal Consumption Rate							60%	60%	60%	60%	60%
Personal Consumption Expenditure							5,760	5,760	5,760	5,760	5,760
GET Rate							4%	4%	4%	4%	4%
Average GET							230	230	230	230	230
Direct, Indirect & Induced Jobs							4	8	12	16	20
Restaurant Consumption GET							920	1,840	2,760	3,680	4,600
Average Income (Auto Repair)							15,000	15,000	15,000	15,000	15,000
Payroll Deduction Rate							20%	20%	20%	20%	20%
Payroll Deduction							3,000	3,000	3,000	3,000	3,000
Net Payroll							12,000	12,000	12,000	12,000	12,000
Personal Consumption Rate							60%	60%	60%	60%	60%
Personal Consumption Expenditure							7,200	7,200	7,200	7,200	7,200
GET Rate							4%	4%	4%	4%	4%
Average GET							288	288	288	288	288
Direct, Indirect & Induced Jobs							6	6	6	6	6
Auto Repair Consumption GET							1,728	1,728	1,728	1,728	1,728
Average Income (Health, Professional)							18,000	18,000	18,000	18,000	18,000
Payroll Deduction Rate							20%	20%	20%	20%	20%
Payroll Deduction							3,600	3,600	3,600	3,600	3,600
Net Payroll							14,400	14,400	14,400	14,400	14,400
Personal Consumption Rate							60%	60%	60%	60%	60%
Personal Consumption Expenditure							8,640	8,640	8,640	8,640	8,640
GET Rate							4%	4%	4%	4%	4%
Average GET							346	346	346	346	346
Direct, Indirect & Induced Jobs							4	4	4	4	4
Health, Professional Consumption GET							1,384	1,384	1,384	1,384	1,384
Commercial Center Consumption GET							6,722	10,332	13,942	17,552	21,162

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	TOTAL
14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	
20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	
2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	
11,200	11,200	11,200	11,200	11,200	11,200	11,200	11,200	11,200	11,200	11,200	11,200	11,200	
60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	
6,720	6,720	6,720	6,720	6,720	6,720	6,720	6,720	6,720	6,720	6,720	6,720	6,720	
4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	
269	269	269	269	269	269	269	269	269	269	269	269	269	
30	40	50	60	70	80	123	123	123	123	123	123	123	
8,070	10,760	13,450	16,140	18,830	21,520	33,087	33,087	33,087	33,087	33,087	33,087	33,087	328,449
12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	
20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	
2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	
9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	
60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	
5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	
4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	
230	230	230	230	230	230	230	230	230	230	230	230	230	
12	16	20	24	28	32	36	40	44	61	61	61	61	
2,760	3,680	4,600	5,520	6,440	7,360	8,280	9,200	10,120	14,030	14,030	14,030	14,030	116,840
15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	
20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	
3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	
12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	
60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	
7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200	
4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	
288	288	288	288	288	288	288	288	288	288	288	288	288	
6	6	6	6	6	6	6	6	6	6	6	6	6	
1,728	1,728	1,728	1,728	1,728	1,728	1,728	1,728	1,728	1,728	1,728	1,728	1,728	25,920
18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	
20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	
3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	
14,400	14,400	14,400	14,400	14,400	14,400	14,400	14,400	14,400	14,400	14,400	14,400	14,400	
60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	
8,640	8,640	8,640	8,640	8,640	8,640	8,640	8,640	8,640	8,640	8,640	8,640	8,640	
4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	
346	346	346	346	346	346	346	346	346	346	346	346	346	
4	4	4	4	4	4	4	4	4	4	4	4	4	
1,384	1,384	1,384	1,384	1,384	1,384	1,384	1,384	1,384	1,384	1,384	1,384	1,384	20,760
13,942	17,552	21,162	24,772	28,382	31,992	44,479	45,399	46,319	50,229	50,229	50,229	50,229	491,969

KEALAKEHE MASTER PLAN
PUBLIC REVENUES AND COSTS
For the Years 1992 - 2011

File Name: REVFINAL.WK1
Date: 09/10/90
Time: 12:00 AM

	Schedule	YEAR 1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	
Schools Personal Consumption GET												
Average Income						25,300	25,300	25,300	25,300	25,300	25,300	25
Payroll Deduction Rate						20%	20%	20%	20%	20%	20%	
Payroll Deduction						5,060	5,060	5,060	5,060	5,060	5,060	5
Net Payroll						20,240	20,240	20,240	20,240	20,240	20,240	20
Personal Consumption Rate						60%	60%	60%	60%	60%	60%	
Personal Consumption Expenditure						12,144	12,144	12,144	12,144	12,144	12,144	12
GET Rate						4%	4%	4%	4%	4%	4%	
Average GET						486	486	486	486	486	486	
Total Direct, Indirect & Induced Jobs						48	52	55	59	65	69	
Schools Consumption GET						23,328	25,272	26,730	28,674	31,590	33,534	34
Services Personal Consumption GET												
Average Income (Personal Services)							13,800	13,800	13,800	13,800	13,800	13
Payroll Deduction Rate							20%	20%	20%	20%	20%	
Payroll Deduction							2,760	2,760	2,760	2,760	2,760	2
Net Payroll							11,040	11,040	11,040	11,040	11,040	11
Personal Consumption Rate							60%	60%	60%	60%	60%	
Personal Consumption Expenditure							6,624	6,624	6,624	6,624	6,624	6
GET Rate							4%	4%	4%	4%	4%	
Average GET							265	265	265	265	265	
Direct, Indirect & Induced Jobs							6	12	18	24	30	
Services Personal Consumption GET							1,590	3,180	4,770	6,360	7,950	9

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	TOTAL
25,300	25,300	25,300	25,300	25,300	25,300	25,300	25,300	25,300	25,300	25,300	25,300	25,300	
20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	
5,060	5,060	5,060	5,060	5,060	5,060	5,060	5,060	5,060	5,060	5,060	5,060	5,060	
20,240	20,240	20,240	20,240	20,240	20,240	20,240	20,240	20,240	20,240	20,240	20,240	20,240	
60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	
12,144	12,144	12,144	12,144	12,144	12,144	12,144	12,144	12,144	12,144	12,144	12,144	12,144	
4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	
486	486	486	486	486	486	486	486	486	486	486	486	486	
59	65	69	70	70	70	70	70	70	70	70	70	70	
28,874	31,590	33,534	34,020	34,020	34,020	34,020	34,020	34,020	34,020	34,020	34,020	34,020	509,328
13,800	13,800	13,800	13,800	13,800	13,800	13,800	13,800	13,800	13,800	13,800	13,800	13,800	
20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	
2,760	2,760	2,760	2,760	2,760	2,760	2,760	2,760	2,760	2,760	2,760	2,760	2,760	
11,040	11,040	11,040	11,040	11,040	11,040	11,040	11,040	11,040	11,040	11,040	11,040	11,040	
60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	
6,624	6,624	6,624	6,624	6,624	6,624	6,624	6,624	6,624	6,624	6,624	6,624	6,624	
4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	
265	265	265	265	265	265	265	265	265	265	265	265	265	
18	24	30	36	42	48	54	60	66	72	78	87	87	
4,770	6,360	7,950	9,540	11,130	12,720	14,310	15,900	17,490	19,080	20,670	23,055	23,055	190,800

