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JOHN WAIHEE
GOVERNOR

March 5, 1993

TO: The Honorable Hoaliku L. Drake, Chairperson
Hawaiian Homes Commission

SUBJECT: Final Environmental Impact Statement for the Kawaihae Ten-Year Master Plan

I am pleased to accept the Final Environmental Impact Statement for the Kawaihae Ten-Year Master Plan as satisfactory fulfillment of the requirements 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 appropriate legislative bodies and governmental agencies to consider if the societal benefits justify the economic, social, and environmental impacts which will likely occur. These impacts are adequately described in the statement, and together with the comments made by reviewers, provide useful analysis of the proposed action.

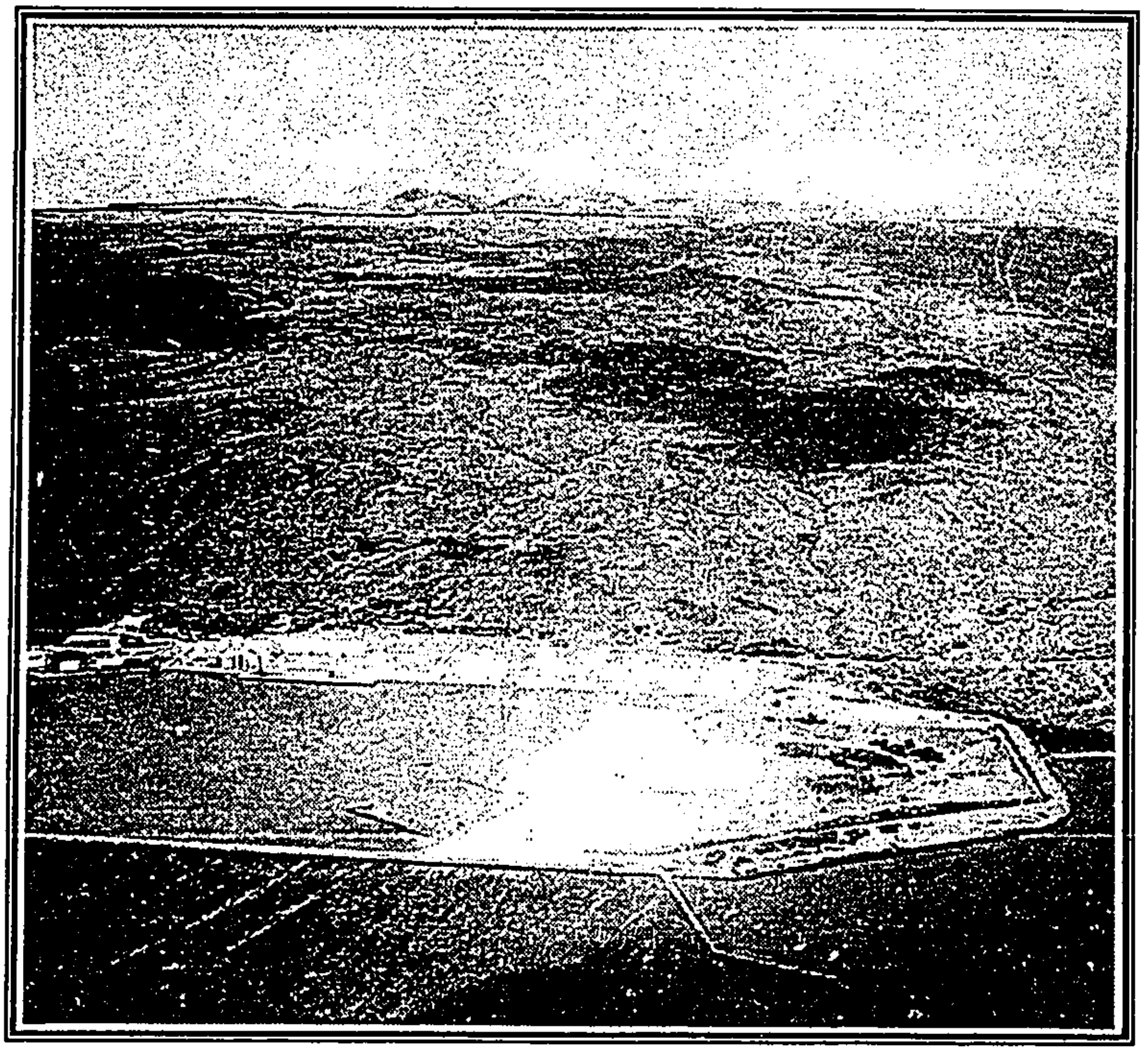
/s/ John Waihee
JOHN WAIHEE

cc: Honorable John C. Lewin

FINAL

ENVIRONMENTAL IMPACT STATEMENT

KAWAIHAE TEN-YEAR MASTER PLAN
KAWAIHAE, SOUTH KOHALA, HAWAII



RMTC
R.M. TOWILL CORPORATION
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Honolulu, HI 96717-4941
(808) 842-1133

PREPARED FOR:
Department of Hawaiian Home Lands
State of Hawaii

DECEMBER 1992

FINAL ENVIRONMENTAL IMPACT STATEMENT

FOR

THE KAWAIHAE TEN-YEAR MASTER PLAN

Kawaihae, South Kohala, Hawaii

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

PROPOSING AGENCY:

Department of Hawaiian Home Lands
State of Hawaii
335 Merchant Street
Honolulu, Hawaii 96813

Hoaliku L. Drake

HOALIKU L. DRAKE, Chairman
Hawaiian Homes Commission

1/4/93

Date

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APPENDICES

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Section 1

INTRODUCTION

SECTION 1

INTRODUCTION

1.1 PROJECT SUMMARY

Project:	Kawaihae Ten-Year Master Plan	
Proposing Agency:	Department of Hawaiian Home Lands State of Hawaii	
Accepting Authority:	Governor State of Hawaii	
Approving Authority:	Chairman Hawaiian Homes Commission	
Tax Map Key Nos.:	6-1-1:3 6-1-3:3, 16-20 6-1-5:1-8	6-1-2:60-63, 65, 69-80, 88 6-1-4:3-20 6-1-6:1-16
Area:	2,115 acres located in the southwest corner of a 10,000-acre site	
Location:	South Kohala district on western coast, Island of Hawaii	
Owner:	Department of Hawaiian Home Lands State of Hawaii	
Existing Land Uses:	Pasture and limited light industry.	
State Land Use Designation:	Agriculture and Urban	
County General Plan Land Use Pattern Allocation Guide Map:	Extensive Ag, Industrial, Medium Density Urban & Urban Expansion	
County Zoning:	Ag, General Industrial & Commercial Village	

1.2 PROJECT BACKGROUND AND DETERMINATION

The Hawaiian Homes Commission Act of 1920 (HHCA) was enacted by the Congress of the United States on July 9, 1921 to distribute benefits to descendants of native Hawaiians inhabiting the Hawaiian Islands prior to 1778. These benefits include establishing a government-sponsored homesteading program. The HHCA set aside approximately 200,000 acres of public land located on the five major Hawaiian Islands to return the native Hawaiians to the land and to the mode of living of their ancestors. The Hawaiian Homes Commission was established to administer the provisions of the HHCA and to establish broad operating policies for the State of Hawaii Department of Hawaiian Home Lands (DHHL). Included in the Act is the authority to:

"1) lease, not sell, land to native Hawaiian beneficiaries for 99-year periods at a rental rate of $1 per year;

2) offer financial assistance to individual homesteaders through low-interest loans for agricultural development and home construction; and

3) provide agricultural and other experts to aid the beneficiary homesteaders in developing their farms and ranches."

Further, the Department has a program goal of exhausting the existing list by the year 2000 by constructing 14,000 homes throughout the State of Hawaii.

The recent trend of native Hawaiians is not the traditional rural homesteading as intended by the HHCA. Trends are favoring urbanization and have resulted in the demand by native Hawaiians for urban residential homestead houselots instead of agricultural or pastoral homesteads. Thus, the primary objective of the Kawaihae Master Plan is to develop lands that can be made available to the Hawaiian people for building residences at truly affordable prices.

However, while the development costs cannot be passed on to the potential residents without diminishing affordability, other income generating uses must be established to make the plan economically feasible. Several uses have been identified as having potential for generating income to help support the implementation of the plan-- these are: an expanded industrial park, a regional commercial/business center, a cultural learning center and resort, a golf course, and development of market residential units.

Given the potentially significant environmental impacts of the project, the Department of Hawaiian Home Lands has determined that an environmental impact statement (EIS) is needed. Hence, one is being prepared in accordance with Chapter 343, Hawaii Revised Statutes (HRS), and the EIS regulations promulgated by Chapter 200 of Title 11, State Department of Health.

The purposes of the EIS are to provide information to public officials and members of the community about the nature of the subject action; to assess the existing environmental conditions of the property and surrounding areas; to evaluate potential impacts of the proposed development, to present mitigating actions for those impacts, and to consider alternatives to the subject action.

1.3 PROJECT LOCATION AND OWNERSHIP

The overall Kawaihae Long Range Master Plan encompasses approximately 10,000 acres of DHHL lands located on the southwestern slopes of the Kohala Mountains on the Island of Hawaii. See Figure 1-1, Location Map. The project site is situated about 26 miles north of Keahole Airport and 8 miles west of the town of Waimea. Kawaihae Harbor is located across Kawaihae Road at the southeast corner of the project area. The subject project site of 2,115 acres for which a ten-year Master Plan was prepared is located in the southwest corner of the larger (Long Range) Master Plan area, see Figure 1-2, Vicinity Map.

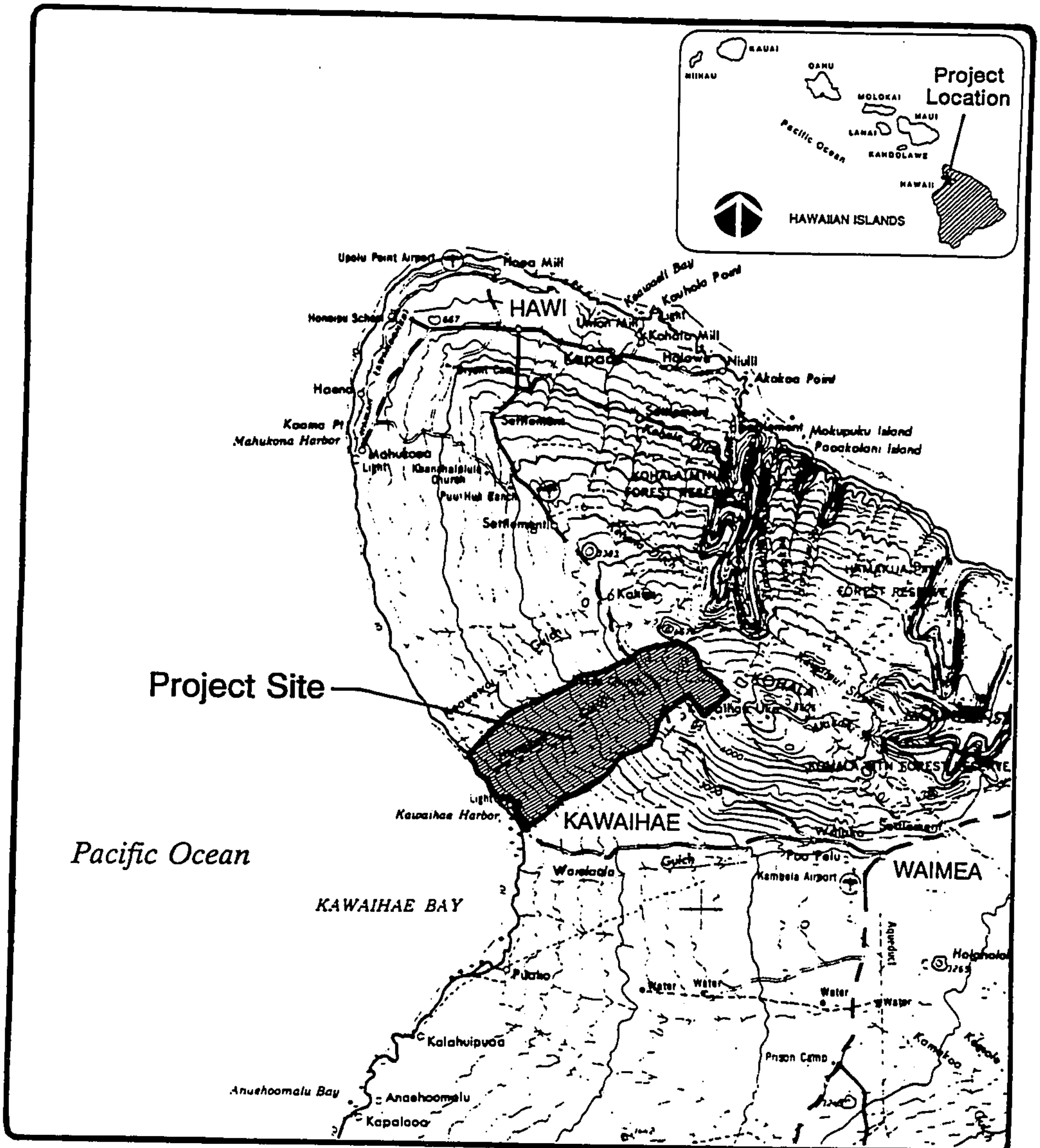

Figure 1-1
Location Map
KAWAIHAE MASTER PLAN

For the Department of Hawaiian Home Lands
State of Hawaii

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MILES

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OCTOBER 91

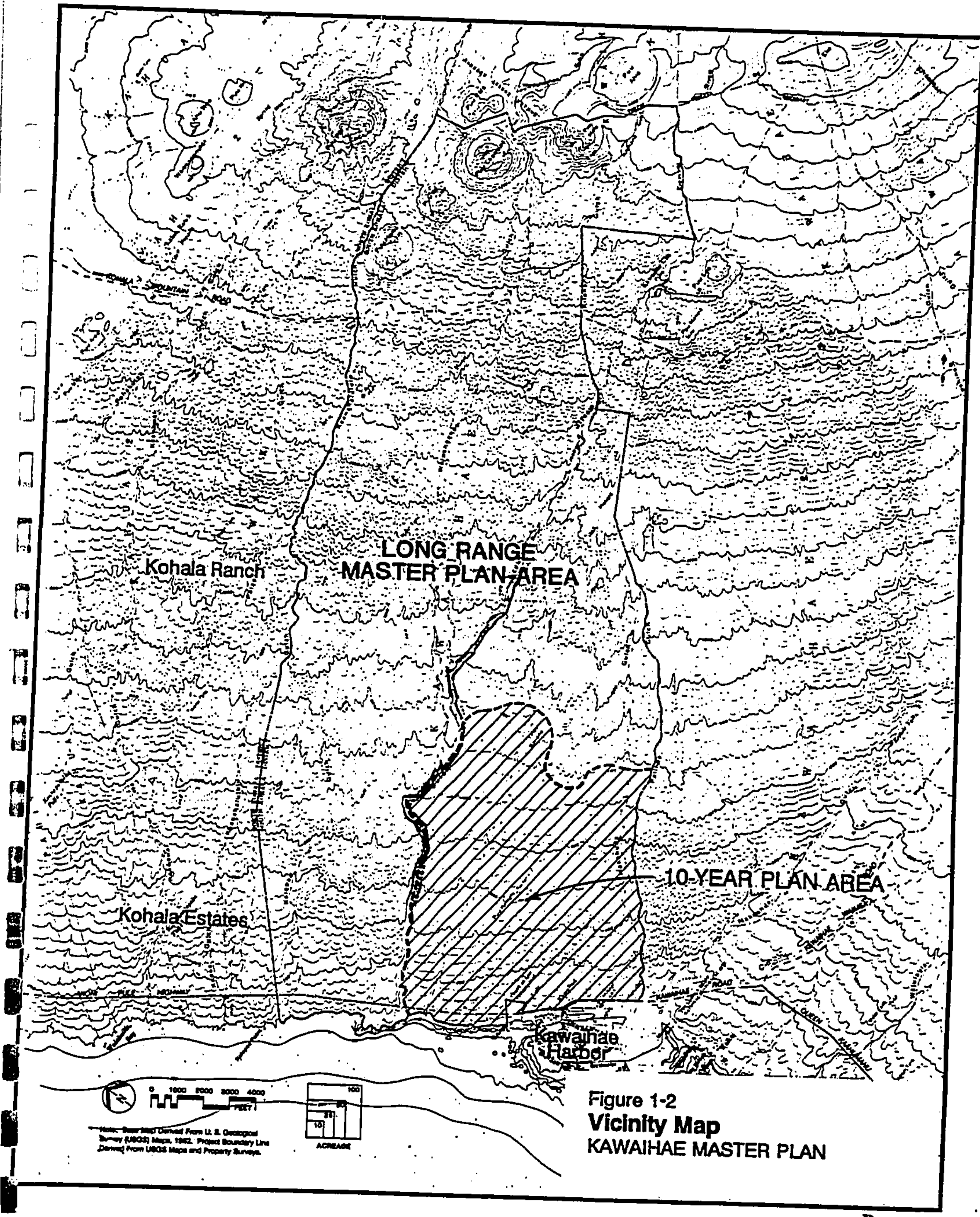


Figure 1-2
Vicinity Map
KAWAIHAE MASTER PLAN

The owner of the property is the Department of Hawaiian Home Lands. The lands to the south of the project site are owned by the Queen Emma Foundation. DHHL is the owner of the property located directly north of the project site.

1.4 SUMMARY OF MAJOR IMPACTS

1.4.1 Archaeological Features

The archaeological sites identified throughout the master plan area will have an impact on the location and alignment of the proposed bypass road at the makai end of the project area.

1.4.2 Terrain

Slope conditions vary greatly throughout the site with gradients ranging from 5% to greater than 20%. The cost of grading, excavation, and construction on land with such a wide range of slope conditions is high. Design guidelines for the various land uses, particularly for the proposed industrial park will be enforced to minimize view impacts and costs of grading.

1.4.3 Drainage

The existence of numerous gulches and gullies throughout the master plan area will complicate development of the site. Major gulches, specifically Honokoa Gulch, will greatly influence circulation and development patterns thereby limiting north-south connections.

Further, gullies and swales in the middle portion of the site will make infrastructure development more costly.

1.4.4 Visual Impact

The implementation of the Kawaihae Master Plan will result in major changes to the area in terms of land use and activity. The visual impact of these changes are of concern as the existing undeveloped landscape will be transformed into an urbanized environment. As the master plan area lies on the slopes of the Kohala Mountains, it is highly visible from various locations in the vicinity including the highway, the Puukohola Heiau National Historic Site, Kohala Ranch, the proposed marina site and neighboring resorts.

Thus, adverse impacts on existing views of the project site shall be minimized by the establishment of specific facilities design criteria along with the development of certain restrictions as to what types of land uses will be allowed in this area.

1.4.5 Economic Feasibility

A major concern in trying to fulfill the objective of making land and affordable housing available to the Hawaiian people is the need to establish other income generating uses to make the plan economically feasible. Several uses have been identified as having potential income to help support the implementation of the plan. These are an expanded industrial park/business center, a commercial center, and cultural learning center.

The project will result in positive impacts on the use of Kawaihae Harbor with the growing population's demand for consumer goods, construction and other supplies.

Long-term employment will be created for harbor operations, industrial park businesses, and resort uses.

1.5 ALTERNATIVES CONSIDERED

The "no project" means that the property would go undeveloped thereby resulting in no impact on the existing environment. However, this option would not be acceptable in that critically needed residential lots and areas for industrial expansion for the Kawaihae Harbor would not occur, thereby aggravating the West Hawaii housing shortage and forecasted industrial land shortage. Bypass road alternatives analysis included the option of maintaining the existing alignment (proposed by the State Department of Transportation in 1976) versus the newly proposed alignment that sites the road more mauka in the Ten-Year Master Plan. The rationale for the more mauka alignment considers the additional archaeological sites discovered in the study conducted for the current plan, and to provide clearer separation between the residential and industrial land uses.

1.6 NECESSARY PERMITS AND APPROVALS

A. Federal

U.S. Army Corps of Engineers	404 Permit for Streambank Improvements
U.S. Department of Interior, National Park	Graves Protection

B. State of Hawaii

Department of Health	Approval of new distribution systems for public water.
	NPDES permit for grading

C. County of Hawaii

Planning Department	Subdivision Plan Approval; Zoning (Commercial and Industrial)
	Special Management Area Permit
Department of Public Works	Building Permits; Grading Permits Drainage Master Plan Approval; Sewer Master Plan approval
Department of Water Supply	Water Master Plan approval

Section 2

DESCRIPTION OF PROPOSED ACTION

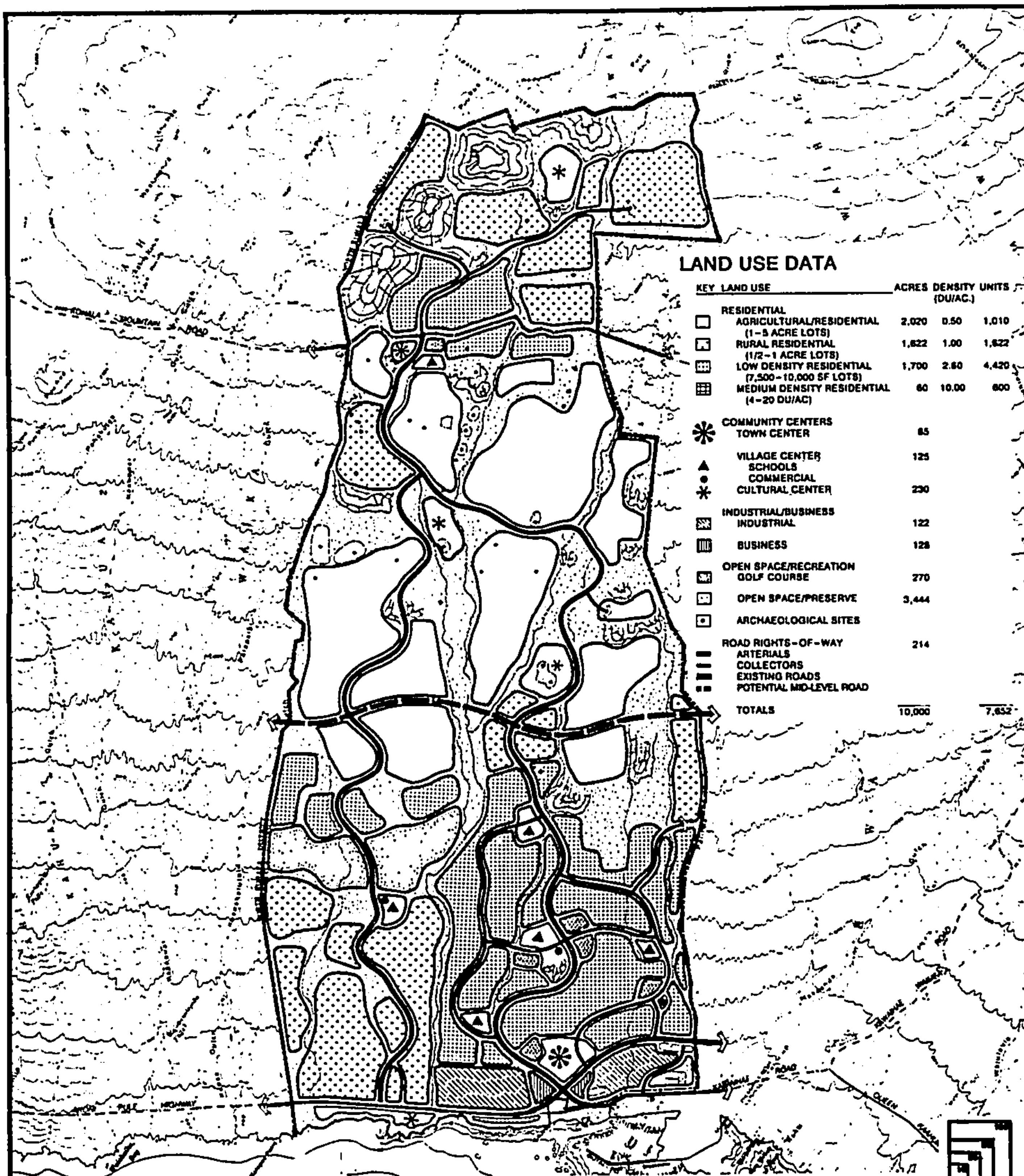
SECTION 2
DESCRIPTION OF THE PROPOSED ACTION

2.1 OVERVIEW OF THE LONG RANGE MASTER PLAN

The Kawaihae Long Range Master Plan features a unique new master planned community covering approximately 10,000 acres of land on the southwestern slopes of the Kohala Mountains. A variety of land use activities that are critical to establishing and sustaining a well balanced, vibrant new community are included as integral parts of the Plan. These uses encompass residential, agricultural, community services, recreational, commercial, business and industrial activities. Some of the major amenities that will be provided in the community include:

* Major Town Centers
* Neighborhood/Village Centers
* Public Schools and Day Care Centers
* Neighborhood and District Parks
* Green Belts and Pedestrian Pathways
* Hawaiian Cultural Centers

In addition to these amenities, there will be other uses that will provide income to help support the overall development program. These income producing uses may include: a regional commercial/business center, industrial parks, a golf course and a Hawaiian cultural centers. Figure 2-1 depicts the Draft Concept Plan for the 10,000 acre Kawaihae planning area. The proposed action for which this EIS is being prepared is on the development of approximately 2,115 acres in the southwest corner of the Long-Range Master Plan area. This area is referred to as the Kawaihae 10-Year Plan. The following paragraphs describe the 10-Year Plan and its various components.