KEALAKEHE MASTER PLAN
PUBLIC REVENUES AND COSTS
For the Years 1992 - 2011

File Name: REVFINAL.WK1
Date: 09/10/90
Time: 12:00 AM

	Schedule	YEAR 1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	
Schedule B: State Corporate Income Tax Revenue												
Residential		86,080	57,920	45,760	47,488	48,448	67,072	67,072	45,440	33,792	31,808	3
Golf Course		0	0	57,600	2,916	3,038	3,159	3,281	3,402	3,524	3,645	
Commercial		0	0	0	0	36,640	56,960	71,744	86,528	105,312	96,096	11
School		0	0	0	208,000	0	0	0	0	0	0	
Total Corporate Income Tax Revenue		86,080	57,920	103,360	258,404	88,126	127,191	142,097	135,370	142,628	131,549	15
Schedule B-1: Residential Corporate Income Tax Revenue												
Single Family Development Corporate Income Tax		86,080	57,920	44,480	44,160	45,120	62,720	64,000	45,440	28,160	29,760	3
Multi-Family Development Corporate Income Tax		0	0	1,280	3,328	3,328	4,352	3,072	0	5,632	2,048	
Total Residential Corporate Income Tax Revenue		86,080	57,920	45,760	47,488	48,448	67,072	67,072	45,440	33,792	31,808	3
Single Family Profit/Unit		5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	
Single Family Units		269	181	139	138	141	196	200	142	88	93	
Single Family Profit		1,345,000	905,000	695,000	690,000	705,000	980,000	1,000,000	710,000	440,000	465,000	53
Tax Rate		6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	
Single Family Development Corporate Income Tax		86,080	57,920	44,480	44,160	45,120	62,720	64,000	45,440	28,160	29,760	3
Multi-Family Profit/Unit				4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	
Multi-Family Units				5	13	13	17	12	0	22	8	
Multi-Family Profit				20,000	52,000	52,000	68,000	48,000	0	88,000	32,000	2
Tax Rate				6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	
Multi-Family Development Corporate Income Tax				1,280	3,328	3,328	4,352	3,072	0	5,632	2,048	
Schedule B-2: Golf Course Corporate Income Tax Revenue												
Construction				57,600								
Operations				0	2,916	3,038	3,159	3,281	3,402	3,524	3,645	
Golf Course Corporate Income Tax Revenue				57,600	2,916	3,038	3,159	3,281	3,402	3,524	3,645	
Construction												
Construction Cost		22,500,000										
Profit Margin		4%										
Construction Taxable Income		900,000										
Corporate Income Tax Rate		6.4%										
Construction Corporate Income Tax		57,600										
Operations												
Average Revenue/Round				20	20	20	20	20	20	20	20	
Rounds Per Year				54,000	56,250	58,500	60,750	63,000	65,250	67,500	6	
Operating Revenue				1,080,000	1,125,000	1,170,000	1,215,000	1,260,000	1,305,000	1,350,000	1,39	
Profit Margin				5%	5%	5%	5%	5%	5%	5%		
Taxable Income				54,000	56,250	58,500	60,750	63,000	65,250	67,500	6	
Corporate Income Tax Rate				5.4%	5.4%	5.4%	5.4%	5.4%	5.4%	5.4%		
Operations Corporate Income Tax Rate				2,916	3,038	3,159	3,281	3,402	3,524	3,645		

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	TOTAL
5,440	33,792	31,808	35,456	47,808	57,024	52,672	46,784	37,568	58,240	58,240	56,000	51,520	1,032,192
3,402	3,524	3,645	3,767	3,888	4,010	4,131	4,253	4,374	4,496	4,617	4,739	4,860	123,696
6,528	105,312	96,096	110,880	125,664	140,448	155,232	170,016	184,800	192,192	192,192	192,192	192,192	2,109,088
0	0	0	0	0	0	0	0	0	0	0	0	0	208,000
5,370	142,628	131,549	150,103	177,360	201,482	212,035	221,053	226,742	254,928	255,049	252,931	248,572	3,472,976
5,440	28,160	29,760	33,920	43,200	31,680	34,240	31,680	22,720	58,240	58,240	56,000	51,520	929,280
0	5,632	2,048	1,536	4,608	25,344	18,432	15,104	14,848	0	0	0	0	102,912
5,440	33,792	31,808	35,456	47,808	57,024	52,672	46,784	37,568	58,240	58,240	56,000	51,520	1,032,192
5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	
142	88	93	106	135	99	107	99	71	182	182	175	161	
0,000	440,000	465,000	530,000	675,000	495,000	535,000	495,000	355,000	910,000	910,000	875,000	805,000	
6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	
5,440	28,160	29,760	33,920	43,200	31,680	34,240	31,680	22,720	58,240	58,240	56,000	51,520	929,280
4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	
0	22	8	6	18	99	72	59	58	0	0	0	0	
0	88,000	32,000	24,000	72,000	396,000	288,000	236,000	232,000	0	0	0	0	
6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	
0	5,632	2,048	1,536	4,608	25,344	18,432	15,104	14,848	0	0	0	0	102,912
													57,600
3,402	3,524	3,645	3,767	3,888	4,010	4,131	4,253	4,374	4,496	4,617	4,739	4,860	66,096
3,402	3,524	3,645	3,767	3,888	4,010	4,131	4,253	4,374	4,496	4,617	4,739	4,860	123,696
													57,600
20	20	20	20	20	20	20	20	20	20	20	20	20	
3,000	65,250	67,500	69,750	72,000	74,250	76,500	78,750	81,000	83,250	85,500	87,750	90,000	
0,000	1,305,000	1,350,000	1,395,000	1,440,000	1,485,000	1,530,000	1,575,000	1,620,000	1,665,000	1,710,000	1,755,000	1,800,000	
5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	
3,000	65,250	67,500	69,750	72,000	74,250	76,500	78,750	81,000	83,250	85,500	87,750	90,000	
5.4%	5.4%	5.4%	5.4%	5.4%	5.4%	5.4%	5.4%	5.4%	5.4%	5.4%	5.4%	5.4%	
3,402	3,524	3,645	3,767	3,888	4,010	4,131	4,253	4,374	4,496	4,617	4,739	4,860	66,096

KEALAKEHE MASTER PLAN
PUBLIC REVENUES AND COSTS
For the Years 1992 - 2011

File Name: REVFINAL.WK1
Date: 09/10/90
Time: 12:00 AM

Schedule B-3: Commercial Corporate Income Tax Revenue	Schedule	YEAR 1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Construction of Commercial Center											
Operations						38,640	20,000	20,000	20,000	24,000	0
Commercial Corporate Income Tax Revenue						0	36,960	51,744	66,528	81,312	96,096
						38,640	56,960	71,744	86,528	105,312	96,096
Construction of Commercial Center											
Site Improvement/Acre						200,000					
Acres						26					
Commercial Development						5,200,000					
Construction Cost/Sq.Ft.											
Sq.Ft.						125	125	125	125	125	
Construction Development						50,000	50,000	50,000	50,000	60,000	
						6,250,000	6,250,000	6,250,000	6,250,000	7,500,000	
Construction											
Profit Margin						11,450,000	6,250,000	6,250,000	6,250,000	7,500,000	
Construction Taxable Income						5%	5%	5%	5%	5%	
Corporate Income Tax Rate						572,500	312,500	312,500	312,500	375,000	
Construction Corporate Income Tax						6.4%	6.4%	6.4%	6.4%	6.4%	
						36,640	20,000	20,000	20,000	24,000	
Operations											
Sales/Sq.Ft.							231	231	231	231	231
Sq.Ft.							50,000	70,000	90,000	110,000	130,000
Operating Revenue							11,550,000	16,170,000	20,790,000	25,410,000	30,030,000
Profit Margin							5%	5%	5%	5%	5%
Taxable Income							577,500	808,500	1,039,500	1,270,500	1,501,500
Corporate Income Tax Rate							6.4%	6.4%	6.4%	6.4%	6.4%
Operations Corporate Income Tax Rate							36,960	51,744	66,528	81,312	96,096

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	TOTAL
20,000	24,000	0	0	0	0	0	0	0	0	0	0	0	120,640
36,528	81,312	96,096	110,880	125,664	140,448	155,232	170,016	184,800	192,192	192,192	192,192	192,192	1,988,448
36,528	105,312	96,096	110,880	125,664	140,448	155,232	170,016	184,800	192,192	192,192	192,192	192,192	2,109,088
													200,000
													26
													5,200,000
125	125												
0,000	60,000												
0,000	7,500,000												625
													260,000
0,000	7,500,000												32,500,000
5%	5%												
2,500	375,000												
6.4%	6.4%												
0,000	24,000												
													120,640
231	231	231	231	231	231	231	231	231	231	231	231	231	
0,000	110,000	130,000	150,000	170,000	190,000	210,000	230,000	250,000	260,000	260,000	260,000	260,000	2,690,000
0,000	25,410,000	30,030,000	34,650,000	39,270,000	43,890,000	48,510,000	53,130,000	57,750,000	60,060,000	60,060,000	60,060,000	60,060,000	621,390,000
5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	
9,500	1,270,500	1,501,500	1,732,500	1,963,500	2,194,500	2,425,500	2,656,500	2,887,500	3,003,000	3,003,000	3,003,000	3,003,000	
6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	
6,528	81,312	96,096	110,880	125,664	140,448	155,232	170,016	184,800	192,192	192,192	192,192	192,192	1,988,448

KEALAKEHE MASTER PLAN
PUBLIC REVENUES AND COSTS
For the Years 1992 - 2011

File Name: REVFINAL.WK1
Date: 09/10/90
Time: 12:00 AM

Schedule B-4: School Corporate Income Tax Revenue

	Schedule	YEAR 1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
School Construction		0	0	0	65,000,000	0	0	0	0	0	0
Profit Margin		5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Taxable Income		0	0	0	3,250,000	0	0	0	0	0	0
Corporate Income Tax Rate		6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%
School Construction Corporate Income Tax		0	0	0	208,000	0	0	0	0	0	0

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	TOTAL
0	0	0	0	0	0	0	0	0	0	0	0	0	
5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	
0	0	0	0	0	0	0	0	0	0	0	0	0	
6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	6.4%	
0	0	0	0	0	0	0	0	0	0	0	0	0	208,000

KEALAKEHE MASTER PLAN
PUBLIC REVENUES AND COSTS
For the Years 1992 - 2011

File Name: REVFINAL.WK1
Date: 09/10/90
Time: 12:00 AM

Schedule C: State Individual Income Tax Revenue	Schedule	YEAR 1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	
Construction		1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,2
Golf Course		0	0	0	41,831	41,831	41,831	41,831	41,831	41,831	41,831	
Commercial		0	0	0	0	0	20,086	30,390	40,694	50,998	61,302	
School		0	0	0	0	85,200	92,300	97,625	104,725	115,375	122,475	1
Services Personal		0	0	0	0	0	4,608	9,216	13,824	18,432	23,040	
Individual Income Tax		1,255,716	1,255,716	1,255,716	1,297,547	1,382,747	1,414,541	1,434,778	1,456,790	1,482,352	1,504,364	1,5
Schedule C-1: Construction Individual Income Tax Revenue												
Average Income		24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	2
Deductions		5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	
Taxable Income		18,980	18,980	18,980	18,980	18,980	18,980	18,980	18,980	18,980	18,980	1
Income Tax Rate		8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	
Ave. Construction Individual Income Tax		1,661	1,661	1,661	1,661	1,661	1,661	1,661	1,661	1,661	1,661	
Direct, Indirect & Induced Jobs		756	756	756	756	756	756	756	756	756	756	
Construction Individual Income Tax Rev.		1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,25
Schedule C-2: Golf Course Individual Income Tax Revenue												
Golf Course Individual Income Tax Rev.				38,776	38,776	38,776	38,776	38,776	38,776	38,776	38,776	3
Restaurant Individual Income Tax Rev.				3,055	3,055	3,055	3,055	3,055	3,055	3,055	3,055	
Total GC & Restaurant Individual Inc. Tax Rev.				41,831	41,831	41,831	41,831	41,831	41,831	41,831	41,831	4
Average Income (Golf Course)				17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17
Deductions				5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5
Taxable Income				11,980	11,980	11,980	11,980	11,980	11,980	11,980	11,980	11
Income Tax Rate				8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	
Ave. Golf Course Individual Income Tax				1,048	1,048	1,048	1,048	1,048	1,048	1,048	1,048	1
Direct, Indirect & Induced Jobs				37	37	37	37	37	37	37	37	
Golf Course Individual Income Tax Rev.				38,776	38,776	38,776	38,776	38,776	38,776	38,776	38,776	38
Average Income (Restaurant)				12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12
Deductions				5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5
Taxable Income				6,980	6,980	6,980	6,980	6,980	6,980	6,980	6,980	6
Income Tax Rate				8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8
Ave. Restaurant Individual Income Tax				611	611	611	611	611	611	611	611	
Direct, Indirect & Induced Jobs				5	5	5	5	5	5	5	5	
Restaurant Individual Income Tax Rev.				3,055	3,055	3,055	3,055	3,055	3,055	3,055	3,055	3