Long Range Development Plan

KAWAIHAE MASTER PLAN

DEPARTMENT OF HAWAIIAN HOME LANDS • STATE OF HAWAII

R.M. TOWILL CORPORATION

Figure 2-1

2.2 TEN-YEAR PLAN OVERVIEW

The Kawaihae Master Plan 10-Year Plan encompasses over 2,100 acres of land in the southwestern portion of the Master Plan area. The 10-Year Plan area will the initial development phase of the overall Long-Range Kawaihae Master Plan. It will be the focus of higher density land use development activity and will contain the Kawaihae Town Center. The main objective of the 10-Year Plan is to provide for development of approximately 3,500 residential units. A secondary objective, but critical for the implementation of the Plan, is the development of income generating activities that will supplement legislative appropriations, or finance the sale and repayment of revenue bonds. Additionally, another key objective is the creation of job opportunities for native Hawaiian beneficiaries. The following sections will discuss the 10-Year Plan development theme, land use components and circulation, and infrastructure development.

2.3 DEVELOPMENT THEME

As the initial phase of the Kawaihae Master Plan, the 10-Year Plan will be the beginning of a major new community on the Island of Hawaii. The development theme for the 10-Year Plan centers on the development of the community around a distinctive town center which will be designed utilizing components of other small towns located throughout the Big Island. The theme is further cultivated through the development of focal points of community activities within the project to create a sense of belonging. These focal points will be in the form of a central community center and smaller "village centers" consisting of a various of community facilities that will serve the residents of the community.

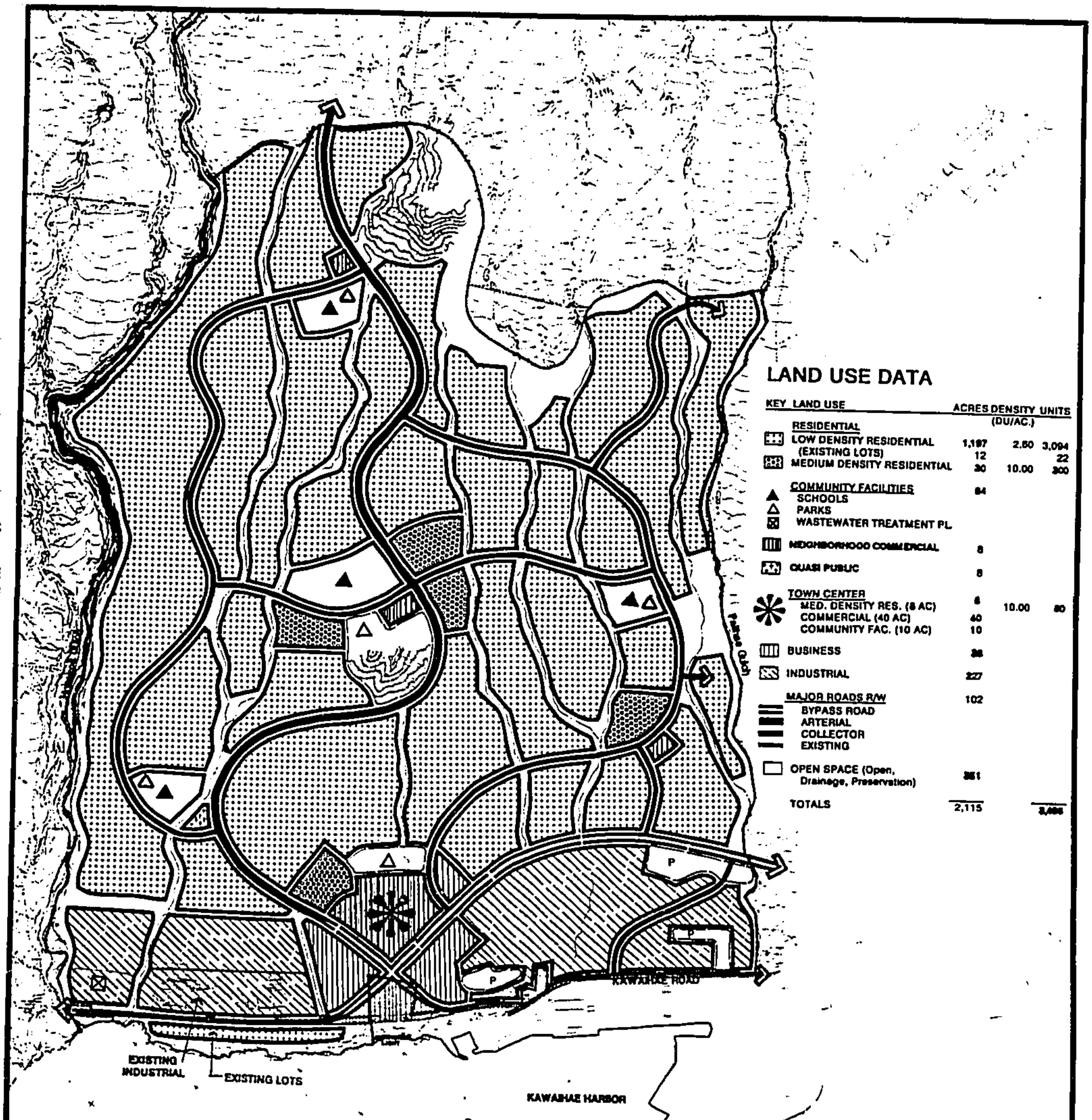
Community facilities will utilize Hawaiian architectural elements and the relation to historical and cultural sites throughout the area is emphasized.

2.4 LAND USE COMPONENTS

The 10-Year Plan has a variety of land use components that are important to sustaining a strong, viable community. These components include residential, community, commercial, business and industrial activities. Key features of the Plan include medium and low density housing, public schools, parks, church/day care center sites, a town center, business centers and industrial parks. Figure 2-2 depicts the Draft Kawaihae 10-Year Plan. Land use allocations for the various uses shown on the Plan are summarized by use, land area, and housing unit counts and densities in Table 2-1. Each of the various components of the Plan are discussed in the subsequent paragraphs.

TABLE 2-1
10-YEAR PLAN LAND USE ALLOCATIONS

LAND USE	ACREAGE	DENSITY (Units/Acre)	UNITS
RESIDENTIAL			
Low Density	1,197	2.60	3,094
Medium density	30	10	300
Existing Lots	12		22
COMMUNITY FACILITIES	84		
COMMERCIAL	8		
QUASI-PUBLIC	8		
TOWN CENTER			
Medium Density Residential	8	10	80
Commercial	40		
Community Facilities	10		
BUSINESS	38		
INDUSTRIAL	227		
MAJOR ROADS RIGHTS-OF-WAYS	102		
OPEN SPACE	351		
TOTALS	2,115		3,496



Land Use Plan

KAWAIHAE 10-YEAR MASTER PLAN

DEPARTMENT OF HAWAIIAN HOMELANDS ▪ STATE OF HAWAII

R. M. TOWILL CORPORATION

Figure 2-2

2.4.1 Residential

In pursuing the primary objective of providing for the development of approximately 3,600 residential units as part of the 10-Year Plan, DHHL is departing from developing the traditional larger homestead parcels and shifting toward higher density residential development to better respond to the growing demand for housing. Two categories of residential development will be provided for in the 10-Year Plan: low density residential development and medium density residential development.

- Low Density Residential

  As reflected in Table 2-1, the majority of the residential land will be for low density development. These areas will have single family residential lots ranging in size from 7,500 square feet to 10,000 square feet. Development density will be about 2.60 units per acre in response to the slope conditions. Nearly 3,100 units can be accommodated at this designated density.

- Medium Density Residential

  The 10-Year Plan has 38 acres designated for medium density residential. This includes 30 acres located adjacent to community and village centers, community facilities complexes and eight acres within the Town Center. The development density will average 10 units per acre, which will result in 300 units. Product types may include duplexes, townhouses and apartments. These higher density residential developments are located next to community facilities to increase the concentration of people at those locations, thereby establishing strong focal points for community activity. To respond to a growing sector of housing needs, an elderly housing project will be included within the Town Center.

2.4.2 Community Facilities

Included as part of the Kawaihae 10-Year Plan are a full range of community facilities which will be designed to serve the residents of the community. The facilities being planned include three elementary schools, an intermediate school, neigborhood and community parks, recreation centers, churches, day care centers, neighborhood convenience centers and a town center. Many of these community facilities will be clustered to form community activity centers and will be centrally located for easy access from various parts of the community. There will be three general types of community activity centers: a town center, a community center and three "village centers." Each of these centers are discussed below:

- Town Center

  As the main focal point for the entire community, the Town Center will contain many of the major facilities that will service the community. These facilities include a community park with gymnasium, a library, a post office, a community activity center, a fire station, a police station, a bank, and other community support services. Figures 2-3 and 2-4 illustrates a proposed Town Center concept.
- Community Center

  A community center will be located in the central portion of the 10-Year Plan next to Puu Kamalii, see Figure 2-5. This center will include an intermediate school, a neighborhood commercial center, a passive park and various other community related facilities.
- Village Centers

  There are "village centers" within the 10-Year Plan, each of which will have an elementary school collocated with a neighborhood park and a church and/or a day care center. These "village centers" will be located at major circulation nodes and will also be accessible by pedestrian pathways. Figure 2-6 depicts the village center concept.