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	TOTAL
55,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	25,114,320
41,831	41,831	41,831	41,831	41,831	41,831	41,831	41,831	41,831	41,831	41,831	41,831	41,831	711,127
40,694	50,998	61,302	71,606	81,910	92,214	128,456	130,900	133,344	143,731	143,731	143,731	143,731	1,416,824
04,725	115,375	122,475	124,250	124,250	124,250	124,250	124,250	124,250	124,250	124,250	124,250	124,250	1,660,200
13,824	18,432	23,040	27,648	32,256	36,864	41,472	46,080	50,688	55,296	59,904	66,816	66,816	552,960
56,790	1,482,352	1,504,364	1,521,051	1,535,963	1,550,875	1,591,725	1,598,777	1,605,829	1,620,824	1,625,432	1,632,344	1,632,344	29,655,431
24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	480,000
5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	100,400
18,980	18,980	18,980	18,980	18,980	18,980	18,980	18,980	18,980	18,980	18,980	18,980	18,980	379,600
8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	
1,661	1,661	1,661	1,661	1,661	1,661	1,661	1,661	1,661	1,661	1,661	1,661	1,661	33,220
756	756	756	756	756	756	756	756	756	756	756	756	756	
55,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	1,255,716	25,114,320
38,776	38,776	38,776	38,776	38,776	38,776	38,776	38,776	38,776	38,776	38,776	38,776	38,776	659,192
3,055	3,055	3,055	3,055	3,055	3,055	3,055	3,055	3,055	3,055	3,055	3,055	3,055	51,935
41,831	41,831	41,831	41,831	41,831	41,831	41,831	41,831	41,831	41,831	41,831	41,831	41,831	711,127
17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000	289,000
5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	85,340
11,980	11,980	11,980	11,980	11,980	11,980	11,980	11,980	11,980	11,980	11,980	11,980	11,980	203,660
8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	
1,048	1,048	1,048	1,048	1,048	1,048	1,048	1,048	1,048	1,048	1,048	1,048	1,048	17,816
37	37	37	37	37	37	37	37	37	37	37	37	37	
38,776	38,776	38,776	38,776	38,776	38,776	38,776	38,776	38,776	38,776	38,776	38,776	38,776	659,192
12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	
5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	
6,980	6,980	6,980	6,980	6,980	6,980	6,980	6,980	6,980	6,980	6,980	6,980	6,980	
8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	
611	611	611	611	611	611	611	611	611	611	611	611	611	
5	5	5	5	5	5	5	5	5	5	5	5	5	
3,055	3,055	3,055	3,055	3,055	3,055	3,055	3,055	3,055	3,055	3,055	3,055	3,055	51,935

KEALAKEHE MASTER PLAN
PUBLIC REVENUES AND COSTS
For the Years 1992 – 2011

File Name: REVFINAL.WK1
Date: 09/10/90
Time: 12:00 AM

Schedule	YEAR 1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Schedule C–3: Commercial Individual Income Tax Revenue										
Retail Individual Income Tax						7,860	15,720	23,580	31,440	39,300
Restaurant Individual Income Tax						2,444	4,888	7,332	9,776	12,220
Banking Individual Income Tax						5,238	5,238	5,238	5,238	5,238
Health, Professionals Individual Income Tax						4,544	4,544	4,544	4,544	4,544
Total Commercial Individual Income Tax Revenue						20,086	30,390	40,694	50,998	61,302
Commercial Center Individual Income Tax										
Average Income (Retail)						14,000	14,000	14,000	14,000	14,000
Deductions						5,020	5,020	5,020	5,020	5,020
Taxable Income						8,980	8,980	8,980	8,980	8,980
Income Tax Rate						8.75%	8.75%	8.75%	8.75%	8.75%
Ave. Retail Individual Income Tax						786	786	786	786	786
Direct, Indirect & Induced Jobs						10	20	30	40	50
Retail Individual Income Tax						7,860	15,720	23,580	31,440	39,300
Average Income (Restaurant)						12,000	12,000	12,000	12,000	12,000
Deductions						5,020	5,020	5,020	5,020	5,020
Taxable Income						6,980	6,980	6,980	6,980	6,980
Income Tax Rate						8.75%	8.75%	8.75%	8.75%	8.75%
Ave. Restaurant Individual Income Tax						611	611	611	611	611
Direct, Indirect & Induced Jobs						4	8	12	16	20
Restaurant Individual Income Tax						2,444	4,888	7,332	9,776	12,220
Average Income (Auto Repair)						15,000	15,000	15,000	15,000	15,000
Deductions						5,020	5,020	5,020	5,020	5,020
Taxable Income						9,980	9,980	9,980	9,980	9,980
Income Tax Rate						8.75%	8.75%	8.75%	8.75%	8.75%
Ave. Auto Repair Individual Income Tax						873	873	873	873	873
Direct, Indirect & Induced Jobs						6	6	6	6	6
Auto Repair Individual Income Tax						5,238	5,238	5,238	5,238	5,238
Average Income (Health, Professional)						18,000	18,000	18,000	18,000	18,000
Deductions						5,020	5,020	5,020	5,020	5,020
Taxable Income						12,980	12,980	12,980	12,980	12,980
Income Tax Rate						8.75%	8.75%	8.75%	8.75%	8.75%
Ave. Health, Professional Individual Income Tax						1,136	1,136	1,136	1,136	1,136
Direct, Indirect & Induced Jobs						4	4	4	4	4
Health, Professional Individual Income Tax						4,544	4,544	4,544	4,544	4,544
Schedule C–4: Schools Individual Income Tax Revenue										
Schools Consumption										
Average Income (Schools)	25,300	25,300	25,300	25,300	25,300	25,300	25,300	25,300	25,300	25,300
Deductions	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020
Taxable Income	20,280	20,280	20,280	20,280	20,280	20,280	20,280	20,280	20,280	20,280
Income Tax Rate	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%
Ave. Schools Individual Income Tax	1,775	1,775	1,775	1,775	1,775	1,775	1,775	1,775	1,775	1,775
Direct, Indirect & Induced Jobs	48	52	55	59	65	69				
Schools Individual Income Tax	85,200	92,300	97,625	104,725	115,375	122,475				