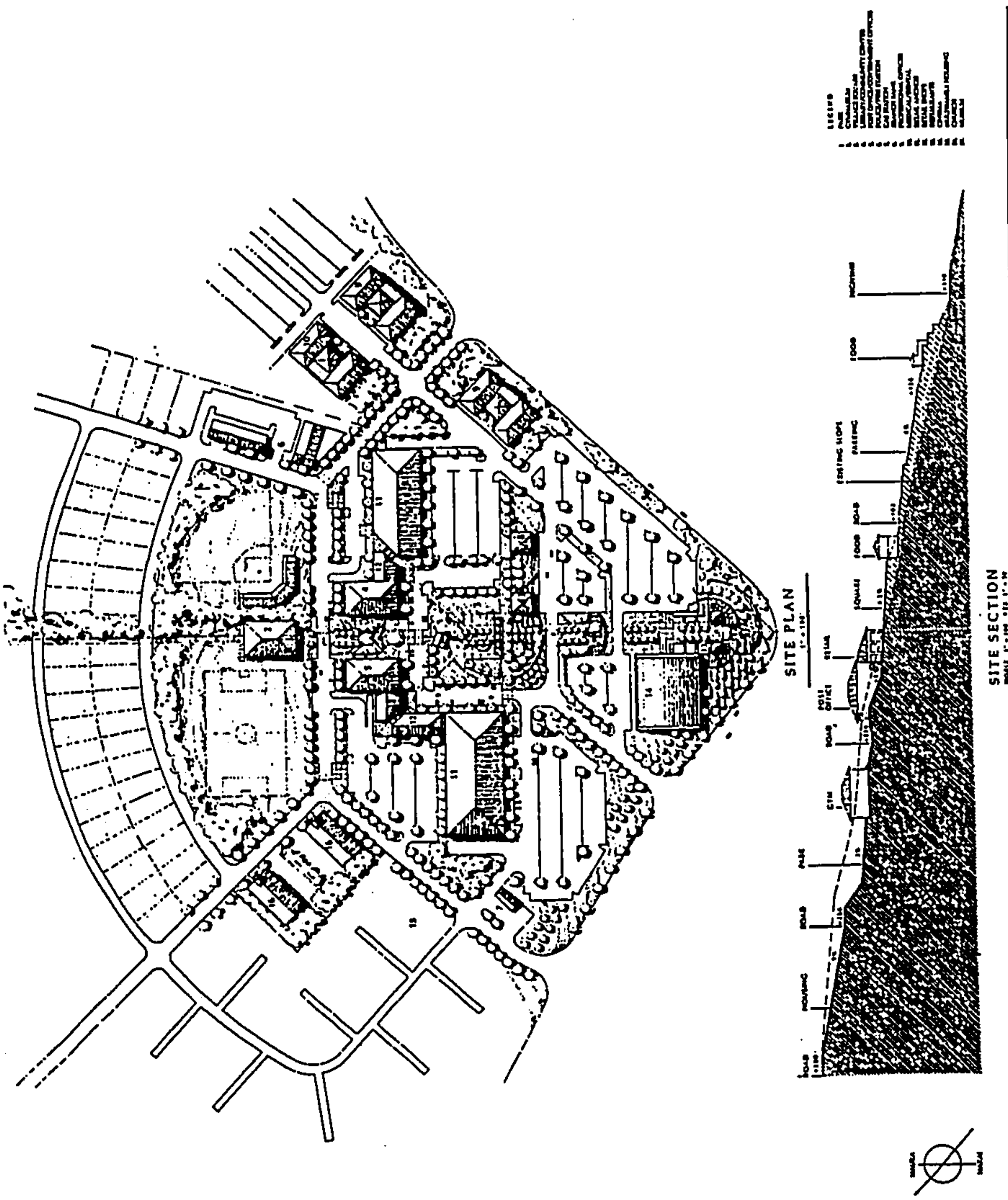


Figure 2-3
Conceptual Town Center Plan
KAWAIHAE MASTER PLAN

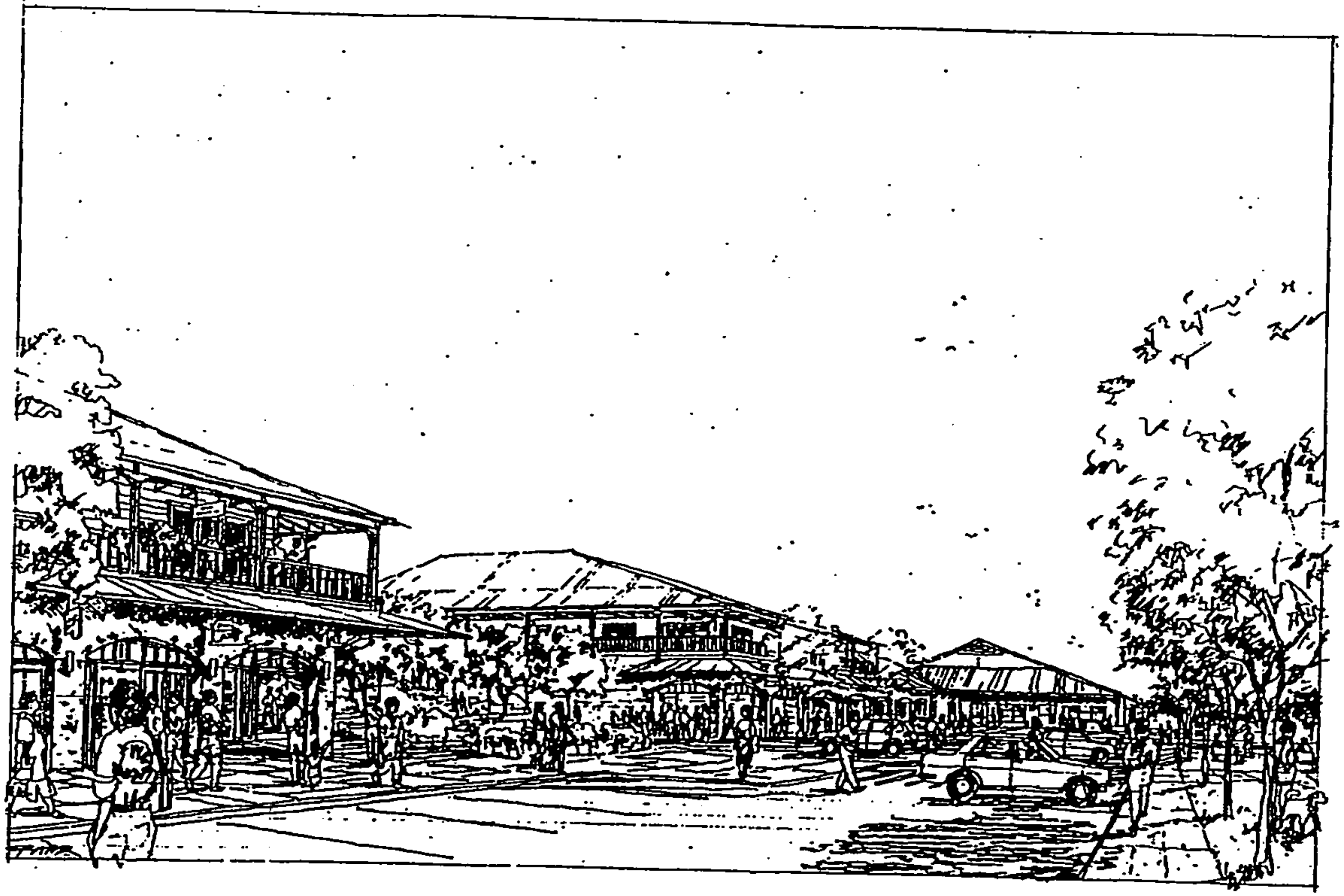


Figure 2-4
Town Center, Main Street & Village Green
KAWAIHAE MASTER PLAN

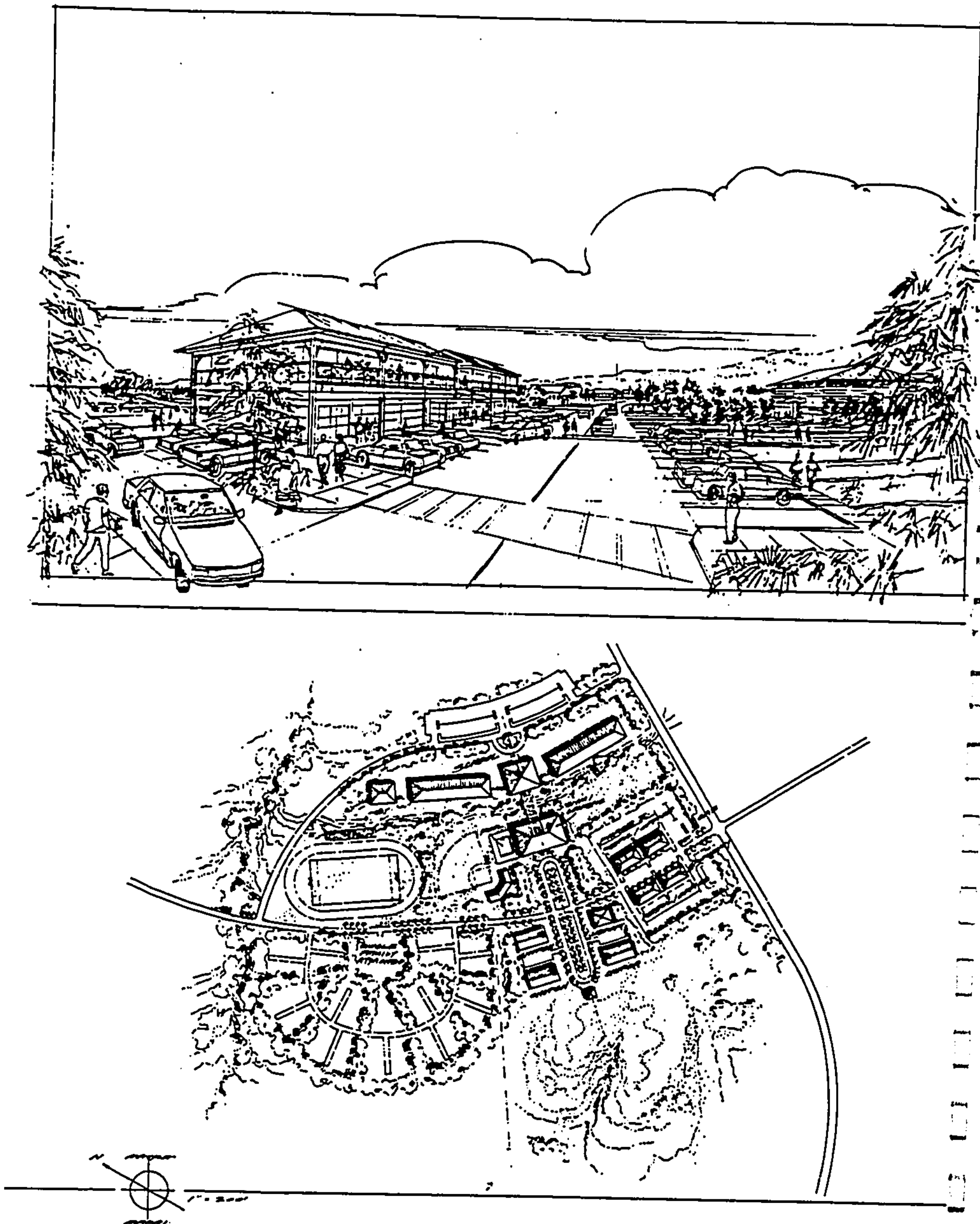


Figure 2-5
Mauka Community Center
KAWAIHAE MASTER PLAN

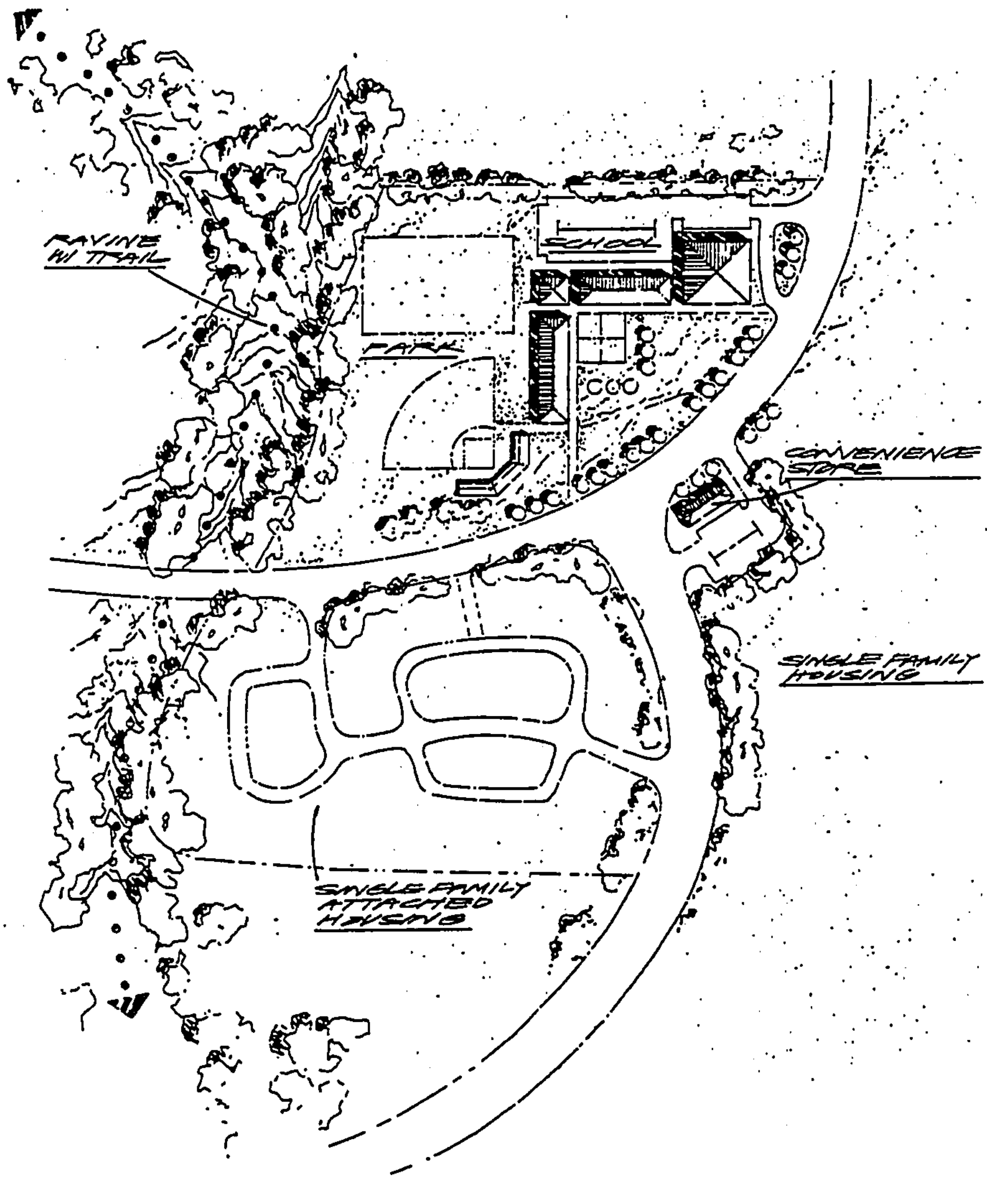


Figure 2-6
Typical Village Center Plan
KAWAIHAE MASTER PLAN

2.4.3 Commercial

The 10-Year Plan will include three general types of commercial facilities: a community shopping center, a neighborhood complex and a convenience store. The community shopping center will be a part of the town center. Although primarily geared to support the community, it will also draw visitors and customers from adjacent communities. The commercial component of the town center will include a major grocery store, a drug store, specialty shops, restaurants, a gas station and theaters. A six-acre neighborhood commercial complex will also be located in the center of the community. This complex will be designed to serve the residents of the community and include small retail stores, commercial services and office space. A convenience store with a gas station will be collocated with the "village center" at the secondary entrance to the project.

2.4.4 Business/Commercial

The 10-Year Plan has approximately 38 acres designated for business/commercial use. Location of the business/commercial facilities will be at the main entry in to the community, opposite of the town center. A variety of business/commercial uses and professional office space will be developed as part of the Kawaihae community; however, the primary intent will be to provide services for the region. The planned growth of Kawaihae Harbor will dictate the need for maritime and related support facilities. Two of the three parcels designated for business/commercial will be makai of the proposed bypass road and easily accessible from the harbor.

2.4.5 Industrial

A total of about 227 acres of land will be dedicated toward industrial use with the possibility of adding another 95 acres, if expansion is necessary. This significant amount of land dedicated toward industrial use is directly related to the planned growth of Kawaihae Harbor. In addition to expansion of the existing industrial park along Akoni Pule Highway, land mauka of Kawaihae Harbor will be developed for industrial uses that desirably should be located next to the port. Both light and heavy industrial activities will be accommodated with the less obtrusive types of activities being located along the perimeters to minimize the visual impacts on adjacent lands. The proposed bypass road is aligned to provide a buffer between the harbor industrial area and the residential community. Should future demand require expansion mauka of the bypass road, only light industrial activities should be allowed in the expansion area. To further mitigate the negative visual impact of industrial uses, facilities design criteria will be established along with requirements for landscaping.

2.5 CIRCULATION

Implementation of the Kawaihae 10-Year Plan will require that significant changes be made to the existing circulation system. In addition to realignment of roadways, a complete new roadway network will be built. There will be four general categories of roadways that will be constructed as part of the development: the bypass (arterial), the mauka-makai spine (secondary arterial), residential collectors and neighborhood streets. Each of these are described below:

2.5.1 Akoni-Pule Bypass

A new four to six-lane bypass road with a 150-foot right-of-way will be constructed to provide access to the community. The main purpose of the bypass will be to route traffic away from Kawaihae Harbor. It will serve as a land use boundary separating the harbor and industrial activities from the residential community. The proposed alignment of the road deviates significantly from previous proposed alignments. The higher route was chosen to avoid most of the area that contains a high concentration of archaeological sites. It also was routed such that it would provide separation between the industrial and residential uses. The bypass will replace the existing Kawaihae Road as the main linkage to the Kawaihae to Waimea Road and the Queen Kaahumanu Highway. Figures 2-7 and 2-8 show a typical

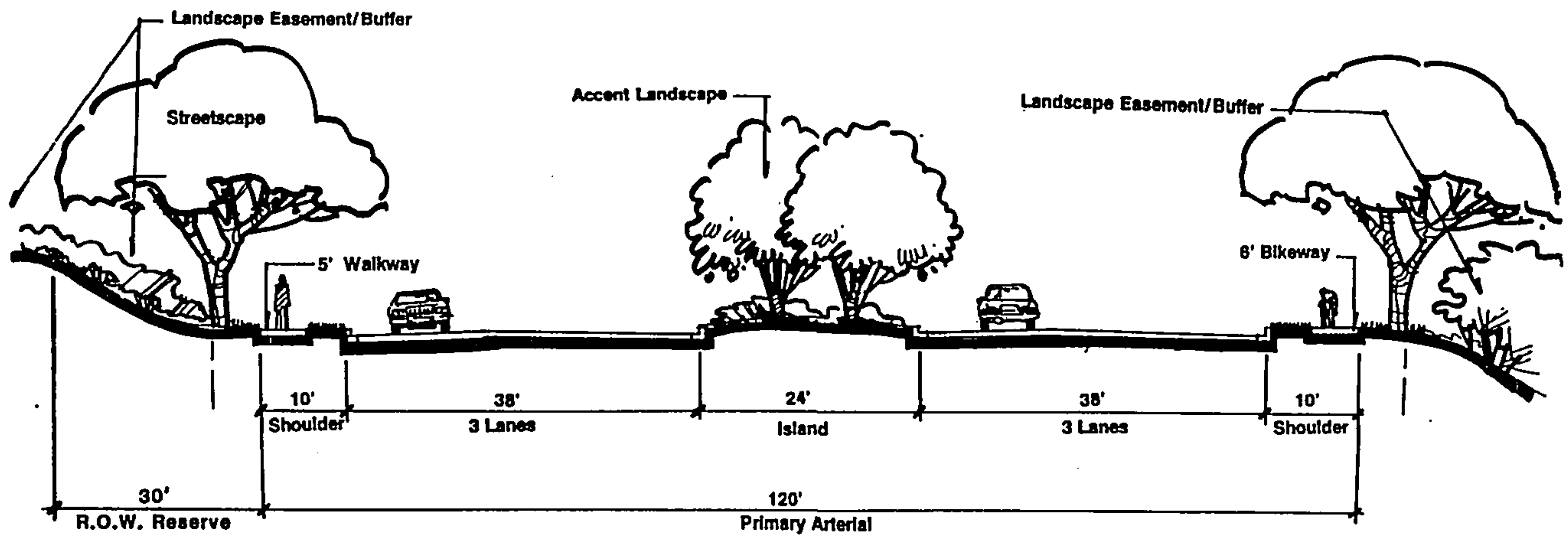


Figure 2-7
Section - Primary Arterial Road (By-Pass Road)
KAWAIHAE MASTER PLAN

Prepared For: Department of Hawaiian Home Lands
By: R.M. Towill Corporation

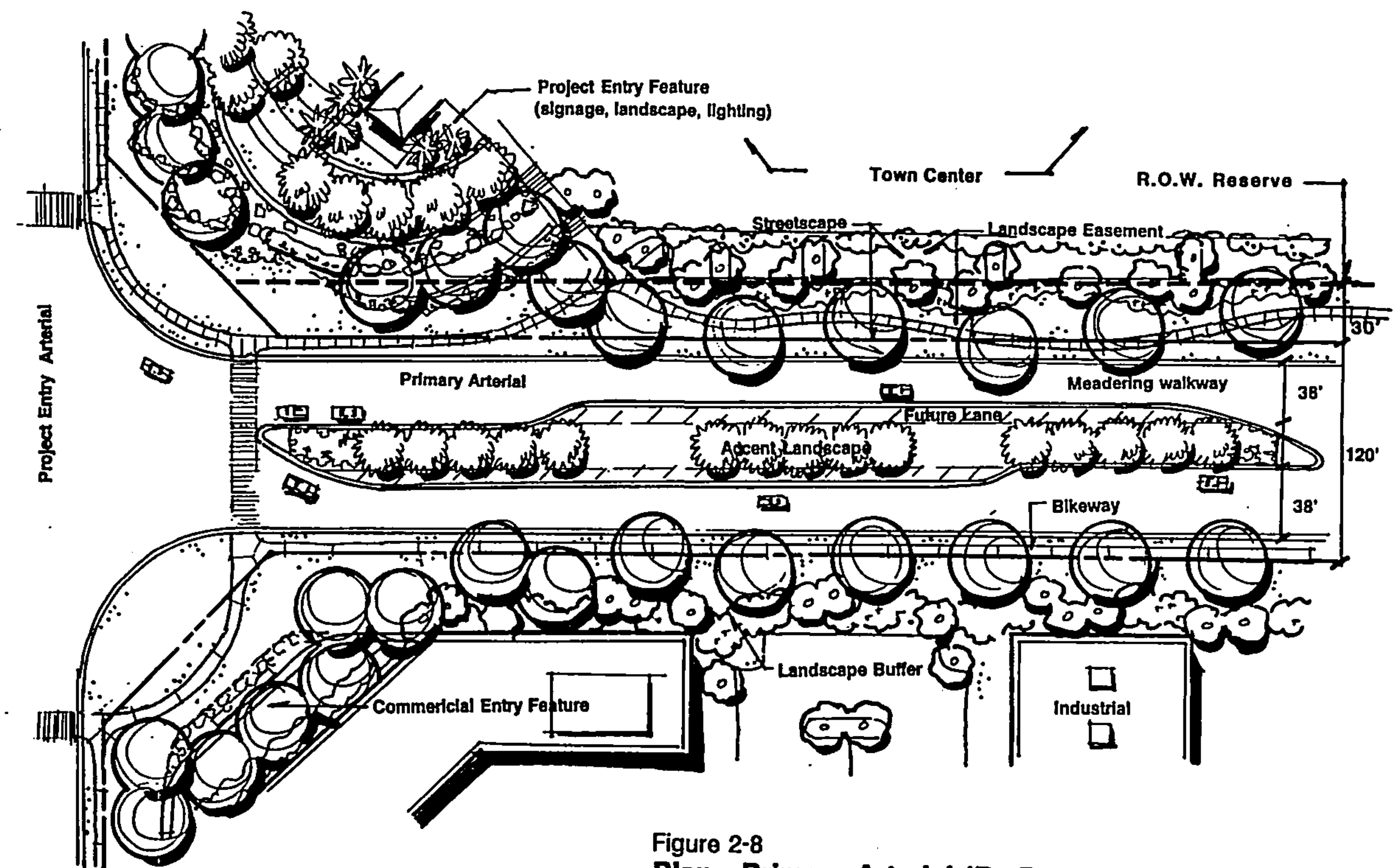


Figure 2-8
Plan - Primary Arterial (By-Pass at Project Entry)
KAWAIHAE MASTER PLAN

Prepared For: Department of Hawaiian Home Lands
By: R.M. Towill Corporation

section and plan view of the roadway. It will be heavily landscaped as it passes through the community and have a bikeway. Pedestrian walkways will be limited to specific areas. The roadway will require 120 feet. However, an additional 30 feet will be set aside for potential future transit usage, for a total right-of-way of 150 feet.

2.5.2 Mauka-Makai Spine Road

The mauka-makai spine road will be the main roadway into the community and will eventually provide a connection to the Kohala Mountain Road, linking the upper and lower portions of the overall Kawaihae Master Plan area. It will also tie into the existing Akoni Pule Highway to provide access to Kawaihae Harbor. The roadway typically will have a right-of-way 80 feet wide. There will be four travel lanes, one turning lane and include a pathway on one side. At the main entrance to the community, next to the town center, the right-of-way will be 120 feet wide and include a landscaped median and walkways on both sides. Figures 2-9 and 2-10 illustrate a typical section and plan view of the roadway at an intersection with a residential collector road.

2.5.3 Residential Collector Roads

All major collector roads through the residential areas will have rights-of-ways that are 60 feet wide. Roadways will typically have two travel lanes and a turning lane. Through most segments of these roadways, on-street parking will not be allowed. These streets will have curbs and gutters and will be landscaped with canopy trees and have a pedestrian/bike pathway on one side. A typical section of the residential collector road is shown in Figure 2-11. A plan view of a residential collector road is shown on Figure 2-12.

2.5.4 Minor Residential Streets

Minor residential streets will have 50-foot rights-of-ways with no curbs and gutters, see Figures 2-12 and 2-13. These roads will accommodate two travel lanes and allow on-street

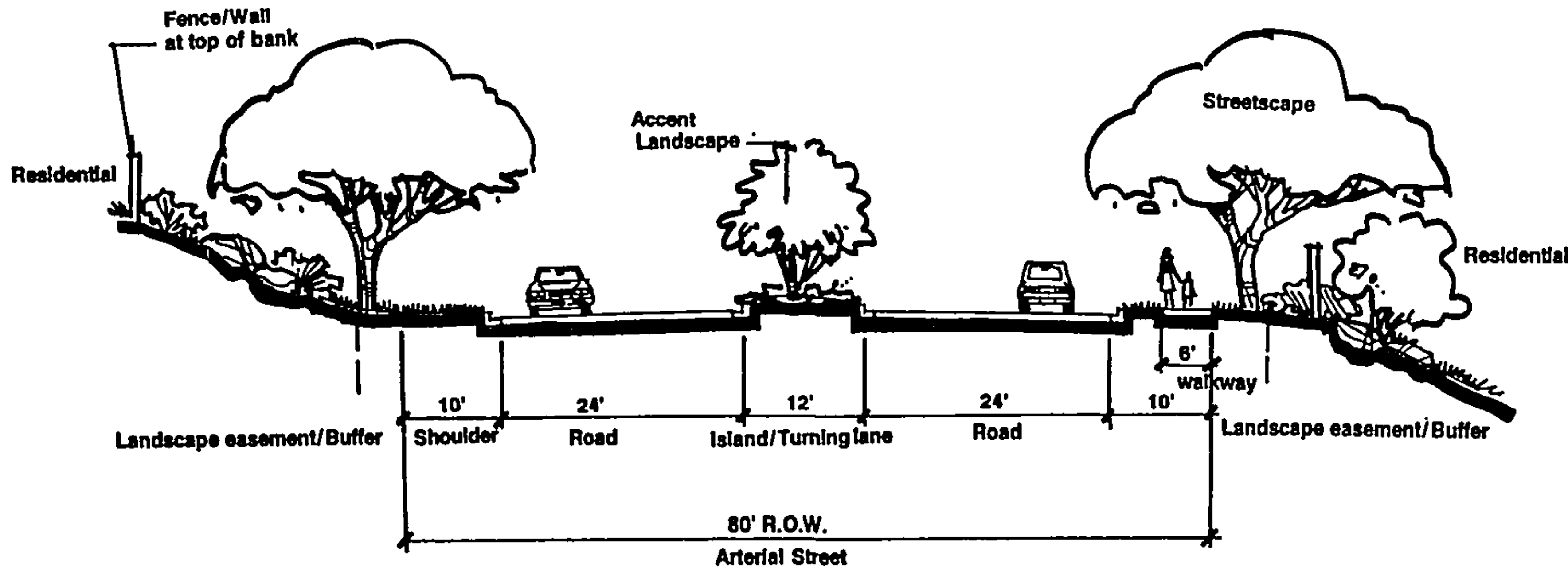


Figure 2-9
Section - Arterial Street, Mauka-Makai Spine Road
KAWAIHAE MASTER PLAN

Prepared For: Department of Hawaiian Home Lands
By: R.M. Towill Corporation

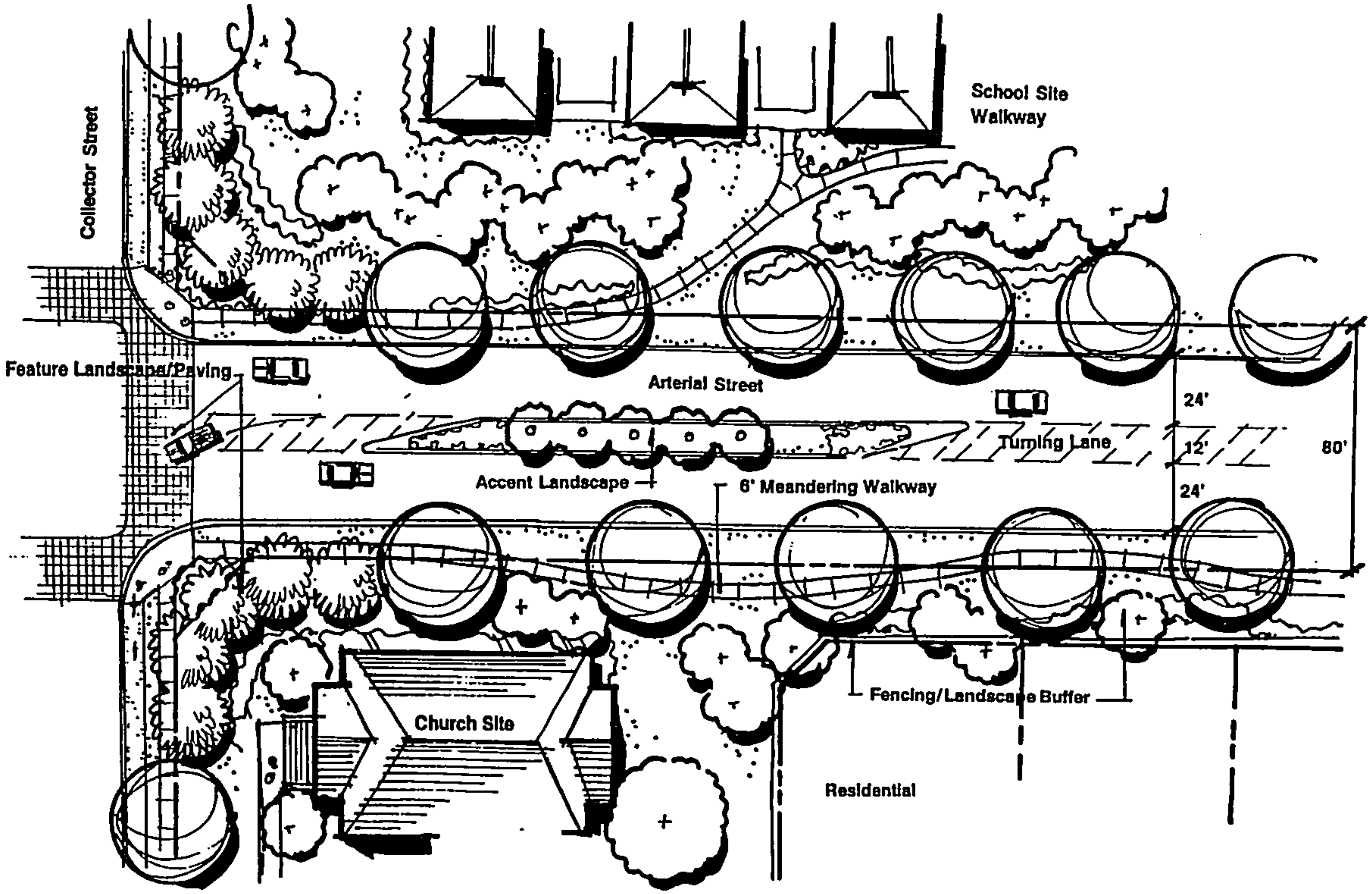


Figure 2-10
Plan - Arterial Street, Mauka-Makai Spine Road
KAWAIHAE MASTER PLAN

Prepared For: Department of Hawaiian Home Lands
By: R.M. Towill Corporation

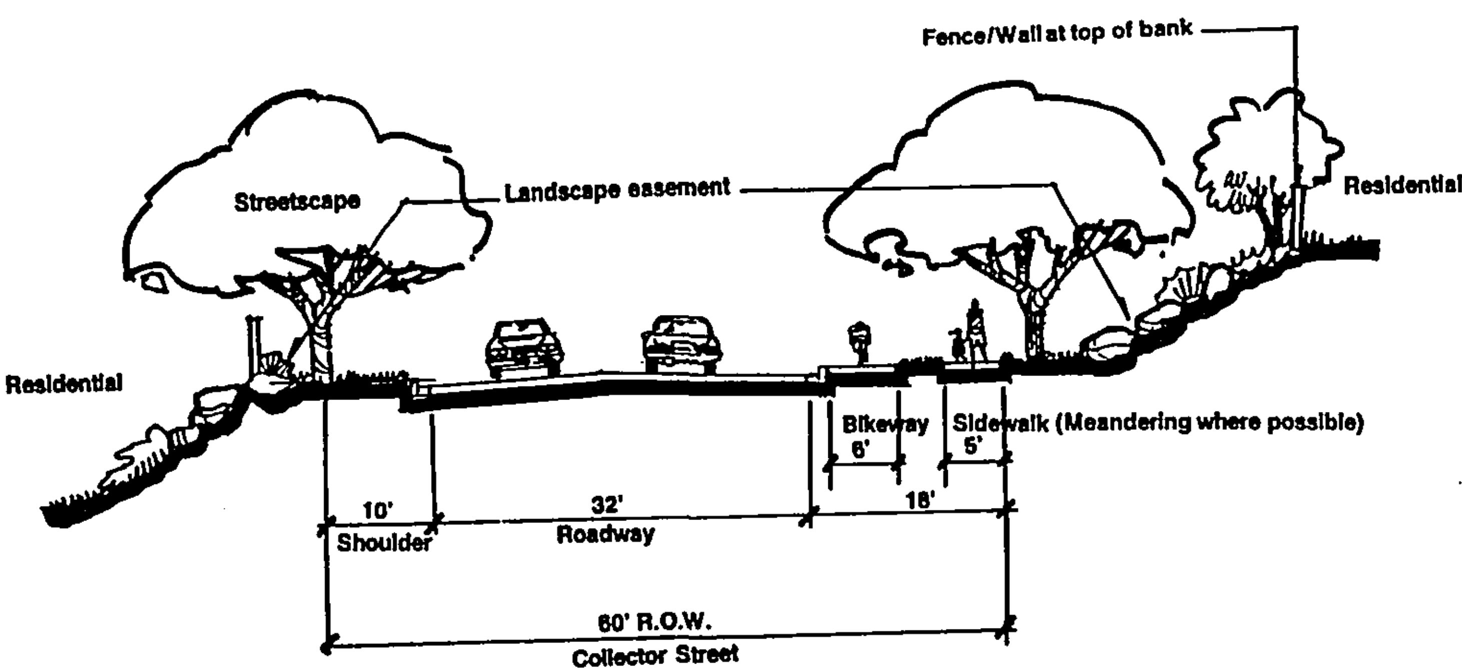


Figure 2-11
Section - Collector Street
KAWAIHAE MASTER PLAN

Prepared For: Department of Hawaiian Home Lands
By: R.M. Towill Corporation

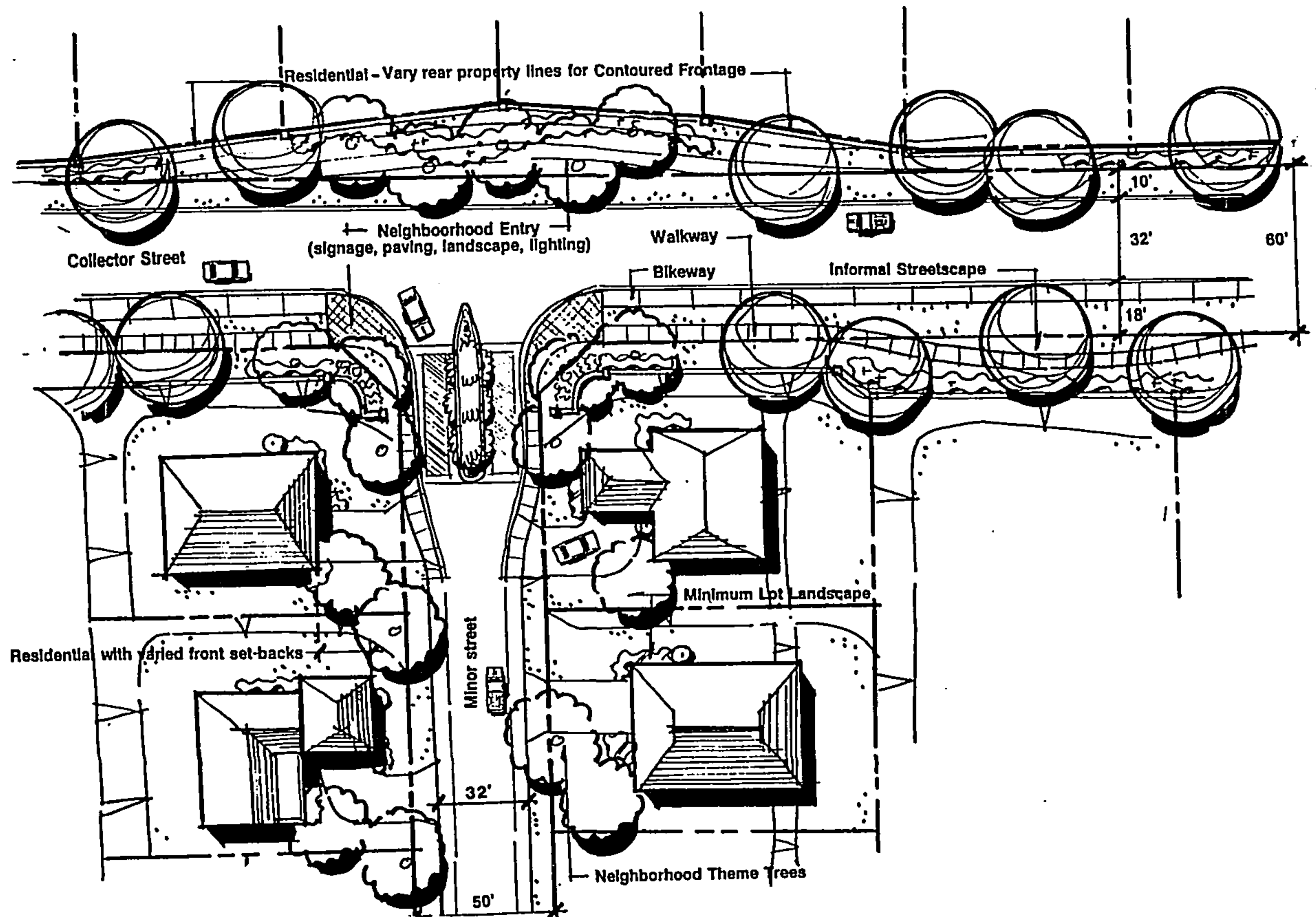


Figure 2-12
Plan - Collector Street/Minor Street
KAWAIHAE MASTER PLAN

Prepared For: Department of Hawaiian Home Lands
By: R.M. Towill Corporation

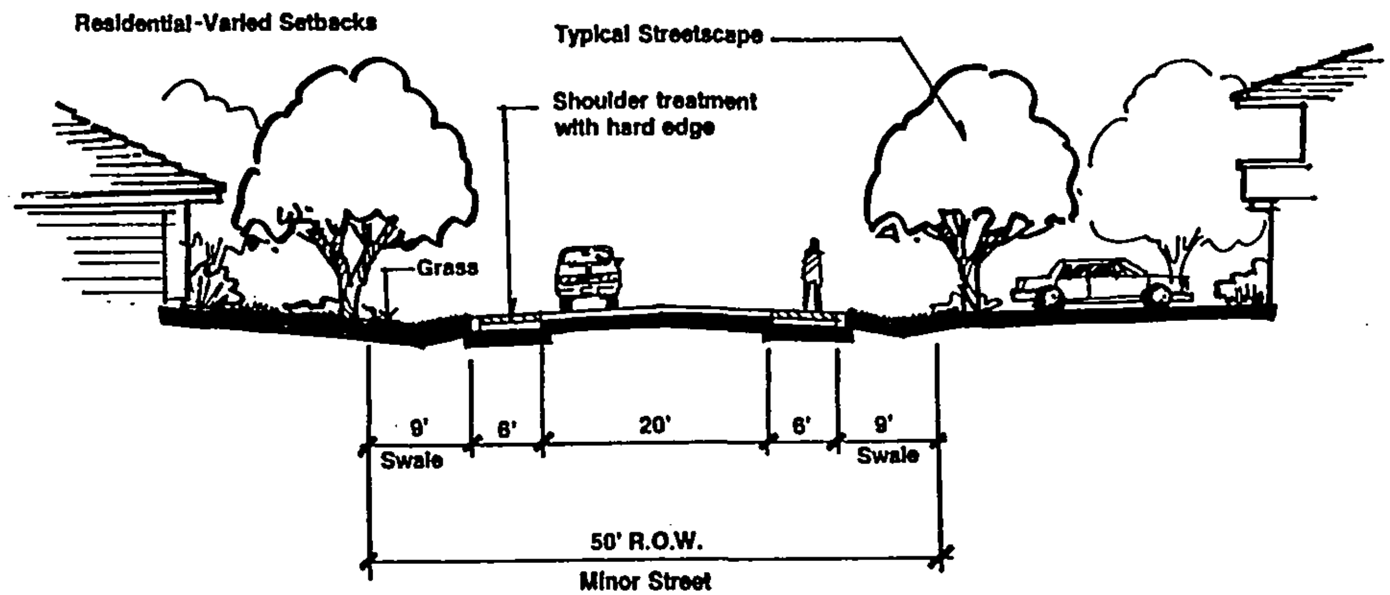


Figure 2-13
Section - Minor Street
KAWAIHAE MASTER PLAN

Prepared For: Department of Hawaiian Home Lands
By: R.M. Towill Corporation

parking on shoulders. Grassed swales will be used for drainage with headers at the pavement shoulder edges to minimize erosion.

2.6 OPEN SPACE/LANDSCAPE PLAN

The open space and landscape components of the master plan will have a significant impact on the visual impressions and quality of life with in the community. Specific application and treatment of these elements can provide beauty, visual interest, definition of land uses/activities and scale, as well as protection against undesirable climatic/environmental elements such as sun, rain, wind, noise, or unfavorable views. All of these elements will be incorporated in the approach to the landscape development of Kawaihae.

Preservation and enhancement of the site's existing open space/land form elements in conjunction with any proposed landscape development will be one objective of this component. This will inevitably lead to more sensitive treatment of the project development and offer to residents and visitors, a more natural/scenic community environment in which to live. Figure 2-14 illustrates the Kawaihae 10-Year Plan, Open Space/Landscape Concept Plan.

The 10-Year Plan area encompasses generally developable lands (slopes at 10-12%) with numerous drainage ways and Puu Kamalii. The Honokoa Gulch runs along the north western boundary and is a significant physical barrier. Archaeological sites are interspersed through the existing makai industrial areas and Harbor region. Tree coverage is limited and generally confined to the drainage areas, so the site is quite exposed. As a result, mauka views are uninhibited all the way down to the Harbor and Ocean. These conditions provide many opportunities for spectacular community vistas; however, in many areas of the site there will be a need for development of protective micro climates to provide for a more hospitable environment for residents.

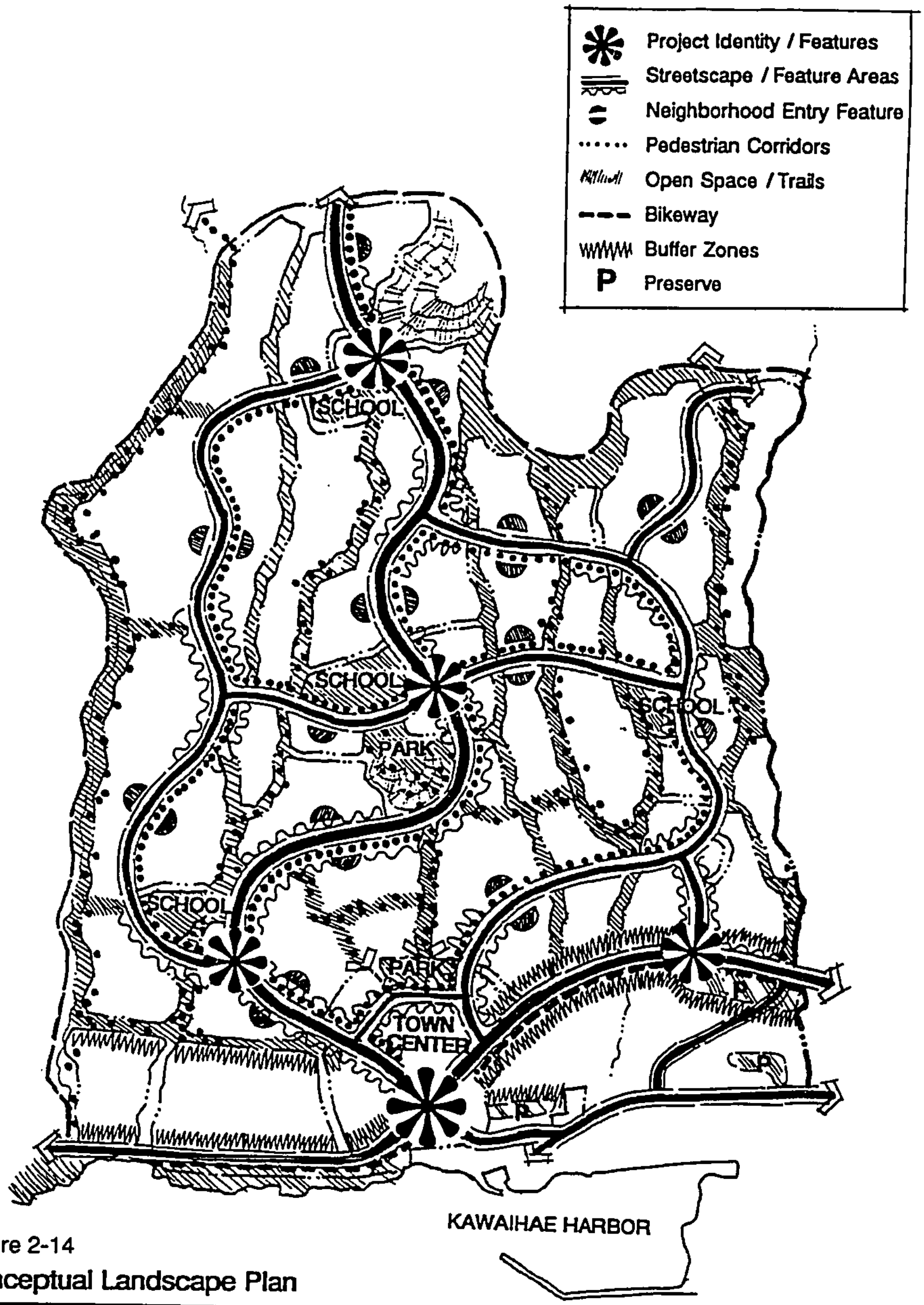


Figure 2-14
Conceptual Landscape Plan

KAWAIHAE 10-YEAR MASTER PLAN

DEPARTMENT OF HAWAIIAN HOMELANDS ▪ STATE OF HAWAII

R. M. TOWILL CORPORATION

2.6.1 Landscape Development Components

The landscape development portion of the project will play an integral part in the identity of the community as well as in the definition of major land use components and open space areas. Each of these components will require specific landscape treatments with variants dependent upon the function of the area, site specific conditions/climate, plant characteristics /maintenance issues (more specifically-drought/wind resistant materials), and general aesthetic considerations, water availability and cost of maintenance.

The primary landscape elements of the project will center around five basic categories of landscape treatment. Each of these categories will have a hierarchy of characteristics within each use to emphasize and define the importance or scale of specific elements of the project see Figure 2-15, Landscape Development Hierarchy. These categories are: streetscape, project/neighborhood identity features, special use areas, buffer zones, and general open space.

A plant palette (Table 2-2) has been developed which is indicative of landscape materials that meet basic parameters for lower maintenance/water consumption, climatic/disease resistance, desirable growth and aesthetic characteristics. Specific plant material selections can be made for each category of use in accordance with these factors.

* Streetscape

  This element will encompass treatment of the vehicular roadway system and related pedestrian or bike transportation corridors. Streetscape areas will utilize a hierarchy of materials to correspond to the location of the primary arterial, arterial, collector, and neighborhood streets (see Figures 2-7 to 2-13, Road Sections).

KAWAIHAE
LANDSCAPE DEVELOPMENT HIERARCHY

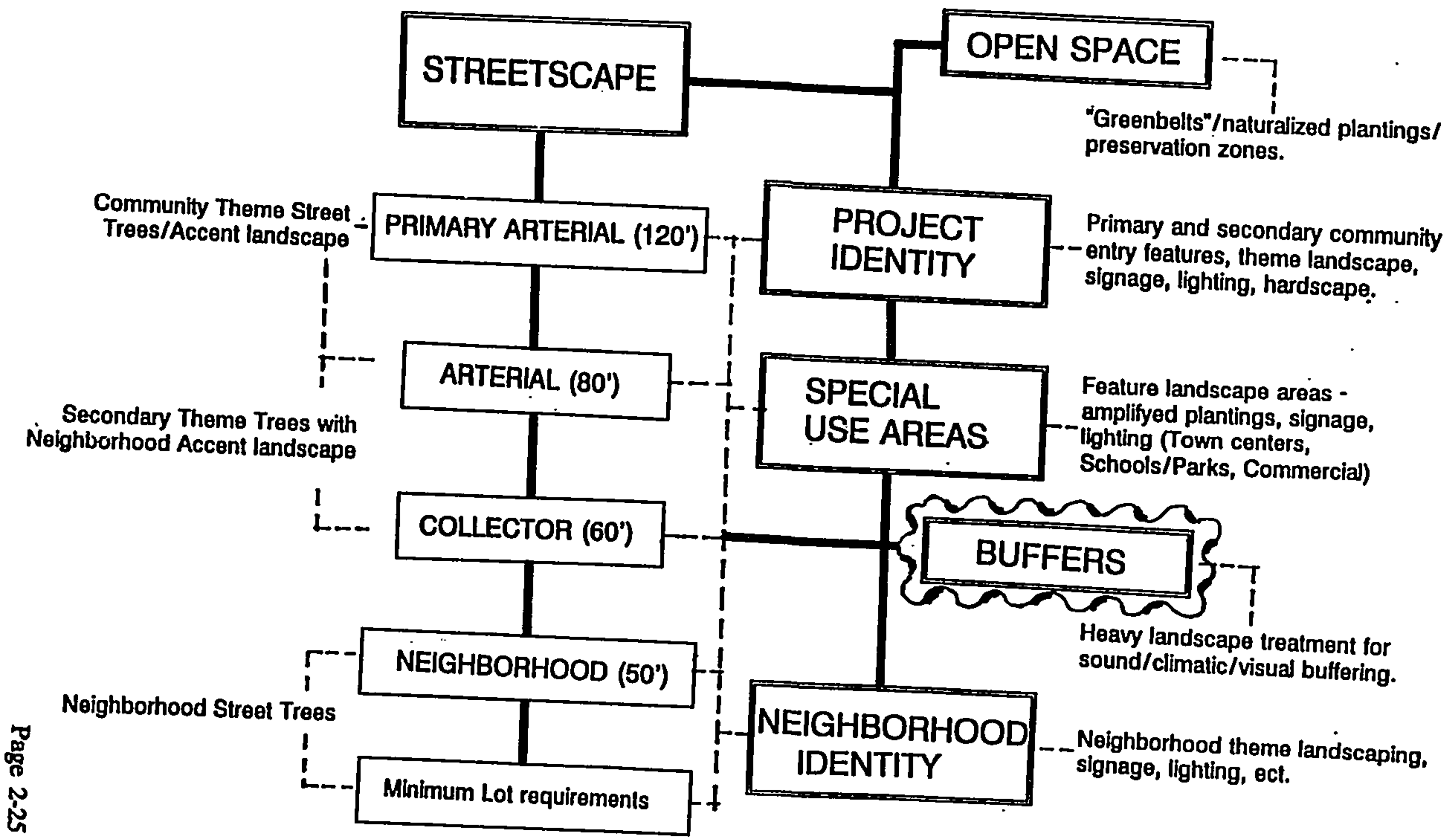


Figure 2-15

TABLE 2-2 (Sht 1 of 2)
KAWAIHAE - PLANT PALETTE

Common Name/Botanical Name	(Use Codes)
Large Trees	
Monkey pod -Samanea saman	A,B
Koa - Acacia koa	A,B
Ficus - F. retusa/benjamina	B,D,E
Kamani Tree - Calophyllum inophyllum	A,B,
Kiawe - Propopis pallida	B,D,E
Eucalyptus - E. spp.	B,D,E
Clusia - C. rosea	B,C
Candlenut - Aleurites moluccana	B,C
Hau - Hibiscus tiliaceus	D,E
Ironwood - Casuarina equisetifolia	D,E
Cooks Pine - Araucaria columnaris	B,D,E
Pepper tree - Schinus terebinthifolius	D,E
Accent/Flowering Trees	
Coffee - C. arabica	B,C
Kou - Cordia sebestena	A,B,C
Wili-Wili -Erythrina sandwichensis	A,B,C
Plumeria - P. spp.	A,B,C
Crepe Myrtle - Lagerstromia speciosa	B,C
Orchid tree - Bauhinia blakeana	B,C
African Tulip - Spathodea campanulata	B,C
Royal Poinciana - Delonix regia	B,C
Pink shower - Cassia javanica	A,B,C
Golden shower - Cassia fistula	A,B,C
Gold Tree - Tabebuia donnell-smithii	B,C
Jacaranda - J. acutifolia	B,C
Palms	
Chinese fan palm - Livistonia chinensis	B
Loulu palm - Pritchardia spp.	B
Coconut palm - Cocos nucifera	B,C
Royal palm - Roystonea regia	B,C

(Use Code) Definitions:

A - Streetscape
B - Special Use areas
C - Project/Neighborhood Identity Features
D - Buffer Zones
E - General Open Space

TABLE 2-2 (Sht 2 of 2)
KAWAIHAE - PLANT PALETTE

Common Name/Botanical Name	(Use Codes)
Shrubs/vines	
Bougainvillea - B. spp.	A,B,C
Flame vine - Pyrostegia venusta	A,B,C
Natal plum - Carrissa spp.	A,B,C
Ixora - I. spp.	A,B,C
Yellow oleander - Thevetia peruviana	A,B,C,D
Oleander - Nerium oleander	A,B,C,D
Hibiscus - H. spp.	A,B,C
Plumbago - P. capensis	A,B,C
Jasmine - Jasminium spp.	B,C
Orange jasmine - Murreya paniculata	B,C
Crinum lily - C. spp.	B,C
Surinam cherry - Eugenia uniflora	B,C
Pittosporum - P. spp.	B,C
Fire cracker plant - Russelia spp.	A,B,C
Ground covers	
Liriope - L. muscari	B,C
Lantana - L. camara	A,B,C,
Periwinkle - Catharanthus roseus	A,B,C
Rhoeo - R. discolor	A,B,C
Wedelia - W. trilobota	A,B,C
Creeping fig - Ficus pumila	A,B,C
Lippia - Phyla nodifolia	A,B
Grasses	
Common Bermuda grass - Cynodon dactylon	A,B,C
Bahia grass - Paspalum notatum	D,E
St. Augustine grass - Stenotaphrum secundatum	A,B,C

(Use Code) Definitions:

A - Streetscape
B - Special Use areas
C - Project/Neighborhood Identity Features
D - Buffer Zones
E - General Open Space

The primary arterial and arterial roads will receive more intensive treatment and contain the first elements of the community theme landscaping and connections with the project identity features. These will include the selection of a community streetscape theme tree and related accent trees, underplantings, signage, lighting, and hardscape. All of these elements will contribute to establishing the primary identity for the new community and provide a basis for common use of materials through out the project.