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	TOTAL
23,580	31,440	39,300	47,160	55,020	62,880	96,678	96,678	96,678	96,678	96,678	96,678	96,678	959,706
7,332	9,776	12,220	14,664	17,108	19,552	21,996	24,440	26,884	37,271	37,271	37,271	37,271	310,388
5,238	5,238	5,238	5,238	5,238	5,238	5,238	5,238	5,238	5,238	5,238	5,238	5,238	78,570
4,544	4,544	4,544	4,544	4,544	4,544	4,544	4,544	4,544	4,544	4,544	4,544	4,544	68,160
40,694	50,998	61,302	71,606	81,910	92,214	128,456	130,900	133,344	143,731	143,731	143,731	143,731	1,416,824
14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	
5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	
8,980	8,980	8,980	8,980	8,980	8,980	8,980	8,980	8,980	8,980	8,980	8,980	8,980	
8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	
786	786	786	786	786	786	786	786	786	786	786	786	786	
30	40	50	60	70	80	123	123	123	123	123	123	123	
23,580	31,440	39,300	47,160	55,020	62,880	96,678	96,678	96,678	96,678	96,678	96,678	96,678	959,706
12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000	
5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	
6,980	6,980	6,980	6,980	6,980	6,980	6,980	6,980	6,980	6,980	6,980	6,980	6,980	
8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	
611	611	611	611	611	611	611	611	611	611	611	611	611	
12	16	20	24	28	32	36	40	44	61	61	61	61	
7,332	9,776	12,220	14,664	17,108	19,552	21,996	24,440	26,884	37,271	37,271	37,271	37,271	310,388
15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	
5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	
9,980	9,980	9,980	9,980	9,980	9,980	9,980	9,980	9,980	9,980	9,980	9,980	9,980	
8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	
873	873	873	873	873	873	873	873	873	873	873	873	873	
6	6	6	6	6	6	6	6	6	6	6	6	6	
5,238	5,238	5,238	5,238	5,238	5,238	5,238	5,238	5,238	5,238	5,238	5,238	5,238	78,570
18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	18,000	
5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	
12,980	12,980	12,980	12,980	12,980	12,980	12,980	12,980	12,980	12,980	12,980	12,980	12,980	
8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	
1,136	1,136	1,136	1,136	1,136	1,136	1,136	1,136	1,136	1,136	1,136	1,136	1,136	
4	4	4	4	4	4	4	4	4	4	4	4	4	
4,544	4,544	4,544	4,544	4,544	4,544	4,544	4,544	4,544	4,544	4,544	4,544	4,544	68,160
25,300	25,300	25,300	25,300	25,300	25,300	25,300	25,300	25,300	25,300	25,300	25,300	25,300	
5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	
20,280	20,280	20,280	20,280	20,280	20,280	20,280	20,280	20,280	20,280	20,280	20,280	20,280	
8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	
1,775	1,775	1,775	1,775	1,775	1,775	1,775	1,775	1,775	1,775	1,775	1,775	1,775	
59	65	69	70	70	70	70	70	70	70	70	70	70	
104,725	115,375	122,475	124,250	124,250	124,250	124,250	124,250	124,250	124,250	124,250	124,250	124,250	1,860,200

KEALAKEHE MASTER PLAN
PUBLIC REVENUES AND COSTS
For the Years 1992 – 2011

File Name: REVFINAL.WK1
Date: 09/10/90
Time: 12:00 AM

Schedule	YEAR 1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	
Schedule C–5: Services Personal Individual Income Tax Revenue											
Services Personal Consumption											
Average Income (Services Personal)						13,800	13,800	13,800	13,800	13,800	1
Deductions						5,020	5,020	5,020	5,020	5,020	
Taxable Income						8,780	8,780	8,780	8,780	8,780	
Income Tax Rate						8.75%	8.75%	8.75%	8.75%	8.75%	
Ave. Services Personal Individual Income Tax						768	768	768	768	768	
Direct, Indirect & Induced Jobs						6	12	18	24	30	
Services Personal Individual Income Tax						4,608	9,216	13,824	18,432	23,040	2

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	TOTAL
3,800	13,800	13,800	13,800	13,800	13,800	13,800	13,800	13,800	13,800	13,800	13,800	13,800	
5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	5,020	
8,780	8,780	8,780	8,780	8,780	8,780	8,780	8,780	8,780	8,780	8,780	8,780	8,780	
8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	
768	768	768	768	768	768	768	768	768	768	768	768	768	
18	24	30	36	42	48	54	60	66	72	78	87	87	
3,824	18,432	23,040	27,648	32,256	36,864	41,472	46,080	50,688	55,296	59,904	66,816	66,816	552,960

KEALAKEHE MASTER PLAN
PUBLIC REVENUES AND COSTS
For the Years 1992 - 2011

File Name: REVFINAL.WK1
Date: 09/10/90
Time: 12:00 AM

Schedule D: County Real Property Tax Revenue	Schedule	YEAR 1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	
Affordable		152,320	255,136	332,248	405,552	480,760	580,720	683,536	765,408	799,680	830,144	8
Resident Market		78,753	173,689	255,621	351,858	449,395	589,849	725,101	797,929	894,166	983,901	1,0
Non-Resident Market		88,018	99,807	10,175	11,951	12,113	17,442	16,796	9,044	11,951	11,144	
Commercial		0	0	0	0	97,325	150,450	203,575	256,700	320,450	320,450	3
Total County Real Property Tax		319,090	528,632	598,043	769,361	1,039,593	1,338,461	1,629,008	1,829,081	2,026,247	2,145,638	2,2
Schedule D-1: Affordable Unit Real Property Tax Revenue												
Affordable Average Sales Price		105,000	105,000	105,000	105,000	105,000	105,000	105,000	105,000	105,000	105,000	1
Plus Ave. HFDC Price		36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000	
Less Discount on Land (20% x 45,000)		(9,000)	(9,000)	(9,000)	(9,000)	(9,000)	(9,000)	(9,000)	(9,000)	(9,000)	(9,000)	
Affordable Average Sales Price		132,000	132,000	132,000	132,000	132,000	132,000	132,000	132,000	132,000	132,000	13
Homeowner exemption		20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	2
Taxable Value		112,000	112,000	112,000	112,000	112,000	112,000	112,000	112,000	112,000	112,000	11
Tax Rate		0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	
Average Real Property Tax		952	952	952	952	952	952	952	952	952	952	
Affordable Units		160	108	81	77	79	105	108	86	36	32	
Cumulative Affordable Units		160	268	349	426	505	610	718	804	840	872	
Affordable Unit Real Property Tax Revenue		152,320	255,136	332,248	405,552	480,760	580,720	683,536	765,408	799,680	830,144	87
Schedule D-2: Resident Market Unit Real Property Tax Revenue												
Resident Market Average Sales Price		190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	19
Homeowner exemption		20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	2
Taxable Value		170,000	170,000	170,000	170,000	170,000	170,000	170,000	170,000	170,000	170,000	17
Tax Rate		0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	
Average Real Property Tax		1,445	1,445	1,445	1,445	1,445	1,445	1,445	1,445	1,445	1,445	
Market Units		109	73	63	74	75	108	104	56	74	69	
% Resident		50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	
Resident Units		55	66	57	67	68	97	94	50	67	62	
Cumulative Resident Units		55	120	177	244	311	408	502	552	619	681	
Resident Market Unit Real Property Tax Revenue		78,753	173,689	255,621	351,858	449,395	589,849	725,101	797,929	894,166	983,901	1,074
Schedule D-3: Non-resident Market Unit Real Property Tax Revenue												
Non-resident Market Average Sales Price		190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	190
Homeowner exemption		0	0	0	0	0	0	0	0	0	0	
Taxable Value		190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	190
Tax Rate		0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	
Average Real Property Tax		1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1
Market Units		109	73	63	74	75	108	104	56	74	69	
% Non-resident		50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	
Non-resident Units		55	7	6	7	8	11	10	6	7	7	
Cumulative Non-resident Units		55	62	68	76	83	94	104	110	117	124	
Non-resident Market Unit Real Property Tax Revenue		88,018	99,807	10,175	11,951	12,113	17,442	16,796	9,044	11,951	11,144	11