The intensity of the streetscape would vary with progression along the collector roads and neighborhood streets. Changes in the scale or selection of related materials, shade trees or accent trees would signify the differences in the corridors. Special emphasis would be given at intersections, identity features, or neighborhood entrances with clustering of accent trees, neighborhood theme trees and associated landscape development.

In areas where roads or streets will have a negative impact on adjoining residential or other use areas, buffering with in an additional landscape easement (minimum of 10' width) by means of berms/slopes, fences, walls, in conjunction with heavy landscaping, may be utilized.

Pedestrian walkways and bikeways, where not limited by topography, will be incorporated within the roadway system. Location of these corridors are in direct relation to the primary community destination areas such as the Town Center, village centers, schools, parks and open space. Particular emphasis is placed on the collector street walkways/bikeways which will serve as primary routes for families to and from school sites and parks. Where possible, the walkways will meander from the road alignment to follow natural land forms or to emphasize feature streetscape areas.

* Project/Neighborhood Identity Features
  As part of establishing a strong community identity and sense of entry to the project, special treatment of project/village center/neighborhood entries will be emphasized for theme development. This will involve the amplified use of community theme trees and landscaping, and detailed signage, lighting and hardscape as needed to establish a strong material theme and sense of entrance to the community. Secondary features will be emphasized at the various community centers and individual neighborhood entries will have specific theme trees and landscape development to establish a unique character for each neighborhood. Repetition of the primary materials and forms through out the project will complete the theme concept for the community.

* Special Use Areas
  This element involves the detailed treatment of the Town Center, neighborhood village centers, parks, schools, commercial or private use areas. Most of these areas incorporate public or quasi-public uses and would require detailed treatment to provide a desirable environment for the community users. In all cases the community or neighborhood theme elements would be repeated to create a strong sense of place within each area.

  Within the Town Center and village centers, emphasis will be given to enhancing use activity areas and structures as well as screening of parking and service areas from adjoining uses. Other private commercial/industrial use areas will be required to be consistent with the community standards for development. Heavy buffering would be required along the perimeters. In addition, each single family resident will be encouraged to meet a minimum standard for lot landscaping within their neighborhood theme.

School and park sites would be treated to allow for large grassed open areas with naturalized perimeter plantings. Additional buffering or screening between certain park activities and adjoining residential uses would be required in some areas (see Town Center and Village Center Plans, Figures 2-3 to 2-6).

* Buffer Zones

Throughout the project, there will be a need for some form of special treatment for buffering of undesirable views, land uses, sound, or as wind/sun screens. All industrial and commercial areas will include a perimeter buffer combining the use of heavy landscape, walls, fences or berms to lessen the impact on adjoining uses. The arterial and collector streets will incorporate additional landscape easements to accommodate similar devices for road noise, and residential privacy/security. Parks and school sites may have physical barriers in conjunction with some form of visual landscape screen for security along the perimeters. Utilization of natural land forms such as gulches, drainage ways, and ridges will also serve as effective buffers between many land uses.

Since the site has limited existing tree coverage or protective land forms, there will be a need in many areas for wind breaks/sun screens to lessen the impacts of severe weather. Much of the plant material used in more exposed areas will have wind and drought resistance as part of the selection criteria.

* General Open Space

The landscape development network of streetscape, special use areas, identity features and buffer zones will serve as a central spine to the open space system of the community. These corridors will naturally provide a landscaped connection between the various land use activities and parks. These greenbelts will be utilized by residents for scenic avenues and pathways to designated park sites through out the community.

The open space system includes centrally located school sites which will have provisions for open space use areas that combine park functions for vicinity residents. The Town Center and village centers will also include park/open space areas as an integral part of their plans. In some areas the park sites will include preservation of significant puus or archeological sites. One development aspect of the entire site, will be retention of prime view amenities in conjunction with each use area and it's associated open space.

Natural drainageways and other areas considered undesirable for development due to steep slopes, will be selectively improved via naturalized plantings, as scenic and open space amenities. Within designated areas, a continuous open space trail system will be developed to take advantage of the scenic beauty of these natural land forms. In the process of development some lands will altered by grading techniques and rendered unsuitable for general use. These areas will be stabilized with appropriate erosion control/landscape materials and dedicated as community open space.

2.7 PARKS AND RECREATION

The 10 year plan recreation system encompasses all of the general open space system as well as specific park and recreation facilities needed to accommodate the expected resident population of the community.

As shown on the 10-Year Plan (Figure 2-2), there are provisions for a series of community and neighborhood parks throughout the project. These parks are dispersed throughout the community to meet the local recreational needs of the individual neighborhoods and overall community activities.

The Town Center which is located central to the project entry and initial development phases shall include both primary commercial and community center uses. Central to this area is a community park (10 ac.), community activity center/gymnasium, with field and court sports and passive recreation areas for picnic and community gatherings and public events. These park functions would serve vicinity neighborhood residents as well as the entire Kawaihae project area.

At the center of the site is another community park in conjunction with the neighborhood commercial and intermediate school sites. This park (28 ac.) includes preservation of Puu Kamalii and will provide spectacular overviews of the site along with open space opportunities for passive recreation uses (picnicking, hiking trails, scenic overlooks). A Multi-purpose building for park services and vicinity neighborhood social functions would be located within the park. A trail system connecting the various preservation and archeological areas would link to this park as part the overall recreation plan.

The intermediate school site would concurrently provide the facilities for track and ball field sports (with spectator accommodations), courts for basketball, volleyball, tennis, swimming facilities and gymnasium with additional community activity space. Church sites within the community center would have provisions for child day care and play areas for young children in the area.

Three other village centers located along major circulation nodes would include combination elementary school and neighborhood park sites (12 ac. each) at each center. The schools would include recreation buildings, field and ball court facilities as well as areas for playground equipment. The adjoining park site would amplify these facilities and provide additional land for trails, picnic areas, comfort stations, and other passive recreation needs.

The open space/landscape system as previously outlined would provide the connection elements for the park component of the recreation plan. There will be designated bike/pedestrian corridors as well as open space trails that will take advantage of the scenic and recreational opportunities between parks, preserves or other natural areas.

The Kawaihae 10-Year Plan provides approximately 84 acres of park/recreation land uses, plus 351 acres of open space. The projected population at completion of the 10-Year Plan is expected to range from 9,500 to 15,000. Based on the County of Hawaii recreation standard of 5 ac./1000 (population), the plan should provide ample recreational opportunities for the project and some of the adjacent communities

Additional recreation/cultural facilities in the vicinity are located just a few miles to the south along the coastal Highway (Hapuna Beach Park, Samuel M. Spencer Beach Park, Pu'ukolola Heiau National Historic site, and John Young's House site.) Waimea, located approximately 10 miles from the project has district and county community centers, as well as elementary and intermediate school playing fields.

2.8 UTILITIES SYSTEMS

- Water System

  Water demands as a result of implementing this development plan will require new water sources. Possible sources that need to be pursued are onsite wells, desalinization of brackish water, and the State's plan to tap unused water resources in North Kohala and transport the water via a yet to be developed pipeline. The use of brackish water from the first exploratory well for irrigation purposes also will be considered to help reduce the overall potable water requirements.

- Sewage System

  A new sewage treatment plant will need to be constructed to support the Kawaihae development plan. The proposed location for the new plant is south of Honokoa Gulch, approximately 4,000 feet north of the entrance to Kawaihae Small Boat Harbor and about 1,000 feet mauka of the shoreline.

- Drainage System

  The many natural drainage swales and ditches throughout the site will be utilized for drainage; however, additional facilities to capture and control storm water runoff from the denser developed areas may be required.

- Power and Communications Systems

  New electrical, cable and telephone systems will need to be provided. Hawaiian Electric is planning on constructing a 30-acre power plant to support power requirements for all of West Hawaii.

2.9 PROJECT SCHEDULE

It is anticipated that the Master Plan and EIS will be prepared during 1992. Processing of plans and the preparation of Phase 1 detailed plans will be prepared in 1993 with initial construction expected to begin in 1994.

Section 3

AFFECTED ENVIRONMENT

SECTION 3
AFFECTED ENVIRONMENT

3.1 SITE DESCRIPTION

The Ten-Year Master Plan area is bounded to the north by Honokoa Gulch; the Puu Kanane to the east; Palihae Gulch to the south; and Kawaihae Road and the coastline to the west. It stretches from the shoreline up to an elevation of 1,200 feet. Kawaihae Road and Akoni Pule Highway provide access to the makai portion of the site. Figure 3-1 shows the Ten-Year Master Plan site.

Much of the land is undeveloped and is currently leased to Kahua Ranch, Ltd., which in turn has sub-leased the area to Hoepaa, Inc. for cattle and horse grazing. Other land uses on the site include a partially developed 90-acre industrial park and subdivided homestead lots at the makai portion of the site adjacent to Akoni Pule Highway.

3.2 TOPOGRAPHY

The project site lies on the southwestern slopes of the Kohala Mountains. The Ten-year project area elevations stretch from the shoreline up to 1,200 feet. The most prominant topographic feature of the site is the Honokoa Gulch which borders the project site on the north side, makai to mauka. There are segments of the gulch which are over 450' deep making it a major constraint to development. A number of other gulches, gullies and swales cross the site including Mahakuna and Palihae Gulches along the southern edge. Other prominent features include Puu Kamalii in the central portion of the 10-Year Plan area and Puu Kanane on the mauka portion of the site. Slope conditions vary greatly throughout the site, with gradients ranging from 5% to greater than 20%. The majority of the site has 10-15% slopes.

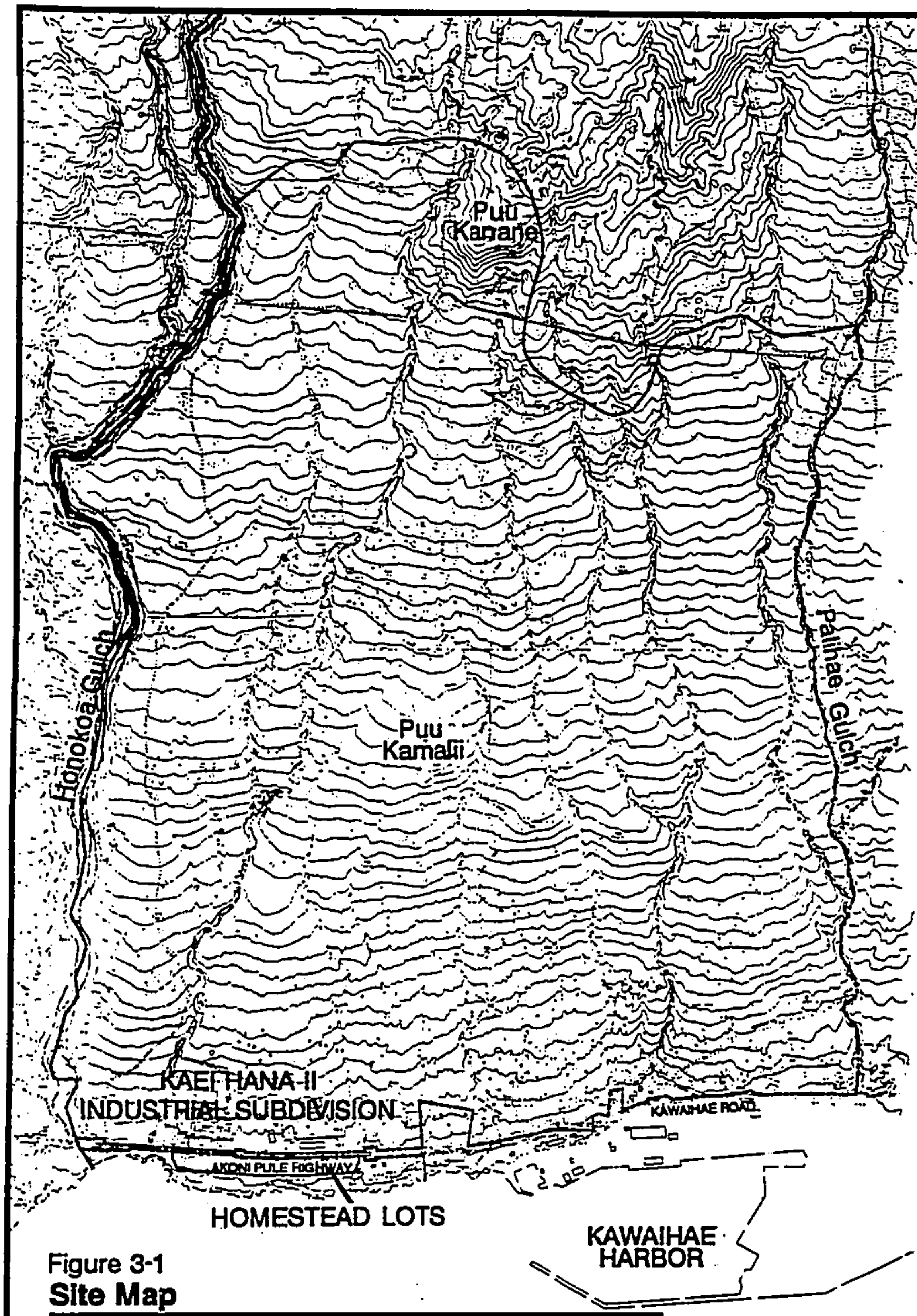


Figure 3-1
Site Map

KAWAIHAE 10-YEAR MASTER PLAN

DEPARTMENT OF HAWAIIAN HOMELANDS ▪ STATE OF HAWAII

R. M. TOWILL CORPORATION

Because of the generally moderate slopes, the topography of the Ten-Year Master Plan area is compatible for development. This area has the most development flexibility and will be able to accommodate higher density uses.

3.2.1 Impacts and Mitigation Measures

The proposed development will change the topographic conditions of the land. Impervious surfaces will be created by the construction of roadways and homes. However, the natural drainage pattern in the area will be maintained. Storm water runoff created by the development will be retained on site by routing the flows to drywells. Water will then infiltrate into the ground and contribute to the groundwater recharge. Natural flows will use existing drainageways to maintain the natural drainage pattern.

3.3 GEOLOGY

3.3.1 Regional Geology

The project site is situated on the southwestern flank of Kohala Mountain which is the oldest of the five shield volcanoes forming the island of Hawaii. Kohala Mountain was formed during the Pleistocene Epoch by basaltic lava flows from the Pololu and Hawi Volcanic series.

Typically, the lava flows of the Pololu series are characterized as thinly bedded with a high degree of porosity.

During the later stages of the active phase of Kohala Mountain, vents of the Hawi Volcanic series opened. These events poured out lavas of andesitic and trachytic composition that covered most of the Pololu rocks. These andesitic rocks generally form thicker and denser flows.

Field reconnaissance indicated that there is a surface layer of ash soil mantling the site. This ash soil is blanketed with many exposed cobbles and boulders. It is believed that this surface ash, the boulders and cobbles are airfall deposits from a large explosive eruptive event which may have occurred on either Mauna Kea or Mauna Loa.

The ash soil at the project site differs from Pahala Ash found in other portions of the island of Hawaii in that the in-situ moisture content is somewhat lower and the soil exists in a friable state as opposed to the plastic soil found in more humid areas such as along the Hamakua Coast and the mauka areas of North and South Kona.

3.3.2 Soils

The project site and its vicinity were previously mapped by the U. S. Department of Agriculture Soil Conservation Service as part of an overall soil survey of the island of Hawaii. In this survey, the Soil Conservation Service mapped the site as having the following soil types:

> Kawaihae very rocky very fine sandy loam (KOC) - These soils consist of very stony excessively drained soils formed in volcanic ash. They are characterized by moderate permeability and a moderate to high susceptibility to erosion.

> Puu Pa extremely stony very fine sandy loam (PVD) - These soils consist of very stony soils formed in volcanic ash underlain by fragmental a'a lava. They are characterized by moderate permeability and a moderate to high susceptibility to erosion.

3.3.3 Subsurface Conditions

Subsurface investigations yielded the following findings: A surface layer, varying between two to four feet in thickness, of reddish-brown silt (Pahala Ash) grading to weathered basalt formation with increasing depth, was found. Below this surface layer, investigation indicated in-situ volcanic formations consisting of interbedded basalt and clinker to the maximum depths explored.

The typical estimated velocities for the various materials underlying the site are:

Material Type (ft. per sec.)	Seismic Velocity
Pahala Ash or Loose Clinker	< 2000
Dense Clinker or Vesicular/Jointed Basalt	1500 to 3500
Dense Basalt	> 3500

Other soil types besides KOC and PVD were identified on the project site according to the publication "Soils Survey of the Island of Hawaii," December 1973. The majority of the soils have characteristics that are quite similar in that over three quarters of the sites topsoils consist of stony or rocky very fine sandy loam (WSD, WMC, KCD, and earlier described KOC). Soil types PVD, WSD and KNC, which cover about half of the site, are extremely stony. KOC, which covers nearly a third of the land and much of the terrain that is better suited for development, is also very rocky. Moderate erosion hazard and medium runoff characteristics of much of the soils throughout the project site present some development constraints.

The majority of lands on the project site are classified overall as poor or very poorly suited for agriculture.

3.3.4 Geologic Resources and Impacts

Hawaii is typically poor in economic geologic resources. There are no economic minerals in exploitable concentrations or quantity and there are no fossil fuel deposits in the islands. Exploitable earth resources in Hawaii are generally limited to groundwater, geothermal energy and the volcanic rock itself.

3.3.4.1 Groundwater Resources

At the project site, groundwater occurs as a basal water table in saturated volcanic rocks at or very near to sea level. No data is available specifically concerning the quality of the groundwater below the project site, however, it is believed that some highly brackish water occurs as a thin lens floating over saline groundwater.

3.3.4.2 Geothermal Resources

Resources of geothermal energy are generally limited to active rift zones. To date, viable geothermal reserves have only been encountered in the East Rift Zone of Kilauea on the eastern side of the island of Hawaii.

The project site is situated on the flank of Kohala Mountain which has apparently been inactive since the Pleistocene Epoch. No known signs of active geothermal or hydrothermal activity are evident on Kohala Mountain.

Therefore, it is unlikely that exploitable energy reserves would be encountered below the surface of the project site.

3.3.4.3 Rock Material Resources

The rock material underlying the site has some potential as an economic earth resource if quarried for use as fill material and/or a source of aggregate material. However, there is nothing extraordinary about the quality of the rock underlying the site with respect to the material available in the region of the project site.

3.4 GEOLOGIC HAZARDS

In general, geologic hazards are seismic activity, volcanic activity, inundation and ground subsidence. All in all, the geotechnical study concluded that these considerations do not present any unusual problems for the project site relative to any other development in this area of West Hawaii.

3.4.1 Seismic Activity

Seismic activity includes earthquakes and faulting. Stresses within the earth causes subterranean rocks to strain to the breaking point. When these stresses are released by the breaking of the rock, the resulting vibrations cause an earthquake.

Except for the island of Hawaii, the Hawaiian Islands are not a highly active seismic area. On the island of Hawaii, earthquakes are relatively frequent but are generally of relatively low magnitude and cause a low intensity of damage (Macdonald and Abbott, 1970). The fault shown in the vicinity of the site on the geologic map by Stearns and Macdonald is an inferred fault, i.e., there is sufficient geological evidence to suspect that there is a fault in that location but insufficient evidence to pinpoint its location or nature. There is no apparent evidence that the fault has been active since the Pleistocene Epoch.

Under the Uniform Building Code, the island of Hawaii has been designated as Seismic Zone 3 which indicates a relatively significant potential for strong ground motion generated by seismic events. The Uniform Building Code also establishes minimum seismic design criteria for any structures constructed in such a zone for resistance to deformation and damage resulting from such strong ground motion. Thus, any structures that will be built as part of the development will be designed with consideration of the hazards of seismic activity.

3.4.2 Volcanic Activity

The island of Hawaii is the youngest of the Hawaiian islands and three of the five volcanoes have been active during historic time. It appears that Kohala Mountain (the flank on which the project site is located) was last active during the Pleistocene Epoch.

Based on the available geologic evidence, it appears that the level of volcanic hazard threat to the project site is low since Kohala Mountain has been dormant for such an extended period of time.

3.4.3 Inundation

Inundation, or flooding, can originate from surface water sources or from tsunami. Most of the project site is sufficiently inland and at a high enough elevation that the possibility of inundation by tsunami is extremely small. The portion of the site makai of the highway that is within the 500-Year Flood Boundary (as defined by FIRM 1982) is not restricted by any development guidelines.

The surface soils/rocks of the project site are highly permeable and well drained. There are well-defined drainage paths upslope and through the site. The majority of precipitation falling on the site either infiltrates immediately or moves toward and through the drainage paths.

3.4.4 Ground Subsidence

Other than faulting during seismic activity, ground subsidence is generally the result of either consolidation of soft or loose subsoils or of the collapse of voids in the subsurface.

The project site is underlain by volcanic rock formation at the surface or at very shallow depths below the surface. This rock formation is highly competent material and is capable of supporting large structural loads. Thus, ground subsidence resulting from the consolidation of soft or loose subsoils is generally not a consideration for the subject project.

Voids, or lava tubes, are sometimes encountered in volcanic rock formation. However, it is common engineering practice to probe the subgrades of building foundations during construction to check for potential lava tubes below the building. If any lava tubes are encountered, they will be filled to reduce the potential of collapse of the foundations.

3.5 DRAINAGE

The most prominent drainage feature is Honokoa Gulch, in which Keawewai Stream runs. This gulch forms the northern boundary of the site in the makai-mauka direction. The Palihae Gulch forms the southern boundary.

Prominent drainage features in this lower portion of the overall Long Range Master Plan area (below approximately the 1,200-foot elevation) are the large gulches (Honokoa, Makahuna and Palihae).

The existence of gulches and gullies throughout the master plan area will complicate development of the site. Major gulches, in particular Honokoa Gulch, will greatly influence circulation and development pattern, limiting north-south connections.

3.6 CLIMATE

The climate of the Kawaihae area is very much affected by its leeward and coastal situation. During periods of strong trade winds, winds approach the project area from the east between the Kohala Mountains and Mauna Kea. Kona storms generate occasional strong winds from the south during winter. When the larger scale trade winds or Kona winds are weak or absent, small scale landbreeze-seabreeze and/or mountain-induced circulation may develop. These smaller scale phenomena tend to dominate the wind pattern for the area causing winds to be predominantly bimodal with an east-west orientation. During the daytime, winds move onshore from the west while at night a 180-degree shift typically occurs reversing the flow. Wind speeds generally vary between 5 to 20 miles per hour, although there can be prolonged periods of higher or lower velocities. Based on temperature data for the area, temperatures on the lower elevations of the project site likely range between 55 degrees F and 95 degrees F while the higher areas are 3 to 5 degrees F cooler. Average annual rainfall is very low, between 10 to 20 inches with summer months being the driest.

Hot and dry conditions in the lower region makes most types of agricultural uses difficult and undesirable unless extensive irrigation is provided.

3.6.1 Impacts

The project is not expected to significantly impact existing climatic conditions at the project site. The structural considerations and siting of buildings in the development will accommodate the frequent windy conditions. Other measures such as wind breaks will be utilized in the design details.

3.7 FLORA AND FAUNA

3.7.1 Flora

The majority of the vegetation on the Kawaihae lands consists of alien (non-native) plants.

There are few different vegetation types. Generally, the types of vegetation closely follow the climatic and topographic features of the site. Dry grass lands with areas of moderate kiawe tree coverage occur below the 1,200' elevation.

There are three rare plants found on Kawaihae lands: *Acacia koaia*, *Lobelia hypoleuca* and *Cyanea tritomantha*. They are restricted largely to gulches and the cinder cones above the 2,400' elevations. The *Acacia koaia* are found in two locations: Waipahoehoe Gulch and Honokoa Gulch (Keawewai Stream). *Lobelia hypoleuca* are found at the base of Puu Lapalapa. The *Cyanea tritomantha* are found on the slopes of Puu Mala. Areas with rare plants should be isolated from development and preserved. This should not be a major constraint to development as the rare plants are found on steep, unbuildable slopes and in gulches where development is unlikely.

3.7.1.1Impacts

This project is not in the vicinity of the koai'a forest which is located at the 2,000 to 3,000 foot elevation, and will not have an impact on the rare *acacia koaia* plant. Similarly, the two rare Hawaiian lobelaids seen among the 'Ohi'a/'Olapa Montane Wet Forest are not in the area of the project and will not be impacted. In addition, these rare plants were found on steep unbuildable slopes and in gulches where development is unlikely.

3.7.2 Fauna

No rare native animal species were observed on the property nor have they been reported within the parcel. However, rare animals have been reported in lands adjacent to the Hawaiian Home Lands property. These rare animals include the Hawaiian hoary bat, Hawaiian duck, Hawaiian hawk and the achatinellid land snail.

Because the property is not known to contain any rare animals, impacts on rare animals are not expected. The relatively dry climate and sparse vegetation in the area does not provide good habitat for the rare animals known to exist in the vicinity.

3.8 ARCHAEOLOGICAL RESOURCES

An extensive archaeological survey and testing of the project site was conducted by Cultural Surveys Hawaii, and the results are summarized in Appendix B of this EIS. The methodology utilized in the surveys, a description of the archaeological sites encountered during field work, and probable impacts and mitigation measures are included in this section.

3.8.1 Methods

Literature and aerial photograph research, and field reconnaissance survey methods were employed to conduct the historic and archaeological survey for the project site.

An inventory survey was conducted by pedestrian sweeps across the entire project area up to elevation 600 feet. These were typically conducted by following contours in a north to south and south to north pattern. Particular attention was directed toward the margins of the gulches and the seaward edges of bluffs which often included small features that were not visible at a distance, and to caves. The interval between archaeologists on these traverses was variable depending upon the openness of the terrain but was typically 50 feet.

The description of each site encountered included triangulating and mapping its location, determining the feature's formal type and number, recording representative heights and extents, searching for the presence of surface remains and otherwise recording the site's nature, extent, and probable function. A sketch map was drawn of most sites. Some features were of such simple and common form that no map was generated.

Sites were flagged with heavy yellow construction tape and the edges of sweeps were marked with pink or red flagging tape. Some clearing was done at a number of sites to facilitate accurate recording and mapping. All caves encountered within the project area were explored as far as possible without disturbing cultural material.

The majority of the project area lying between 600 feet and 1,000 feet was surveyed by helicopter owing to the difficulty of access and paucity of sites. When a possible site was observed the team landed and conducted an inspection on foot.

Subsurface testing was limited to those sites specifically listed in the Scope of Work for testing and to sites that were thought to be likely sources for good carbon samples, for carbon isotope dating. Testing consisted largely of collecting charcoal samples for carbon isotope dating and determining the presence or absence of human remains within possible burial features, and determining the presence of a human burial and nature of prehistoric deposits.

When the presence of a human burial was ascertained, no further excavation was attempted to determine the characteristics of the remains. All graves tested were backfilled and returned to a state similar to their former condition.

Oral history interviews were also conducted with long time Kawaihae residents, and the interviews are presented in both complete and summary form in the comprehensive archaeological survey and testing report.

3.8.2 Cultural History

Kawaihae has been the focus of several fairly detailed surveys of the historical and ethnographic record. However, much of the research material focuses on Pu'u Kohola, John

Young's residence, Puako, and Waimea. While studies in these areas touch on important aspects of Kawaihae's history, the archaeological consultant study concluded that much of this research has little direct relevance to the archaeology of the present study area.

Kawaihae has been well known as a residence of kings. Alapai moved to Kikiakoi in Kawaihae and appointed his son Keaweopala to be his successor at Mailekini Heiau in 1754 (Kamakau 1961:77-78). Kamehameha I and his entourage lived at Puu Kohola during its construction (renovation) and with the assasination of Keoua-Kuahuula there in 1790, Kamehameha I became Alii nui of Hawaii Island. Kawaihae was also the residence of Kalanimoku (Kamehameha's treasurer and war leader), Chief Keeaumoku (Kamehameha's general), John Young (Governor of Hawaii 1802-1812), Kuakini (Governor of Hawaii under Liholiho), and the birth place of Queens Kamamalu (wife and half sister of Liholiho) and Emma (wife of Kamehameha IV).

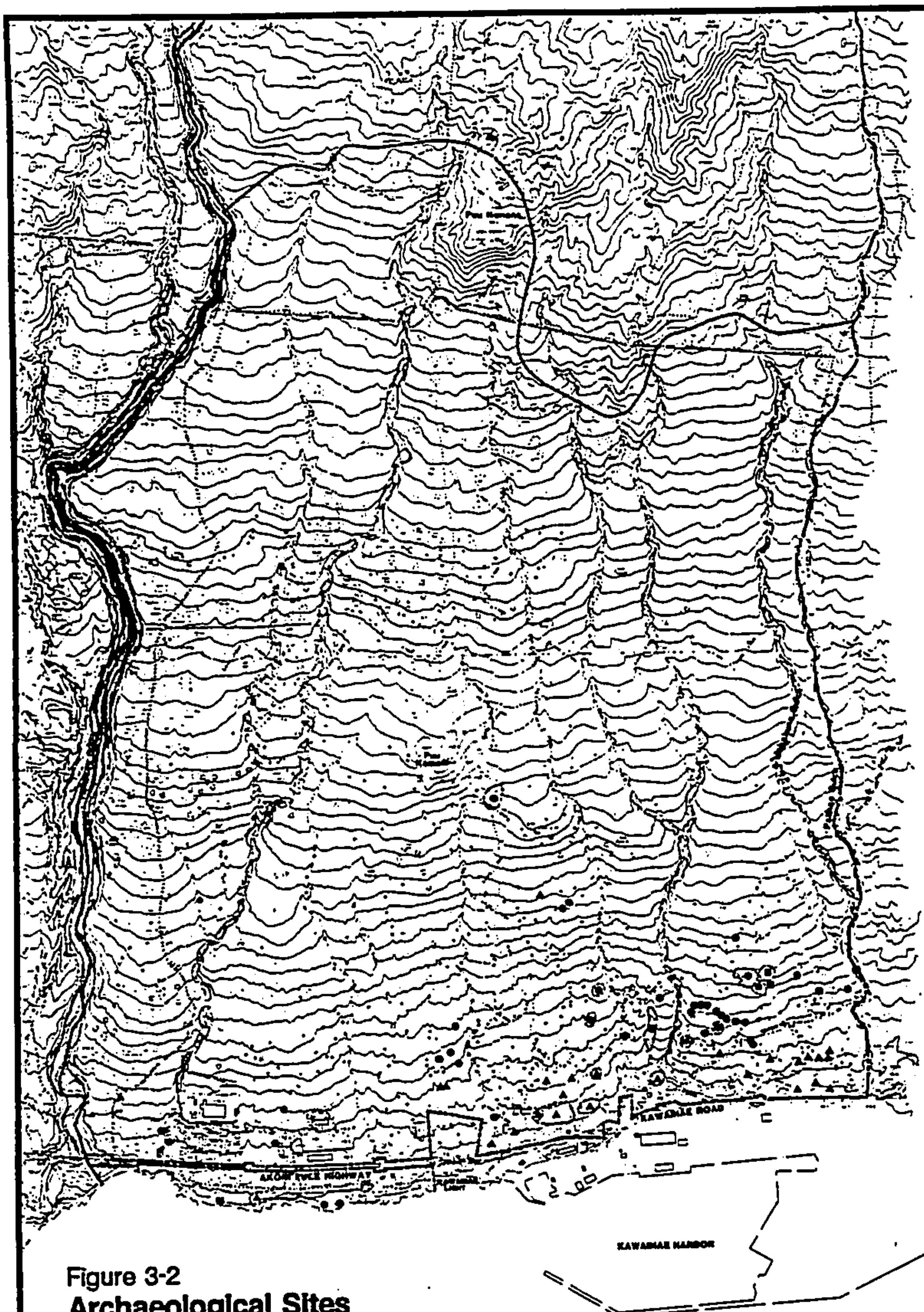
However, to a very large extent, the residence of chiefs was below Puu Kohola (the "King's Residence" designated Site 50-10-05-2297) in the ahupuaa of Kawaihae 2 (Hikina).

Kawaihae was in the early historic period, as it is today, the best anchorage in west Hawaii and as a result early reports exist of the settlement there. The introduction of cattle to Waimea was a major economic boom to the Kawaihae-Waimea area. The shipment of cattle was the major activity with cattle being herded down "cattle road," just back of Doi's Store, and held in corrals near the old wharf until ship day. Cattle were driven into the water, tied by their horns to a small boat, and floated out to the waiting ship even after the construction of a concrete pier in 1937.

The biggest impact on Kawaihae in historic times was the construction of a new Federal deep-draft harbor.

One of the more significant features of the Kawaihae lands is the presence of archaeological sites. An extensive archaeological reconnaissance survey was performed in March 1990 by Cultural Surveys Hawaii. This survey was limited to the lower portion of the project area, below the 1,000' elevation. Figure 3-2, reflects archaeological features in the project area. The features depicted include sites recommended for preservation; sites of known, probable or possible burials; and sites requiring further data recovery. There are also numerous other sites that have been investigated and determined to be not significant or no longer significant. The document containing the recommendations for this archaeological study is included as Appendix B of this EIS. A second survey covering the remainder of the site was conducted in February 1991.

The first reconnaissance revealed that there is a high concentration of archaeological features mauka of Kawaihae Road and Akoni Pule Highway and south of Honokoa Gulch to the 300-foot elevation. Also, a significant number of features were located makai of Akoni Pule Highway between the North Kohala boundary line and Honokoa Gulch. Cultural Surveys Hawaii recommended a number of sites for preservation. The most significant area recommended for preservation was the coastal area of Honokoa Gulch which contained a habitation complex, a canoe shed, four shrine features and a probable area of an observatory. Two caves, the Forbes and Mummy caves within the Honokoa Gulch, were also recommended for preservation. Other sites recommended for preservation include two shelter complexes near the Makahuna Gulch, a high status and/or men's house and a cave shelter in the Kaiopae Gulch near the coastline. In addition to the sites



LEGEND
- ■ Preservation Sites
- ▲ Burial Sites
- ● Sites for Further Data Recovery

Figure 3-2
Archaeological Sites

KAWAIHAE 10-YEAR MASTER PLAN

DEPARTMENT OF HAWAIIAN HOMELANDS ■ STATE OF HAWAII

R. M. TOWILL CORPORATION

recommended for preservation, there are a large number of burials scattered in the area south of Honokoa Gulch. If relocation of some of these burials is not considered, there will be significant constraints to development in this area.

The later study identified a large number of previously unrecorded archaeological sites north of Keawewai Stream (upper portion of Honokoa Gulch) from about the 2,000-foot elevation up to Kohala Mountain Road and most of the area south of the stream down to the elevation of 1,200 feet. These features included heiaus, permanent prehistoric habitations, historic habitations, a burial site, a shrine, a trail, cave sites and agricultural complexes. Determination of the significance of these sites was not a part of the survey; however, some of the sites did comprise major archaeological complexes which, on a preliminary basis, may warrant preservation.

<u>Nearby Historic Sites</u>

Three historic sites, Puukohola heiau, Mailekini heiau, and the John Young (governor of the Big Island from 1802 to 1812) homestead are located immediately southwest of the project site. The John Young homestead is on Queen Emma Foundation property mauka of Queen Kaahumanu Highway; the two heiaus are makai of the highway. The John Young homestead has been conveyed to the U.S. Department of Interior's National Park Service by Queen Emma Foundation. The Puukohola heiau has been declared a National Historic Site by Congress in August 1972 (86 Stat. 562) "to restore and preserve in public ownership the historically significant temple associated with Kamehameha the Great, ...and the property of John Young..." These three sites have been included in a national park concept plan that was prepared by the U. S. Department of the Interior's National Park Service.

In 1982, the State Department of Transportation's Highways Division identified a proposed highway right-of-way alignment. It was to run along the mauka side of the John Young homestead, and, based on understandings arrived at when the historic site was established in 1972, would constitute the park's eastern boundary. This 1.8 mile project is part of more than ten miles of planned realignment of the existing Waimea-Kawaihae Road.

Subsequently in 1983, Mauna Kea Properties revealed their plans to build their major resort hotel, golf course, and residential subdivision south of the historic site. The golf course was to be built on lands adjacent to the historic site.

In 1984, the National Park Service, Hawaii County, and Mauna Kea Properties jointly funded a study to identify alignment options that would be acceptable to the three parties involved. The final alignment was to blend in with the terrain so as to minimize any visual impact on the park or on future development in the area.

The study concluded that the most feasible location was south of the existing park boundary next to Mauna Kea Properties planned golf course. It was also agreed that, if constructed, the road would serve as the new boundary between the Mauna Kea Properties' planned development and the historic site. It would also be used for public access to the Puukohola Heiau National Historic Site.

The 10-Year Plan proposes future development over much of the area where there is a high concentration of archaeological features. According to the results of the 1990 Cultural Surveys Hawaii Study, the majority of the features have been recorded and do not require further data recovery or preservation. However, there are three sites that are recommended for preservation and 40 that have been designated for further data recovery. The site recommended for preservation will be identified, set aside and secured to insure that they are not disturbed. The data recovery on these sites will be performed prior to any development actions that could affect the sites in order to determine their final disposition. In addition, the archaeological survey by Cultural Surveys Hawaii listed 31 known possible or probable burial sites containing 122 burial features within the 10-Year Plan area. It is being proposed that the burials be consolidated into three locations designated for future preservation. These preservation areas total approximately 20 acres and are focused at identified existing burial and preservation site.

A. Impacts and Mitigation Measures Relative to the Bypass

Since the 1984 National Park Service study, additional archaeological sites were found in southwestern section of the DHHL Ten-Year Master Plan project site through which the earlier proposed Kawaihae bypass road alignment ran.

The master plan studies commissioned by the Department of Hawaiian Home Lands for the Ten-Year Master Plan in early 1990 indicated a need for a new four- to six-lane bypass road with a 150-foot right-of-way that will route traffic away from Kawaihae Harbor. The purpose is to serve as a land use boundary separating the harbor and industrial activities from the residential community. The proposed alignment deviates significantly from the previously proposed alignment. The higher route was chosen so that it would provide separation between the industrial and residential uses. It was also routed so as to avoid most of the area (southwestern section) that contains a high concentration of archaeological sites. The bypass will replace the existing Kawaihae Road as the main linkage to the Kawaihae to Waimea Road and the Queen Kaahumanu Highway.

B. Impacts and Mitigation Measures Relative to Rest of Project Site

While a number of archaeological sites were subjected to an archaeological inventory survey and subsequent data recovery of some sites prior to development, there will be very little impediment to residential development because few archaeological sites are located within the proposed residential areas.

However, extensive archaeological resources are present seaward of the 300-foot elevation in the southern corner of the project area where industrial development is proposed. The archaeology in this area will have a major impact on development owing particularly to the large number of burials known to be present and the possibility that some relocation may not be permitted.

Should unidentified archaeological features be encountered during the course of the project, the State Historic Preservation Office will be notified immediately and work affecting the resource will be stopped until recommended mitigative measures are implemented.

3.9 AIR QUALITY

An air quality impact analysis was conducted for the Ten-Year Master Plan project by B. D. Neal & Associates in October 1991. The results of this study are summarized in this section and the report in its entirety can be found as Appendix C in this EIS. The study examines the potential short- and long-term air quality impacts that could occur as a result of construction and use of the proposed facilities. Mitigative measures to minimize project impacts are recommended where possible and appropriate.

A. Existing Conditions

Both federal and state standards have been established to maintain 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 set at the same level.

Air quality in the project vicinity presently is mostly affected by emissions from natural, industrial, agricultural and/or vehicular sources. The dominant factor for the past several years has been the volcanic haze (vog) from Kilauea Volcano which eventually drifts into the Kona and Kohala areas from more than 60 miles away. Other natural sources of air pollution that may affect the air quality of the site include the ocean, plants and windblown dust. Some particulate and hydrocarbon emissions presently occur from industries located at Kawaihae Port while agriculture in the area may also contribute relatively minor amounts of fugitive dust to the atmosphere. Automotive emissions, primarily nitrogen oxides and carbon monoxide, from traffic attracted by the port or from motor vehicles passing through the area on Kawaihae Road/Akoni Pule Highway may reduce air quality slightly. No air quality monitoring data from the State Department of Health are available for the South Kohala area, but based on what little data are available standards are currently being met despite the persistent vog. On the whole, air quality for the area is presently considered good except for the vog and for occasional fugitive dust problems or problems related to occasional congested traffic locations.

B. Impacts and Mitigation Measures

There will be some short- and long-term impacts on the air quality either directly or indirectly as a result of project construction and use.

Short-term impacts from fugitive dust will occur during the project construction phase. To a lesser extent, exhaust emissions from stationary and mobile construction equipment, from the disruption of traffic, and from workers' vehicles may also affect air quality during the period of construction. State air pollution control regulations require that there be no visible fugitive dust emissions at the property line. Hence, an effective dust control plan will be implemented to ensure compliance with state regulations, especially in dust-prone South Kohala. Fugitive dust emissions can be controlled to a large extent by watering of active work areas, use of wind screens, keeping adjacent paved roads clean, and by covering of open-bodied trucks. EPA estimates that watering twice daily will reduce the amount of fugitive dust by 50 percent. Other dust control measures could include limiting the area that can be disturbed at any given time and/or mulching or chemically stabilizing inactive areas that have been worked.

Paving and landscaping of project areas early in the construction schedule will also reduce dust emissions. Exhaust emissions can be mitigated by moving construction equipment and workers to and from the project site during off-peak traffic hours.

Long-term impacts on air quality could occur indirectly as a result of emissions emanating from vehicular traffic coming to and from the development. Access to the project will likely be accomplished via at-grade intersections constructed along the proposed Kawaihae bypass road.

To assess the impact of emissions from these vehicles, an air quality modeling study was undertaken to estimate current maximum ambient concentrations of carbon monoxide along roadways leading to and from the project area and to predict future levels of air pollution both with and without the proposed project. Based on the modeling results, present worst-case carbon monoxide concentrations were estimated to be within the national ambient air quality standards but may occasionally exceed the state standards near the intersection of Queen Kaahumanu Highway and Kawaihae Road due to over capacity conditions during the afternoon. Because the state standards are set at such stringent levels, however, it is likely that they are currently exceeded at many locations in the state that have moderate traffic volumes.

In the year 2003 without the project, the highest concentrations at this location were projected to decrease to about 60 percent of the 1991 values 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 roadway improvements. Worst-case concentrations would comply with both state and national ambient air quality standards.

In the 2003 with-project scenario, maximum concentrations will be higher compared to the without-project case at several locations within the project vicinity due to increased traffic and to the creation of several intersections along the Kawaihae bypass road. Concentrations should remain within national standards but may occasionally exceed the more stringent state standards. Other than the roadway improvements recommended in the traffic impact analysis, air quality impacts due to project traffic could potentially be reduced further by reducing traffic through the promotion of bus service, carpooling and alternate business and school hours.

Long-term impacts on air quality are also possible due to indirect emissions assoicated with a development's electrical power and solid waste disposal requirements. The proposed project will increase current electrical demand for the county as a whole by about 40 percent; solid waste disposal demand will likely increase by about 10 to 15 percent. Quantitative estimates of these potential impacts were not made, but based on the estimated emission rates involved and the relative changes in demands, some impacts are probable. Requiring homes and businesses to incorporate energy conservation design features and promoting conservation and recycling programs within the proposed development will reduce any impacts.

Impacts on air quality could also occur as a direct result of emissions from industries locating within the industrial zone associated with the project. At this time, sufficient detail is not available to quantitatively assess any such impacts, but before any industries that emit air pollution can begin construction they must apply to the State Department of Health for a permit to construct. Due to the high terrain in the project area and to the bimodal nature of the winds, it is recommended that any air polluting industries applying to locate within the proposed development be examined for potential plume impact on the mountain side and for recirculation of air pollution emissions.

3.10 NOISE

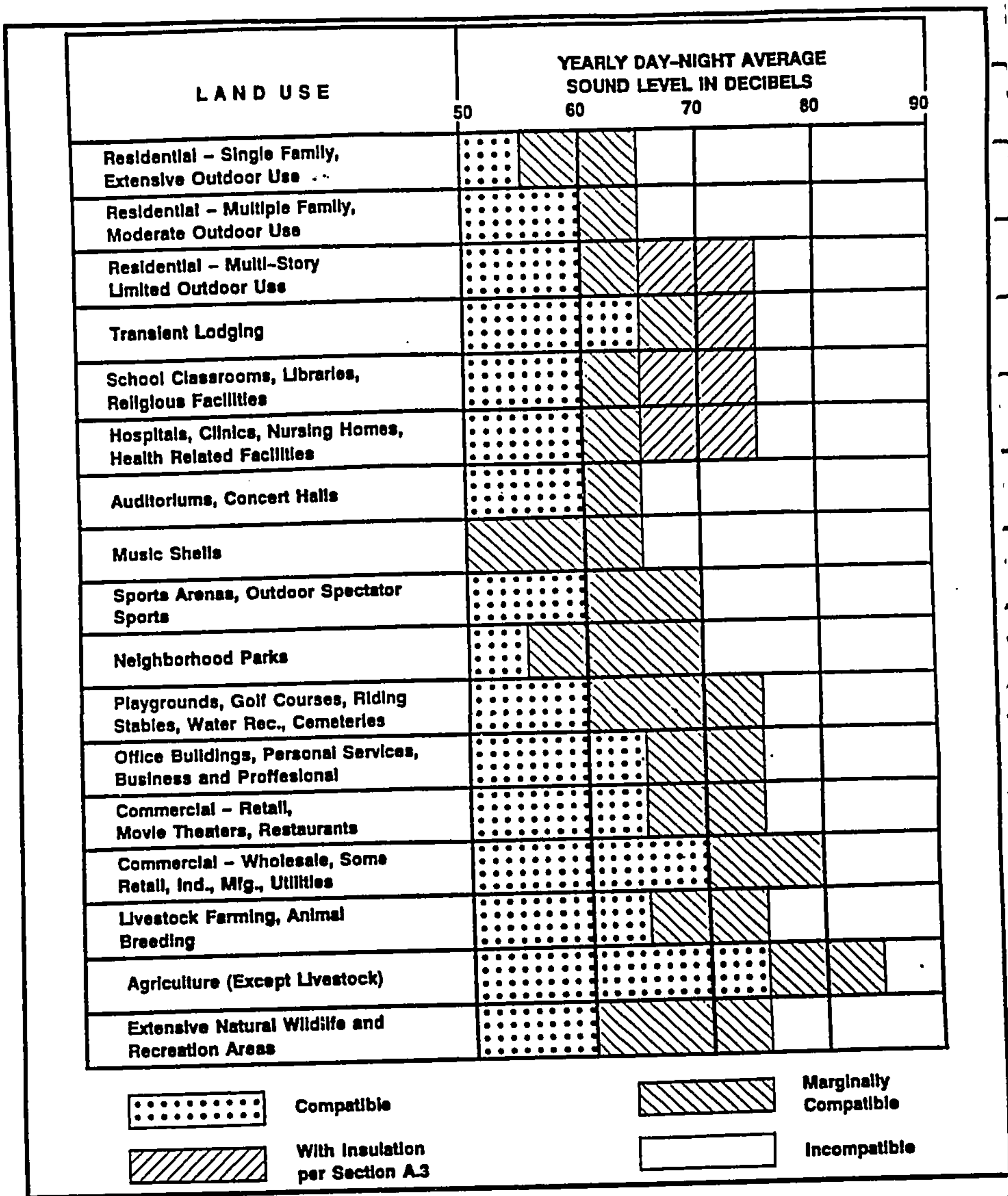
A noise impact study for the project was conducted by Y. Ebisu & Associates in October 1991. The results of the study are summarized in this section, and the study in its entirety is included as Appendix D in this document.