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	TOTAL
765,408	799,680	830,144	870,128	944,384	1,043,392	1,130,976	1,210,944	1,283,296	1,351,840	1,420,384	1,488,928	1,557,472	17,587,248
797,929	894,166	983,901	1,074,936	1,172,473	1,294,720	1,407,864	1,504,101	1,573,027	1,716,082	1,859,137	1,993,089	2,108,833	21,004,520
9,044	11,951	11,144	11,305	12,113	15,181	14,051	11,951	8,560	17,765	17,765	16,635	14,374	428,137
256,700	320,450	320,450	320,450	320,450	320,450	320,450	320,450	320,450	320,450	320,450	320,450	320,450	4,563,450
2,829,081	2,026,247	2,145,638	2,276,819	2,449,420	2,673,743	2,873,340	3,047,446	3,185,333	3,406,137	3,617,736	3,819,101	4,001,129	43,573,355

105,000	105,000	105,000	105,000	105,000	105,000	105,000	105,000	105,000	105,000	105,000	105,000	105,000	
36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000	
(9,000)	(9,000)	(9,000)	(9,000)	(9,000)	(9,000)	(9,000)	(9,000)	(9,000)	(9,000)	(9,000)	(9,000)	(9,000)	
132,000	132,000	132,000	132,000	132,000	132,000	132,000	132,000	132,000	132,000	132,000	132,000	132,000	
20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	
112,000	112,000	112,000	112,000	112,000	112,000	112,000	112,000	112,000	112,000	112,000	112,000	112,000	
0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	
952	952	952	952	952	952	952	952	952	952	952	952	952	
88	36	32	42	78	104	92	84	76	72	72	72	72	1,636
864	840	872	914	992	1096	1188	1272	1348	1420	1492	1564	1636	16,474
765,408	799,680	830,144	870,128	944,384	1,043,392	1,130,976	1,210,944	1,283,296	1,351,840	1,420,384	1,488,928	1,557,472	17,587,248

190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	
20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	
170,000	170,000	170,000	170,000	170,000	170,000	170,000	170,000	170,000	170,000	170,000	170,000	170,000	
0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	
1,445	1,445	1,445	1,445	1,445	1,445	1,445	1,445	1,445	1,445	1,445	1,445	1,445	
56	74	69	70	75	94	87	74	53	110	110	103	89	1,670
50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	
50	67	62	63	68	85	78	67	48	99	99	93	80	1,459
552	619	681	744	811	896	974	1041	1089	1188	1287	1379	1459	
797,929	894,166	983,901	1,074,936	1,172,473	1,294,720	1,407,864	1,504,101	1,573,027	1,716,082	1,859,137	1,993,089	2,108,833	21,004,520

190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	
0	0	0	0	0	0	0	0	0	0	0	0	0	
190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	190,000	
0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	
1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	1,615	
56	74	69	70	75	94	87	74	53	110	110	103	89	1,670
50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	
6	7	7	7	8	9	9	7	5	11	11	10	9	211
110	117	124	131	139	148	157	164	169	180	191	202	211	421
9,044	11,951	11,144	11,305	12,113	15,181	14,051	11,951	8,560	17,765	17,765	16,635	14,374	428,137

[redacted]
PUBLIC REVENUES AND COSTS
For the Years [redacted]

File Name: RE/FINAL_AM1
Date: [redacted]
Time: [redacted]

Schedule D-4: Commercial Real Property Tax Revenue	Schedule	YEAR [redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Site Improvements/Acre												
Acres						250,000						
Infrastructure Development						25						
						6,250,000						
Construction Cost/Sq.Ft.												
Sq.Ft.						125	125	125	125	125		
Construction Development						50,000	50,000	50,000	50,000	60,000		
Infrastructure & Construction						6,250,000	6,250,000	6,250,000	6,250,000	7,500,000		
Cumulative Taxable Value						12,500,000	18,750,000	25,000,000	31,250,000	38,750,000		
Tax Rate						12,500,000	18,750,000	25,000,000	31,250,000	38,750,000	38,750,000	38,750,000
Commercial Real Property Tax Revenue						1.85%	1.85%	1.85%	1.85%	1.85%	1.85%	1.85%
						231,250	346,875	462,500	578,125	717,188	717,188	717,188

CORRECTION

THE PRECEDING DOCUMENT(S) HAS BEEN REPHOTOGRAPHED TO ASSURE LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

KEALAKEHE MASTER PLAN
PUBLIC REVENUES AND COSTS
For the Years 1992 - 2011

File Name: REVFINAL.WK1
Date: 09/10/90
Time: 12:00 AM

Schedule D-4: Commercial Real Property Tax Revenue	Schedule	YEAR 1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	
Site Improvements/Acre												
Acres						200,000						
Infrastructure Development						26						
						5,200,000						
Construction Cost/Sq.Ft.												
Sq.Ft.						125	125	125	125	125		
Construction Development						50,000	50,000	50,000	50,000	60,000		
Infrastructure & Construction						6,250,000	6,250,000	6,250,000	6,250,000	7,500,000		
Cumulative Taxable Value						11,450,000	6,250,000	6,250,000	6,250,000	7,500,000		
Tax Rate						11,450,000	17,700,000	23,950,000	30,200,000	37,700,000	37,700,000	37,70
Commercial Real Property Tax Revenue						0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	
						97,325	150,450	203,575	256,700	320,450	320,450	32

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	TOTAL
													200,000
													26
													5,200,000
125	125												
50,000	60,000												625
250,000	7,500,000												260,000
250,000	7,500,000												32,500,000
200,000	37,700,000	37,700,000	37,700,000	37,700,000	37,700,000	37,700,000	37,700,000	37,700,000	37,700,000	37,700,000	37,700,000	37,700,000	
0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	0.85%	
256,700	320,450	320,450	320,450	320,450	320,450	320,450	320,450	320,450	320,450	320,450	320,450	320,450	4,553,450