The objectives of the study were to describe the existing and future noise environment of the project and its vicinity. Traffic noise level increases and impacts associated with the proposed development were determined within the project site as well as along the public roadways expected to service the project traffic. Assessment of noise impacts from the planned industrial land uses on the makai portions of the project area, as well as from short term construction noise at the site were also included.

A. Existing Conditions

The present noise quality of the proposed project is primarily affected by vehicular generated noise on Akoni Pule Highway and Kawaihae Road, natural sounds from the surf and sounds from the wind moving through the vegetation on site. With the exception of areas affected by traffic noise, ambient sound levels are typical of rural areas.

The noise descriptor used by federal agencies to assess environmental noise is the Day-Night Average Sound Level (Ldn). In the project area, noise levels at lots that front Queen Kaahumanu Highway and Akoni Pule Highway are typically above 60 Ldn (see Figure 3-3 for land use compatibility guidelines). For the purposes of 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 (see Table 3-1). However, due to the local open-living conditions, the predominant use of naturally ventilated dwellings,



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 3-3

TABLE 3-1

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}.

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.

In terms of traffic noise levels in the project area, areas at 50-foot distances from the centerlines of Queen Kaahumanu Highway and Kawaihae-Mahukona and Kawaihae-Waimea Roads are in the "significant exposure, normally unacceptable" category. Traffic noise levels along the right-of-way of a roadway generally represent the worst case levels due to the proximity of the right-of-way to the noise sources. At greater setback distances of 61 to 70 feet, traffic noise along Queen Kaahumanu Highway and Kawaihae Roads decrease to the "moderate exposure, acceptable" category. The same condition exists at 70- to 37-foot setback distances from the centerlines of Kawaihae-Mahukona Road and Akoni Pule Highway, respectively.

Existing traffic noise levels at the mauka portions of the project site are defined as very low (less than 60 Ldn) due to their large setback distances from Akoni Pule Highway and Kawaihae-Mahukona Road. The proposed residential areas of the project are located beyond a half mile from the highway. At 70 feet or greater setback distance from the centerlines of Kawaihae-Mahukona Road or Akoni Pule Highway, traffic noise levels are less than 65 Ldn. For these reasons, the existing levels of roadway traffic noise 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.

B. Impacts and Mitigation Measures

Short-term Construction Noise

Unavoidable, but temporary noise impacts will occur during the construction of the project. Construction activities are predicted to be audible at adjoining properties thereby degrading the quality of the acoustic environment to unacceptable levels during periods of construction. Mitigation measures to reduce construction noise to inaudible levels, such as the use of mufflers, can be utilized as appropriate. In all cases, however, State DOH regulations will be adhered to during construction. Measures including the use of quiet equipment and construction curfew periods will be implemented in accordance with State rules and regulations.

Traffic-Related Noise

Future traffic noise levels along the primary access roadways were calculated for the year 2003 with and without the project. The analysis assumed that the necessary roadway improvements, including the planned Kawaihae Bypass Highway, would be implemented in order to accommodate the increases in future project and non-project traffic.

Project and non-project related traffic increases will contribute to the increase in noise levels along project access roadways. Along Akoni Pule Highway, traffic noise levels are expected to increase significantly by 6.7 to 8.3 Ldn between years 1991 and 2003, with worsening traffic conditions requiring major improvements to the existing highway and other roadways in the project area. Project traffic is projected to result in a 1.6 to 4.4 Ldn increase in traffic noise levels along the existing Kawaihae-Mahukona Road from present levels. Along Queen Kaahumanu Highway, project traffic is projected to result in a 2.5 Ldn increase in traffic noise levels. These increases are considered significant, and reflect the current plans for urbanization of North Kohala and Kawaihae.

Non-project related traffic volume increases (a four-fold increase in North Kohala and Kawaihae) are expected to result in a 0.9 to 6.7 Ldn increase. Noise sensitive receptors along Akoni Pule Highway, Kawaihae-Mahukona Road, Queen Kaahumanu Highway, and Kawaihae-Waimea Road will be impacted by future increases in traffic noise. To minimize these potentially adverse noise impacts, adequate setback distances will be provided.

The Ten-Year Master Plan locates non-noise sensitive, commercial and industrial land uses at the makai (harbor) side of the project site and along Akoni Pule Highway. Thus, adverse traffic noise impacts from the existing sections of Akoni Pule Highway are considered minimal. Traffic noise impacts from the planned bypass highway are possible at the four residential parcels that are located mauka of the bypass highway. For these residential parcels, minimum setback distances of 157 to 190 feet from the centerline of the bypass highway will be implemented to meet FHA/HUD noise standards. Other noise mitigation measures include the use of berms or sound attenuation walls in order to minimize traffic noise impacts.

Noise impacts from industrial uses on the makai project lands are possible if adequate setbacks are not provided between these industrial uses and the residential lands on the inland portions of the project site. Noise attenuation measures as delineated by State Department of Health (DOH) regulations will be adhered to. Where adequate setbacks are not available, enclosure of the noise source, (i.e., the construction of sound attenuating walls, or the installation of silencers or mufflers) are standard noise mitigation measures to reduce noise levels to required property line limits.

3.11 EXISTING DEVELOPMENT

Development on Kawaihae lands is minimal. Much of the master plan area and surrounding lands are undeveloped land used for cattle and horse grazing. There is a partially developed 90-acre industrial park with nine parcels leased out at the northwest portion of the project site along Akoni Pule Highway. On these parcels are several small to medium-sized warehouses and other small structures. On the makai side of Akoni Pule Highway are 22 half-acre homestead lots on which there are three dwelling units. There are also 9 dwelling units and a store spread out on parcels located on the mauka side of Kawaihae Road and at the intersection of Kawaihae Road and Akoni Pule Highway. Of these, two structures are on privately owned parcels.

Impacts and Mitigation Measures

The proposed development will significantly change the existing land use conditions on the project site with extensive urbanization including residential, recreational, commercial, and industrial uses and attendant roadways and other utility systems built to County standards. The existing industrial park facilities are planned to be retained and further expanded upon into a larger complex. Infrastructure for the awarded lots on the makai side of Akoni Pule Highway is currently being developed under a separate project and will remain as presently designed. Other development along Kawaihae Road is expected to remain for the near term. However, as time passes, relocation may be considered as the area will become an industrial center.

3.12 SURROUNDING LAND USES

Figure 3-4 reflects land uses surrounding the 10-Year Master Plan area. Surrounding land uses include the 3,900-acre Kohala Ranch and 750-acre Kohala Estates subdivisions located to the north of the master plan area. Both are "upscale" developments with lots ranging in size from about 3 acres to 20 acres. Northwest of the project site is a 195 single-family residential lot subdivision being developed by Hawaiian Home Lands as part of the Department's homesteading program. Kawaihae Harbor with associated industrial activities is located across Kawaihae Road at the southwest corner of the project site. South of Kawaihae Harbor about a half mile from the southwest corner of the project site is the Puukohola National Historic Site. To the south are undeveloped lands belonging to the Queen Emma Foundation. Areas to the north and south of the upper portions of Kawaihae are used as grazing pastures.

Access to the South Kohala district is mainly the Queen Kaahumanu Highway which opened in 1975 and connects Kailua-Kona with Kawaihae. The high-speed road which extends 33 miles was completed at a cost of $16 million. This coastal highway, part of the island's Belt Highway system, vastly increases accessibility to the South Kohala district from Keahole Airport, the major airport for West Hawaii County.

The Waimea-Kohala Airport, at an elevation of 2,700 feet, is the highest airport in the State. This air terminal handles only a limited number of scheduled charter flights and private aircraft.

Kawaihae Harbor is the second deep water port on the island. This marine facility, completed in 1959, serves industrial, as well as recreational and commercial sport fishing activities. Industrial facilities supporting this harbor are bulk sugar and petroleum storage,

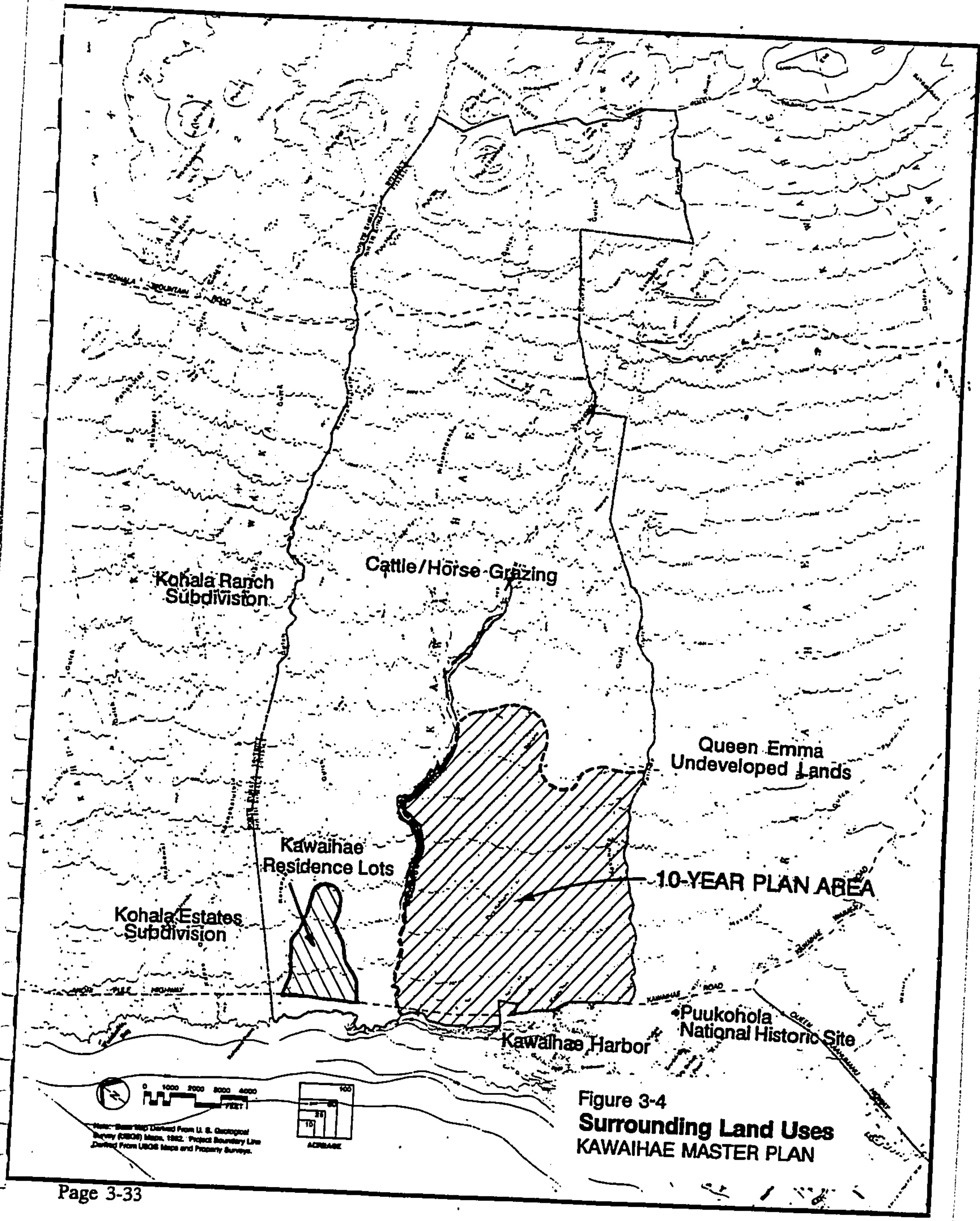


Figure 3-4
Surrounding Land Uses
KAWAIHAE MASTER PLAN

liquid fertilizer and molasses storage, and container and general cargo handling areas. The southern portion of the harbor also has an area reserved for staging of military equipment and supplies that are being transported to and from Pohakuloa Training Area. A small boat marina is also a part of the Kawaihae Harbor complex.

Impacts and Mitigation Measures

The project will introduce a new urban center to the district. It will have the following adverse impacts:

* increased traffic;
* changed existing visual resources by the replacement of open space with urban development

On the other hand, the project will have the following positive impacts:

* Improved access with the proposed Bypass alignment. Access to the project area is currently limited as there is only the two-lane Kawaihae Road/Akoni Pule Highway that crosses on the makai side of the project and the two-lane Kohala Mountain Road that crosses the site approximately four miles inland. With the development of Kawaihae lands and the planned improvements to the adjacent harbor, major access improvements are necessary to accommodate the changes. These improvements will encompass not only the widening of existing roads, but also the routing of a bypass road. Close coordination between the developer and the State Department of Transportation will be maintained to ensure timely and proper financing and construction of the bypass road and upgrading of Queen Kaahumanu Highway to freeway standards.

Issues concerning the level of improvements, routing of a bypass and funding sources will need to be resolved. In addition, plans for developing a freeway linking Kawaihae Harbor and Keahole Airport may have a significant impact on these issues.

* Provide for the growth of Kawaihae Harbor. Over the next two decades, Kawaihae Harbor will undergo some major improvements and growth which will greatly increase the harbor's importance. This, in turn, will likely transform the harbor into a center for harbor related activities. Because of the current limited area available for expansion for harbor related activities, adjacent lands will need to provide room for growth. There has been a great amount of interest expressed by various groups and businesses in locating their activity at or near the harbor. Recognizing that land will need to be dedicated or reserved to support harbor related activities, the question that arises is how much land area will be needed for supporting the future growth of the harbor? Consideration has to be given to the fact that Kawaihae Harbor is the only deep draft harbor on the western coast of the Island of Hawaii and that it will soon become a regional focal point of activity. Not designating enough land for harbor related activities may greatly restrict or complicate future planning and potential growth in the area.

* Provide employment opportunities to surrounding communities.

3.13 VIEWS

The site will offer panoramic views of the South Kohala and North Kona coast; Mauna Kea, Mauna Loa and Hualalai Mountains; and the vast expanses of undeveloped lands of West Hawaii. Views from coastal resorts looking mauka onto the project site are dominated by rolling hillsides with patches of pasture and grazing lands.

Impacts and Mitigation Measures

Present harbor facilities and land scarification produce strong contrasting visual impacts, especially due to the color of the coral landfill and buildings against the hillside. The use of earth tone colors, appropriate landscaping, height limits, and grading techniques to minimize the vertical dimension of structures are ways to minimize the visual impacts.

Mauka views from coastal resort areas, parks, and golf courses will be affected by the development. As the project area lies on the slopes of the Kohala Mountains it is highly visible from various locations in the vicinity including the highway, the Puukohola Heiau National Historic Site, Kohala Ranch, the proposed marina, and neighboring resorts.

As the Akoni Pule Highway and Kawaihae Road traverse the makai portion of the plan area, much of the lower areas to be developed will be highly visible to people travelling along the coastal highway. Thus, certain restrictions will need to be developed as to what types of land uses are allowed in this area along with the establishment of specific design criteria. To create desirable and aesthetically sensitive views, landscaping of new roadways and specific architectural design standards in the CC & R's of the industrial zones will be necessary.

Views from Residential Areas. The placement of landscape buffers and preserve areas coupled with height limits and grading can be utilized to provide visual buffers between industrial and residential and the bypass road.

3.14 OFFSHORE ENVIRONMENT

3.14.1 Existing Uses and Conditions

The makai waters separated from the Kawaihae project site by the Akoni Pule Highway is Kawaihae Bay. Waters in Kawaihae Bay are designated Class A by State of Hawaii Department of Health *Water Quality Standards Map, October 1987.* Class A waters are to be protected for recreational purposes and aesthetic enjoyment, with other uses permitted as long as they are compatible with the protection and propagation of fish, shellfish and wildlife, and with recreation in and on these waters (Chapter 54 of Title 11, Administrative Rules, as amended Oct., 1984).

Two public facilities, located within Kawaihae Bay, interface the project area; they are Kawaihae Harbor and Spencer Beach. Kawaihae Harbor is located directly makai of the project area below the Akoni Pule Highway and Kawaihae Road. It is the second largest harbor on the island, and was constructed in 1958 by blasting and dredging a coral reef platform. The extensive reef off Spencer Beach Park , a County-owned park located south of Kawaihae Harbor, is a continuation of the reef off the harbor. The material removed from the reef for the harbor basin was used for landfill around the perimeter of the basin. An 850-foot long breakwater extends southeast from the main harbor and was constucted in anticipation of a future small boat harbor. The entrance channel and basin for the future harbor were blasted through the reef in 1969 and 1970.

The Army Corps of Engineers has plans to build a 90-boat facility with construction to be underway shortly (*Sea Engineering, Inc. and Environmental Assessment Co., March 1992*).

Spencer Beach Park is used for tennis, camping, picnicking, swimming, and snorkeling. Facilities at the park include restrooms, picnic tables, showers, tennis courts, a pavilion, a parking lot, and a lifeguard tower.

A Hawaiian temple, the Puukohola Heiau National Historic site is located on the Kawaihae coast. Another historic site, Hale o Ka Puni heiau, is believed to be submerged just offshore of Pu'uokohola. Archaeological work is needed to be done to determine the location and extent of the ruins of the temple, which was dedicated to the shark gods.

3.14.2 <u>Oceanographic Conditions</u>

The coast in this area is sheltered from the northeast tradewind waves, but is exposed to wave approach from the northwest, west and southwest. North Pacific swell diffracts and refracts around the islands, and the portion of the energy reaching the shore depends upon the approach direction. Kona storm waves and south swell, however, directly approach the coast. Kona wave periods range from 6 to 10 seconds, and wave heights may be as great as 10 feet. South swell periods range from 12 to 20 seconds, and deepwater heights range from 1 to 4 feet.

Inshore waters are frequently turbid, due to resuspension of silt and fine sediments by wind and waves (ORCA, Ltd, 1984). Infrequent storm water runoff from usually dry streambeds in the area initially carries silt and debris into Kawaihae Bay. Windborne coral dust from the dredging stockpiles at Kawaihae Harbor also adds to the sediment load.

Nearshore currents are relatively weak. Six months of current measurements off the Mauna Lani Hotel, approximately six miles south of Spencer Beach Park, indicated that the nearshore currents (inside the 40-foot contour) had an average speed of less than 0.1 knot (Sea Engineering, 1989). The resultant flow was a weak net transport to the southwest.

The estimated 50 to 100 year tsunami elevations for this coastline are 5.9 and 8 feet, respectively.

3.14.3 Marine Biological Setting

The following description is a summary of qualitative reconnaissances of areas in and around Spencer Beach Park conducted by Sea Engineering and Environmental Assessment Co. in July 1991 and January 1992 in conjunction with a cable landing study for R.M. Towill Corporation. These surveys were taken at 80 to 90 foot depths and at distances of up to 850 feet offshore.

3.14.3.1 Biotope of Sand

Many species that are found in this habitat will bury into the sand to avoid predators and the abrasion that occurs with storm waves. Among those are many of the molluscs and crustaceans such as the kona crab (Ranina serrata). Other species found are the helmet shell (Cassis cornuta), augers (Terebra crenulata, T. maculata and T. inconstans), the leopard cone (Conus leopardus) and flea cone (Conus pulicarius) as well as the sea hare (Brissus sp.), starfish (Mithrodia bradleyi), brown sea cucumber (Bohadschia vitiensis), opelu or mackeral scad (Decapterus macarellus), nabeta (Hemiipteronotus umbrilatus), the goby-like fish (Parapercis schauslandi), uku or snapper (Aprion virescens), hihimanu or sting ray (Dasyatis hawaiiensis) and the weke or white goatfish (Mulloides flavolineatus).

3.14.3.2 Biotope of Emergent Hard Substratum and Corals

The substratum in the biotope of emergent hard substratum and corals is comprised of both basalt rock (pahoehoe) and limestone as well as corals. Channels, depressions and corals provide ample cover for fishes and invertebrates, yet, few organisms were seen in the survey.

Two algal species (Porolithon gardineri and Galaxaura acuminata) occurred, and four coral species (Porites lobata, P. (Synaraea) convexa, P. comoressa and Pocillopora damicornis) were present. Three macroinvertebrate species were encountered in the 4 x 25m census area; these species were the ubiquitous green sea urchin (Echinometra mathaei), the slate pencil urchin (Heterocentrotus mammilatus) and the pearl oyster (Pinctado marginifera). The most abundant fish species in this vicinity include the saddleback wrasse or hinalea lauwili (Thalassoma duperrey) and the small eleotrid (Asterropteryx semipunctatus).

Also in the vicinity were seen the corals (Pavona duerdeni, Montipora flabellata, M. verruscosa, Fungia suctaria), the black sea urchin (Tripneustes gratilla), the moa or boxfish (Ostracion meleagris) and the sharpback puffer (Canthigaster jactotor).

3.14.3.3 Biotope of Scattered Corals

Common coral species seen in this biotope include Porites lobata, Porites compress and Montipora verrucosa. Few macroinvertebrates are seen on the sand substratum but there were a number of burrows or holes created by a number of species including the commensal goby-shrimp, unidentified crustaceans, echinoderms, etc.

This survey noted three coral species (Porites lobata, Porites compressa and Montipora verrucosa). One macroinvertebrate species was noted-- the Hawaiian rock oyster (Spondylus tenebrosus). The fish census noted four species (44 individuals). The most common fishes were the alo'ilo'i or whitespot damselfish (Dascyllus albisella) and the samll eleotrid (Asterropteryx semipunctatus).

In the vicinity were seen the algae or limu (Desmia hornemannii and Cladymenia pacifica), corals (Porites evermanni, Leptastrea purpurea and Pocillopora meandrina), the chrismas-tree worm (Spirobranchus gigantea), oak cone (Conus quin), the butterfly fish or kikakapu (Chaetodon auriga), lizard fish or 'ulae (Synodus binotatus), the brown surgeonfish or ma'i'i'i (Acanthurus nigrofuscus) and goldring surgeonfish or kole (Ctenochaetus strigosus).