KEALAKEHE MASTER PLAN
PUBLIC REVENUES AND COSTS
For the Years 1992 - 2011

File Name: REVFINAL.WK1
Date: 09/10/90
Time: 12:00 AM

Schedule E: Public Operating Revenues		Schedule	YEAR 1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Public Operating Revenues	Est. FY90 Budget	Est. FY90 Per Household											
Res., Apt. & Commercial													
Improved Residential	12,660,000	310											
Apartment	7,778,000	190											
Commercial	3,584,000	88											
Total Res., Apt. & Commercial	24,022,000	588											
Real Property Taxes - Other													
Industrial	1,999,000	49	13,181	22,050	29,694	38,857	48,167	61,544	74,284	81,242	90,160	98,588	108,967
Agricultural	14,041,000	344	92,536	154,800	208,464	272,792	338,152	432,064	521,504	570,352	632,960	692,128	750,952
Conservation	1,064,000	26	6,994	11,700	15,756	20,618	25,558	32,656	39,416	43,108	47,840	52,312	56,758
Hotel/Resort	6,595,000	161	43,309	72,450	97,566	127,673	158,263	202,216	244,076	266,938	296,240	323,932	351,463
Unimproved Residential	2,358,000	58	15,502	26,100	35,148	45,994	57,014	72,848	87,928	96,164	106,720	116,696	126,614
Reconcile Tax Found. & County	866,000												
Total Real Prop. - Other	26,923,000		171,622	287,100	386,628	505,934	627,154	801,328	967,208	1,057,804	1,173,920	1,283,656	1,392,754
Total *Real Prop. County*	*50,945,000*												
Fuel & Utility													
Fuel Tax	2,560,879	63	16,947	28,350	38,178	49,959	61,929	79,128	95,508	104,454	115,920	126,756	137,529
Fuel Tax Increase	2,038,184	50	13,450	22,500	30,300	39,650	49,150	62,800	75,800	82,900	92,000	100,600	109,150
Public Utility Franchise Tax	1,820,500	45	12,105	20,250	27,270	35,685	44,235	56,520	68,220	74,610	82,800	90,540	98,235
Total Fuel & Utility	6,419,563		42,502	71,100	95,748	125,294	155,314	198,448	239,528	261,964	290,720	317,896	344,914
Licenses and Permits	4,290,770	105	28,245	47,250	63,630	83,265	103,215	131,880	159,180	174,090	193,200	211,260	229,215
Money & Prop. (not included)	2,714,800	66											
Intergovernmental Revenues	20,830,954	510	137,190	229,478	309,030	404,390	501,281	640,497	773,084	845,497	938,308	1,026,020	1,113,221
Charges for Services	2,368,160	58	15,602	26,088	35,132	45,973	56,988	72,815	87,888	96,120	106,671	116,643	126,556
Other Revenues	5,059,278	124	33,356	55,734	75,055	98,216	121,748	155,560	187,761	205,349	227,890	249,193	270,371
Fund Bal. (not included)	3,374,016												
Total Public Operating Rev.	96,002,541	2350	214,393	358,550	482,847	631,844	783,232	1,000,752	1,207,914	1,321,056	1,466,069	1,603,115	1,739,364
No. of Units			269	181	156	187	190	273	260	142	182	172	171
Cumulative No. of Units			269	450	606	793	983	1256	1516	1658	1840	2012	2183
County Population	40,849												

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	TOTAL
81,242	90,160	98,588	106,967	116,130	127,547	138,180	147,245	153,566	166,894	180,222	192,766	203,742	2,091,075
70,352	632,960	692,128	750,952	815,280	895,432	970,080	1,033,720	1,078,096	1,171,664	1,265,232	1,353,296	1,430,352	14,680,200
43,108	47,840	52,312	56,758	61,620	67,678	73,320	78,130	81,484	88,556	95,628	102,284	108,108	1,109,550
66,938	296,240	323,932	351,463	381,570	419,083	454,020	483,805	504,574	548,366	592,158	633,374	669,438	6,870,675
96,164	106,720	116,696	126,614	137,460	150,974	163,560	174,290	181,772	197,548	213,324	228,172	241,164	2,475,150
57,804	1,173,920	1,283,656	1,392,754	1,512,060	1,660,714	1,799,160	1,917,190	1,999,492	2,173,028	2,346,564	2,509,892	2,652,804	27,226,012
04,454	115,920	126,756	137,529	149,310	163,989	177,660	189,315	197,442	214,578	231,714	247,842	261,954	2,688,525
82,900	92,000	100,600	109,150	118,500	130,150	141,000	150,250	156,700	170,300	183,900	196,700	207,900	2,133,750
74,610	82,800	90,540	98,235	106,650	117,135	126,900	135,225	141,030	153,270	165,510	177,030	187,110	1,920,375
81,964	290,720	317,896	344,914	374,460	411,274	445,560	474,790	495,172	538,148	581,124	621,572	656,964	6,742,650
74,090	193,200	211,260	229,215	248,850	273,315	296,100	315,525	329,070	357,630	386,190	413,070	436,590	4,480,875
45,497	938,308	1,026,020	1,113,221	1,208,582	1,327,400	1,438,059	1,532,400	1,598,184	1,736,890	1,875,597	2,006,144	2,120,373	21,762,136
96,120	106,671	116,643	126,556	137,397	150,905	163,485	174,210	181,689	197,458	213,227	228,068	241,054	2,474,027
05,349	227,890	249,193	270,371	293,532	322,390	349,266	372,179	388,156	421,844	455,532	487,238	514,981	5,285,474
21,056	1,466,069	1,603,115	1,739,364	1,888,361	2,074,010	2,246,911	2,394,314	2,497,099	2,713,822	2,930,545	3,134,520	3,312,998	34,002,512
142	182	172	171	187	233	217	185	129	272	272	256	224	4,158
1658	1840	2012	2183	2370	2603	2820	3005	3134	3406	3678	3934	4158	42,674

KEALAKEHE MASTER PLAN
PUBLIC REVENUES AND COSTS
For the Years 1992 – 2011

File Name: REVFINAL.WK1
Date: 09/10/90
Time: 12:00 AM

	Schedule	YEAR 1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	
Schedule F: Public Operating Costs												
State Public Operating Costs		0	0	0	0	1,578,720	1,710,280	1,808,950	1,940,510	2,137,850	2,269,410	2,302
County Public Operating Costs		577,274	965,700	1,300,476	1,701,778	2,109,518	2,695,376	3,253,336	3,558,068	3,948,640	4,317,752	4,684
Total State & County Public Operating Costs		577,274	965,700	1,300,476	1,701,778	3,688,238	4,405,656	5,062,286	5,498,578	6,086,490	6,587,162	6,987
Schedule F-1: State Public Operating Costs												
Average Salary (Schools)						25,300	25,300	25,300	25,300	25,300	25,300	25
Benefits (30%)						7590	7590	7590	7590	7590	7590	
Total Average Salary and Benefits						32890	32890	32890	32890	32890	32890	3
Direct, Indirect & Induced Jobs						48	52	55	59	65	69	
State Public Operating Costs – Salaries						1,578,720	1,710,280	1,808,950	1,940,510	2,137,850	2,269,410	2,302
Schedule F-2: County Public Operating Costs												
	Est. FY90 Budget	Est. FY90 Per Household										
General Government	14,332,164	351	94,419	157,950	212,706	278,343	345,033	440,856	532,116	581,958	645,840	706,212	766
Public Safety	34,075,014	834	224,346	375,300	505,404	661,362	819,822	1,047,504	1,264,344	1,382,772	1,534,560	1,678,008	1,820
Highways	6,738,874	165	44,385	74,250	99,990	130,845	162,195	207,240	250,140	273,570	303,600	331,980	360
Sanitation and Waste Removal	4,237,651	104	27,976	46,800	63,024	82,472	102,232	130,624	157,664	172,432	191,366	208,048	227
Health, Education and Welfare	3,907,164	96	25,624	43,200	58,176	76,128	94,388	120,576	145,536	159,168			209
Culture and Recreation	7,299,374	179	48,151	80,550	108,474	141,947	175,957	224,824	271,364	296,782			390
Debt Service (not included)	8,357,492	205											
Pension & Retirement	2,592,162	63	16,947	28,350	38,178	49,959	61,929	79,128	95,508	104,45[illegible]	115,920	126,756	137
Health Fund	3,314,000	81	21,789	36,450	49,086	64,233	79,623	101,736	122,796	134[illegible]8	149,040	162,972	176
Miscellaneous	11,148,626	273	73,437	122,850	165,438	216,489	268,359	342,888	413,868	45[illegible],634	502,320	549,276	595
Total Public Operating Costs	96,002,541		577,274	965,700	1,300,476	1,701,778	2,109,518	2,695,376	3,253,336	3,558,068	3,948,640	4,317,752	4,684
No. of Units			269	181	156	187	190	273	260	142	152	172	
Cumulative No. of Units			269	450	606	793	983	1256	[illegible]8	1658	1840	2012	2
County Population	40,849												

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	TOTAL
940,510	2,137,850	2,269,410	2,302,300	2,302,300	2,302,300	2,302,300	2,302,300	2,302,300	2,302,300	2,302,300	2,302,300	2,302,300	
558,068	3,948,640	4,317,752	4,684,718	5,086,020	5,586,038	6,051,720	6,448,730	6,725,564	7,309,276	7,892,988	8,442,364	8,923,068	
498,578	6,086,490	6,587,162	6,987,018	7,388,320	7,888,338	8,354,020	8,751,030	9,027,864	9,611,576	10,195,288	10,744,664	11,225,368	126,047,124
25,300	25,300	25,300	25,300	25,300	25,300	25,300	25,300	25,300	25,300	25,300	25,300	25,300	
7590	7590	7590	7590	7590	7590	7590	7590	7590	7590	7590	7590	7590	
32890	32890	32890	32890	32890	32890	32890	32890	32890	32890	32890	32890	32890	
59	65	69	70	70	70	70	70	70	70	70	70	70	
940,510	2,137,850	2,269,410	2,302,300	2,302,300	2,302,300	2,302,300	2,302,300	2,302,300	2,302,300	2,302,300	2,302,300	2,302,300	34,468,720
581,958	645,840	706,212	766,233	831,870	913,653	989,820	1,054,755	1,100,034	1,195,506	1,290,978	1,380,834	1,459,458	14,976,925
382,772	1,534,560	1,678,008	1,820,622	1,976,580	2,170,902	2,351,880	2,506,170	2,613,756	2,840,604	3,067,452	3,280,956	3,467,772	35,590,950
273,570	303,600	331,980	360,195	391,050	429,495	465,300	496,825	517,110	561,990	606,870	649,110	686,070	7,041,375
172,432	191,360	[illegible]	227,032	246,480	270,712	293,280	312,520	325,936	354,224	382,512	409,136	432,432	4,438,200
159,168	[illegible]		209,568	227,520	249,888	270,720	288,480	300,864	326,976	353,088	377,664	399,168	4,096,800
296,782			390,757	424,230	465,937	504,760	537,895	560,966	609,674	658,382	704,186	744,262	7,638,825
104,45[illegible]	115,920	126,756	137,529	149,310	163,989	177,660	189,315	197,442	214,578	231,714	247,842	261,954	2,688,525
134,[illegible]98	149,040	162,972	176,823	191,970	210,843	228,420	243,405	253,854	275,886	297,918	318,654	336,798	3,456,675
452,634	502,320	549,276	595,959	647,010	710,619	769,860	820,365	855,582	929,838	1,004,094	1,073,982	1,135,134	11,650,275
958,068	3,948,640	4,317,752	4,684,718	5,086,020	5,586,038	6,051,720	6,448,730	6,725,564	7,309,276	7,892,988	8,442,364	8,923,068	91,578,404
142	182	172	171	187	233	217	185	129	272	272	256	224	4,158
1658	1840	2012	2183	2370	2603	2820	3005	3134	3406	3678	3934	4158	42,674

KEALAKEHE MASTER PLAN
PUBLIC REVENUES AND COSTS
For the Years 1992 - 2011

File Name: REVFINAL.WK1
Date: 09/10/90
Time: 12:00 AM

	Schedule	YEAR 1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Schedule A: State General Excise Tax (GET) Revenue											
Development		0	0	900,000	2,600,000	553,280	250,000	250,000	250,000	300,000	0
Operations		0	0	0	43,200	45,120	509,040	695,760	882,480	1,069,200	1,255,920
Personal Consumption		348,516	348,516	348,516	361,728	385,056	395,312	401,970	409,114	417,230	424,374
Total GET		348,516		1,248,516	3,004,928	983,456	1,154,352	1,347,730	1,541,594	1,786,430	1,680,294
Schedule A-1: Development General Excise Tax Revenue											
Golf Course Development GET		0	0	900,000	0	0	0	0	0	0	0
Commercial Construction GET		0	0	0	0	458,000	250,000	250,000	250,000	300,000	0
School Development GET		0	0	0	2,600,000	0	0	0	0	0	0
Church/Child Care Development GET		0	0	0	0	95,280	0	0	0	0	0
Total Development GET		0	0	900,000	2,600,000	553,280	250,000	250,000	250,000	300,000	0
Golf Course Development GET											
Construction Cost				22,500,000							
GET Rate				4%							
Golf Course Development GET				900,000							
Commercial Development GET											
Site Improvement/Acre						200,000					
Acres						26					
Commercial Development						5,200,000					
GET Rate						4%					
Commercial Site Devevelopment GET						208,000					
Construction Cost/Sq.Ft.						125	125	125	125	125	
Sq.Ft.						50,000	50,000	50,000	50,000	60,000	
Construction Development						6,250,000	6,250,000	6,250,000	6,250,000	7,500,000	
GET Rate						4%	4%	4%	4%	4%	
Construction GET						250,000	250,000	250,000	250,000	300,000	
Commercial Development GET						458,000	250,000	250,000	250,000	300,000	
School Development GET											
Construction Development					65,000,000						
GET Rate					4%						
School Development GET					2,600,000						

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	TOTAL
250,000	300,000	0	95,280	0	0	0	0	0	0	0	0	0	5,198,560
882,480	1,069,200	1,255,920	1,442,640	1,629,360	1,816,080	2,002,800	2,189,520	2,376,240	2,470,560	2,472,480	2,474,400	2,402,400	25,777,200
409,114	417,230	424,374	430,060	435,260	440,460	454,537	457,047	459,557	465,057	466,647	469,032	469,032	8,387,021
541,594	1,786,430	1,680,294	1,967,980	2,064,620	2,256,540	2,457,337	2,646,567	2,835,797	2,935,617	2,939,127	2,943,432	2,871,432	39,362,781
0	0	0	0	0	0	0	0	0	0	0	0	0	900,000
250,000	300,000	0	0	0	0	0	0	0	0	0	0	0	1,508,000
0	0	0	0	0	0	0	0	0	0	0	0	0	2,600,000
0	0	0	95,280	0	0	0	0	0	0	0	0	0	190,560
250,000	300,000	0	95,280	0	0	0	0	0	0	0	0	0	5,198,560
													22,500,000
													900,000
													200,000
													26
													5,200,000
													208,000
125	125												
50,000	60,000												625
50,000	7,500,000												260,000
4%	4%												32,500,000
250,000	300,000												1,300,000
250,000	300,000												1,508,000
													2,600,000