One small green turtle (Chelonia mydas) was seen in the biotope of scattered corals about 900 feet from shore in about 15 feet of water during the January 1992 survey. Offshore of Spencer Beach Park appears to have appropriate shelter for green turtles (i.e., undercuts, ledges and caves) at a size and scale appropriate for green turtle resting areas. However, it was noted that little macroalgae present in the area that could be utilized as forage (Balazs, 1980, Balazs et al. 1987). Further, no information was found to suggest that nesting of sea turtles at Spencer Beach has occurred in histoical times.

The biological survey did not find any rare or unusual species or communities other than the single threatened greensea turtle noted above. Another protected species, the humpback whale (Megaptera novaeangliae), was not seen offshore of the study area during the period of study. As noted by Herman (1979), humpback whales tend to be found in regions remote from human activities and the proposed project is in relatively close proximity to Kawaihae Harbor which has been the major commercial port serving West Hawaii for many years.

3.14.4 Potential Impacts and Mitigation Measures

The potential for impact to the shallow marine communities will be minimal in the short and long term. To avoid adversely affecting them, all Federal, State, and County standards and guidelines will be adhered to in drainage system design and project construction practices.

Sea turtles are permanent residents in inshore Hawaiian habitats. Although the remote potential exists for problems caused by constuction site surface runoff during the construction phase, the generation of particulate material appears not to hinder the green turtle in Hawaiian waters. In previous cases cited on Oahu, the turtles appeared to establish new resting areas in turbid water directly offshore of the construction site (Brock 1990a).

The reason(s) for this shift in resting areas is unknown but may be related to the turtles seeking water of poor clarity to possibly lower predation by sharks (a major predator on green sea turtles).

Section 4

SOCIO-ECONOMIC ENVIRONMENT

SECTION 4
SOCIO-ECONOMIC ENVIRONMENT

4.1 SOCIAL AND ECONOMIC CHARACTERISTICS

A market demand assessment of the proposed land uses was conducted for the Kawaihae master plan by Real Estate Services, Inc. in May 1991. The report findings are summarized in this section, and the report in its entirety can be found in the Appendices.

4.2 POPULATION CHARACTERISTICS

The South Kohala district had the second highest increase in resident population in Hawaii County during the period 1980 to 1989 of 95 percent. The resident population increased from 4,607 in 1980 to 9,000 in 1989. Much of this increase in population was attributed to the development of three major resorts: the Mauna Kea Beach Resort, Mauna Lani Resort and the Waikoloa Beach Resort. The basic population and commercial center within the South Kohala district is Waimea where a variety of small businesses serve the local population.

Recent social and economic trends indicate that Hawaii will continue to experience fairly rapid population growth. The County of Hawaii population is projected to increase significantly from 122,300 people in 1989 to 206,100 people in 2010, a 68.5 percent increase over the 1989 population figure.

Although the population of the South Kohala district is relatively high, population in the Kawaihae area is low (about 150 people) according to the 1985 Kawaihae Development Plan. Most of the residents in the South Kohala district reside in Waimea or near the resort developments south of Kawaihae.

Because this area has been reserved for the native Hawaiians, the ethnic group in the Kawaihae area will be dominated by people of Hawaiian ancestry. The Hawaiian people will be returned to the land of their ancestors. The Kawaihae area's historic significance is a result of Puukohola Heiau and Kamehameha's consolidation of control over the islands.

Impacts

The Kawaihae Ten-Year Master Plan is proposed to provide approximately 3,500 residential units over the next 10 years. This project will fulfill about 11 percent of the total projected housing need of 13,000 units for DHHL applicants by the year 2000. Assuming a typical household size of 3.73 persons per household, this indicates a population increase at the Kawaihae project site of 13,055 persons.

The Kawaihae project will provide much needed new dwelling units for qualified native Hawaiians.

4.3 ECONOMIC CHARACTERISTICS

Tourism and agriculture are Hawaii County's main industries. The tourist industry, here as with the other islands throughout the State, is the key industry in Hawaii County, particularly in West Hawaii where the Kona and Kohala coasts have almost all of the County's hotel room inventory.

Hawaii County has the highest cattle and calves inventory with 131,500. Other livestock inventory include milking cows, hogs and pigs, and chickens. Agricultural activity in the Kawaihae area consists mostly of cattle ranching.

The civilian labor force for Hawaii County totaled 56,900. Of this total, 54,700 were employed leaving 3.9 percent unemployed in 1989. This is the highest percent of unemployment compared to the other three counties. The job count for the County was 51,600 of which 45,750 were for non-agricultural employment and 5,850 were for agricultural employment. The per capita personal income for the County of Hawaii in 1988 was $13,331.

Kawaihae Harbor is the only deep draft harbor on the west coast of the Big Island. It is being expanded to accommodate the growing number of commodities being shipped directly to West Hawaii rather than shipped and trucked via Hilo. The harbor expansion includes enlargement of the barge terminal backup area, dredging of the barge terminal berth, paving the container yard area and extending the oversea pier. There are also plans for the construction of a small boat harbor adjacent to Kawaihae Harbor on the south side.

West Hawaii's main airport, Keahole, is in the process of a major expansion of its facility by the addition of a $30 million runway extension and related improvements. Related improvements include relocating navigational aids, installing airfield lighting, building a service road for rescue and fire fighting equipment and constructing a blast pad. The State is subsequently requiring land area at Kawaihae for a jet fuel tank farm that will provide storage capacity for the expanded airport. The location of the tank farm at Kawaihae is due to its proximity to Kawaihae Harbor.

<u>Other Project Impacts</u>

Assuming the estimated direct population increase of 9,625 persons, the indicated direct market demand for commercial space includes a community center (30,000 square feet of direct demand) and several (possibly 3 to 4) free-standing convenience stores with associated support uses (i.e., gas station and offices, each on approximately 3/4 acres of land) over the initial 10 year development term.

The commercial space demand is not isolated to the retail aspect of commercial space. A segment of the commercial demand is seen in the expansion of the Kawaihae Harbor and the need for maritime and support facilities serving the harbor needs. Commercial office space, situated near the harbor, is part of this overall commercial demand.

According to the project market study, there is a demand for approximately 250 acres of industrial use land, in both light and general industrial uses. The estimate is based on the assumption that the land will be developed in a manner similar to other industrial subdivisions and will be available at competitive rates. The proposed project will help provide the area needed to fulfill the demand.

Hawaii's economy will be enhanced due to the increase in tax revenues resulting from the improvements planned by the development. The change from passive agricultural use to residential and other urban uses will increase land values. In addition, the increase in population brought on by the development will directly increase economic activity in the area. Opportunities for small businesses will increase as the need for community support increases.

As indicated in a 1985 Environmental Impact Statement for the Kawaihae Small Boat Harbor project for the construction of a harbor for light-draft vessels, positive economic impacts would result from the State's small boat harbor project. These include:

* Recreational and commercial opportunities will be greatly enhanced by the project, including boating and related offshore fishing activities, shoreside fishing and passive recreation.

SLICE WASTE AND RED TAPE SURVEY

OFFICE OF ENVIRONMENTAL QUALITY CONTROL

As a part of the State's initiative to reduce regulatory burden and improve customer service, the Office of Environmental Quality Control seeks your feedback and suggestions on how it can improve its current operations. Please remove this page, complete the survey below, turn the page over, fold on the dotted lines, tape (do not staple), stamp and mail. Use more paper if necessary. To save on postage you may also fax this form to 586-4186. Thank you for your assistance!

1. How can we reduce the number of reports/documents (e.g., environmental assessment, etc.) required to be filed with OEQC?

2. How can we consolidate or eliminate the current forms (e.g., the OEQC Bulletin publication form, forms in Appendix H of "A Guidebook to the Hawai'i State Environmental Review Process"?

3. Do you consider the current rules (Chapters 200 and 201, Title 11, Hawai'i Administrative Rules) or portions thereof obsolete? If so, please identify the rule and illustrate why it should be eliminated.

4. Please indicate your level of satisfaction with OEQC operations and include any comments you would like us to consider.

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HONOLULU, HAWAII 96813

* Provision of temporary construction jobs and permanent operations and maintenance jobs at the completed harbor area.

* The harbor's commercial activities will create permanent job opportunities.

The development of the large resorts along the Kohala coast will increase the need for workers in the visitor industry. The proposed residential subdivisions could supply many of these workers.

The Keahole Airport expansion will translate into additional short and long-term jobs in construction, airport operations and tourism in West Hawaii.

The project will not significantly affect the available cattle grazing areas. Grazing generally occurs in the higher elevations above the project site where cattle fodder is more abundant. There will be no negative impact on farming due to the terrain and climate.

Section 5

PUBLIC SERVICES

SECTION 5
PUBLIC SERVICES

5.1 PUBLIC FACILITIES AND SERVICES

This section contains a discussion of the project's infrastructure systems and public services, impacts and appropriate mitigation measures.

5.2 FLOODING AND DRAINAGE

According to the Flood Insurance Rate Map panel 137, September 16, 1988, no flood insurance is required, except in a limited area approximately 3,500 feet north of Puako Road and mauka of Kawaihae-Waimea Road which is designated Zone "X" (area of 100-year flood with average depth of less than one foot).

Major gulches in the area include Keanahalulu Gulch, Kaiopae Gulch, Kawaihae Gulch, Kilohana Gulch, Honokoa Gulch, Waiapahoehoe Gulch, Keawewai Gulch, Makahuna Gulch and Palihae Gulch. The Kaiopae Gulch occurs immediately to the north of the project and the Honokoa Gulch occurs to the south of the project site. Smaller drainageways occur within the project site and will be left open for the purposes of maintaining the natural drainage pattern in the area. Existing culverts under Akoni Pule Highway provide for the storm water runoff to leave the site and discharge into Class A coastal waters.

The numerous natural drainage features throughout the site will help to lessen some of the drainage system requirements; however, additional facilities to capture and control storm water runoff from the denser developed areas will be required.

Impacts and Mitigation Measures

Increased on-site drainage caused by the creation of impervious surfaces will be routed to drywells that will be developed within the roadway shoulders. Natural storm water runoff will continue to use existing drainageways in areas that will be retained as open space. These open space areas generally occur on the makai side of the project.

Because the project will not increase runoff discharging into the coastal waters, no impact on the existing drainage pattern is expected. The drainage system within the project will maintain the natural drainage pattern in the area.

5.3 POTABLE WATER

A. Existing Conditions

Currently there is no County water system or sources to support the master planned area. The County's existing 8-inch water main running along the makai boundary of the project site has the capacity to only support the existing services in the area. The adjacent Kohala Ranch has developed their own private water system, which includes wells, reservoirs and a distribution system. Since there is no existing potable water system to tie into, a new water source, storage and distribution system will need to be developed for the project.

An exploratory well was drilled in 1990 at an elevation approximately 1,400 feet above mean sea level (msl) on the south side of Honokoa Gulch; however, the water tested to be brackish. The State Department of Land and Natural Resources, Division of Water Resource Management (DWRM) has drilled another exploratory well on the north side of Honokoa Gulch at about 1,600 feet msl. The results of the test were summarized as follows:

The well was pump tested for 72 hours at a constant rate of 130 gpm (.09 mgd) and salinity of 170 ppm chlorides. Water temperature was 84.2°F. Drawdown in the well appeared to stabilize at 4.0 feet. An observed 0.2 foot increase in drawdown during the last two hours of the test probably is insignificant due to a normal margin of error in reading the air line pressure gage. Also, earlier pump tests of the well showed a stable drawdown.

Based on the results of the pumping test, the well is capable of producing potable water with a chloride content of 170 ppm at a constant rate of 130 gpm. However, if the well is used as a municipal source of supply, it will normally be pumped intermittently 16 hours or less per day. A pump capacity of 200 gpm has been recommended (State DLNR, September 1992).

B. Water Source Development

Implementation of the development plan will require an extensive water development program capable of delivering a maximum daily demand of approximately 4.7 million gallons a day (mgd). Possible sources planned for the development are (1) drilling wells at the site (2) desalinization of brackish water and (3) importing water from wells located in North Kohala.

Of the three sources, well development offer a good prospect for a reliable method to provide water to the development because the wells would be located on the project site and water would be available with minimal delay and without the need of additional transmission mains and other supporting facilities as the other alternates. The 1,600-foot elevation has been determined through previous well drilling activities in the region to be the elevation at which potable quality water can be obtained. Wells below this elevation are likely to produce brackish water with high chloride content. Domestic drinking water supply wells at or above 1,600 feet msl have also been successfully developed by Kohala Ranch. A yield of about 700 gpm per well is anticipated at the project site.

The second anticipated source is the desalinization of water. Water for this alternative would be provided by brackish water wells drilled along the makai portion of the site. Although brackish water is readily available, the initial construction and annual operating costs of a desalinization plant will be high. Some private enterprises have expressed interest in constructing and operating such a facility in the area, however, none have submitted a detailed proposal. Questions to be answered and potential problems include: the effect on the water table; disposal of waste products; and the effect on ocean salinity and marine life.

The third possible future source is the State's North Kohala water tapping project. This proposal involves the State's plan to tap unused water resources in North Kohala and transport the water to the arid South Kohala district where rapid development is occurring. Although the allocation of the water has not yet been determined, a certain allotment is anticipated for the project. Because of the limited amount of water anticipated from the wells and desalinization plant, the future expansion and development of the project will depend greatly on all sources of water.

C. Land Use and Demand Description

Water demands for the project were calculated according to the rates specified in the DWS standards for the various land use designations. Table

5-1 shows a summary of the total land use area for the different categories and the water demands for each classification. The quantities were calculated from average factors indicated in the DWS standards. However, because of the arid environment of the area, the demand for water may be greater.

TABLE 5-1
SUMMARY OF PROJECT WATER DEMAND ACCORDING TO LAND USE

Development Designation	Approx. Dwelling/ Acre	Total Area (Acres)	Gal/Acre	Avg. Day Demand (Gallons)	Max. Day Demand (Gallons)
Low Density Residential	2-3/4	1,197	1,100	1,316,700	1,975,050
Medium Density Residential	10	30	4,000	120,000	180,000
Existing Lots		12	2,900	34,800	52,200
Industrial		227	4,000	908,000	1,362,000
Commercial		46	3,000	138,000	207,000
Town Center		58	3,000	174,000	261,000
School/Parks		84	4,000	336,000	504,000
Religious		8	3,000	24,000	36,000
Preservation		20	4,000	80,000	120,000
	TOTAL	1,682		3,131,500	4,697,250

D. Description of the Water Supply Plan

The development of potable water sources for the project is crucial to the full development of the project and the availability of potable water may become the limiting factor. The estimated water demand for the Ten-Year development plan for the project is 3.1 million gallons per day average with a maximum daily demand of 4.7 million gallons per day.

Deep wells proposed at the project site are anticipated to provide about 3 mgd and the remaining 1.5 mgd provided by importing water or from a desalination facility. Since the wells will be located north of Honokoa Gulch, water will be transported down to and along Akoni Pule Highway and across Honokoa Gulch to the project site. Since water from the sources will commence at the lower levels, booster pumps will be required to pump water up to the higher elevations though pipelines ranging in sizes from 16 inches to 20 inches in diameter. Obtaining water from North Kohala via a proposed pipeline is a third potential source.

The water distribution system will be divided into 6 service zones to maintain water pressures within the Department of Water Supply's standards.

Seven (7) reinforced concrete reservoirs will be required to fulfill fire protection and minimum storage requirements.

The demand and storage capacities of the reservoirs at the different pressure zones were tabulated and are presented in Table 5-2.

TABLE 5-2 - STORAGE REQUIREMENTS

Reservoir No.	Pressure Zone (Ft.Elev.-msl)	Service Limit (Ft.Elev.-msl)	Avg Day Demand (Gal.)	Max. Day Demand (Gal.)	Reservoir Capacity (Million Gal.)
1.	310	0 to 210	1,138,427	1,707,641	1.7
2.	576	210 to 476	615,866	923,799	1.0
3.	842	476 to 742	602,407	903,911	1.0
4.	1108	742 to 1008	415,020	622,530	1.0
5.	1374	1008 to 1274	251,800	377,700	0.5
6.	1374A	1008 to 1274	59,600	89,400	0.1
7.	1640	1274 to 1540	48,180	72,270	0.1

The ultimate factor that will decide the growth of the development is the availability of potable water, and the design of the infrastructure will depend greatly on the location and size of the sources.

Impacts and Mitigation Measures

If the approximately 3,600 units including the industrial, commercial and other community centers are developed, the project will require an average daily demand of 3.1 million gallons of water per day (mgd). The on-site wells are anticipated to provide about 3 mgd while the remainder to be provided by other sources.

Pumping 2 to 3 mgd is not anticipated to have any major, long term, adverse impacts on the groundwater source since Kohala Ranch has been successfully pumping potable water in the same region for many years without adverse effects.

Since the State's well is adequately spaced apart from the neighboring sources, sustained pumping of the originally drilled well is not anticipated to produce any significant adverse effect on the aquifer or surrounding area.

The estimated cost of developing and transporting 20 mgd of water from North Kohala wells is between $20 million to $30 million. A proportional share of the total cost will be borne by developers that will be utilizing this source.

This cost of constructing a desalinization plant for the project is not available at this time. However, based on costs of desalinization plants built elsewhere, a 1 mgd plant is estimated to cost about $3 million and a 5 mgd facility about $10 million.

The construction of a desalinization plant will be expensive but if developed by private enterprises, the economic impact will be reduced. Excessive pumping of brackish water may increase the dissipation of the groundwater transition zone and enhance the intrusion of ocean water. The disposal of the concentrated brine (by-product) from desalinization into the ocean will require conformance to the National Pollutant Discharge Elimination System (NPDES) regulations and a permit must be obtained from the Clean Water Branch of the State Department of Health (DOH).

Periodic monitoring of the water quality of the potable and non-potable wells shall be conducted by the State DLNR and DOH to prevent degradation of the aquifer.

The impact of tapping groundwater resources in the North Kohala mountains is anticipated to have minimal adverse effects to the groundwater resources since there appears to be an abundant supply of untapped fresh water currently overflowing into the ocean. However, the economic impacts of constructing the wells and transmission mains to the dry South Kohala District will be that the cost shall be borne by the land developers; there will be increased availability of water; and there will be more construction jobs.

Water conservation methods will be encouraged to conserve the precious commodity. To promote water conservation, treated sewage effluent will be used to irrigate a proposed golf course. Landscaping plant palette will be selected emphasizing species that are drought-resistant.

On-site development costs for the water system is estimated to be about $42 million.

5.4 WASTEWATER TREATMENT AND DISPOSAL

A. Existing Conditions

Presently, there are no municipal sewage systems or sewage treatment facilities in the area. Residential development in the region relies primarily on private septic tanks, cesspools or private sewage treatment plants. The nearest municipal wastewater treatment facility for the West Hawaii Region is located at Kealakehe in North Kona.

A new wastewater treatment plant (WWTP) will be designed and constructed in increments to support the phased growth of the Ten-Year Master Plan and will be sized to treat an average flow of 2.5 mgd.

B. Proposed System

The design capacity of the first phase of the facility will be 2.5 mgd and may increased during the later phases of construction. The ultimate development is anticipated to generate about 4 mgd of wastewater. Expansion of the facility will be limited by the effluent disposal capacity of the area. The treated effluent will be pumped into injection wells located near the facility.

The plant will be located south of Honokoa Gulch, approximately 4,000 feet north of the entrance to Kawaihae Small Boat Harbor and about 1,000 feet mauka of the shoreline. Injection wells at this location pose minimal risk of contamination to waters within the small boat harbor. It is also below the State Department of Health's UIC line which parallels the shoreline at approximately 200 feet msl.

Sewer lines ranging from 8 inches to 30 inches in diameter will collect sewage and convey it to the treatment plant and/or pump stations utilized as necessary.

TABLE 5-3
SEWER FLOWS FOR THE TEN-YEAR DEVELOPMENT PLAN

Land Use	No. of Dwelling Per Acre	Area (ac)	Density CPA 4/unit	Population	Q (gcd)	Avg. Flow (mgd)
Commercial		46	30	1,380	100	0.138
Existing Lots		12	4	48	100	0.005
Industrial		227	30	6,810	100	0.681
Low Density Residential	2-3/4	1,197	11	13,167	100	1.317
Medium Density Residential	10	30	40	1,200	100	0.120
Preservation		20		80	100	0.008
Religious		8		80	100	0.008
Schools/Parks		84	1,200/ school	4,800	25	0.12
Town Center		58	30	1,740	100	0.174
	TOTAL	1,682				2.571

C. Impacts and Mitigation Measures

Current Department of Health regulations prohibit cesspools thereby requiring all of the sewage from the project will be treated at the new wastewater treatment plan and the effluent disposed into injection wells. The injection wells will be located approximately 4,000 feet from the Kawaihae Small Boat Harbor and seepage from the injection wells pose minimal risk of contamination within the harbor. The injection wells will also be located makai of the UIC line and pose no danger to the potable groundwater resources in the area.

The cost of the proposed sewage improvements is about $35,885,550.

The new wastewater treatment plant will be designed and constructed in increments to support the phased growth of the development. The wastewater treatment plant will be able to accommodate the wastewater from the expansion of the Kawaihae Harbor commercial facilities. DOT Harbors Division will be required to pay a proportionate share of the cost of developing the wastewater treatment plant and transmission lines.

5.5 SOLID WASTE

Solid waste is currently disposed of at the Kealakehe Sanitary Landfill. This landfill is reaching capacity and some of the wastes are trucked to Hilo for disposal. A new solid waste landfill site is being planned for the West Hawaii region. When this new landfill is opened for operation, the solid waste will be disposed of at this site. This new sanitary landfill is being designed to provide service for a 20-year period. Until this new landfill site is opened, solid waste will continue to be disposed of at the Kealakehe landfill or trucked to Hilo for disposal. An area within the development will be designated for a transfer station. Although the actual location is undetermined, it will be situated close to the highway within lands designated for industrial use. Upon completion of its construction, the actual operation and maintenance of the facility will be coordinated between DHHL and the County.

A. Impacts and Mitigation Measures

The project will generate approximately 36 tons of solid waste per day (based on 5 pounds per capita per day and 4 persons per unit).

The new sanitary landfill planned for the West Hawaii Region is expected to be open for operation by the time the project is fully developed. Because the sanitary landfill is planned to accommodate growth in the West Hawaii Region, significant impacts on the sanitary landfill are not expected. The developer will investigate all possible on-site reduction and diversion measures to reduce solid waste in conformance with Act 324-91 regarding Solid Waste Management. A study will be conducted to designate an area adjacent to the refuse transfer station or nearby lands for recycling or composting activities. The developer will identify and segregate construction waste and investigate composting or recycling options. Further, special informational and educational programs on recycling and greenwaste diversion activities in the community will also be promoted to encourage solid waste reduction.

5.6 TRAFFIC/TRANSPORTATION SYSTEM

A. Existing Conditions

The project site extends mauka of the present Kawaihae community. Existing residential and commercial areas are located along the Kawaihae Road and Akoni Pule Highway, which form the makai boundary of the master plan area. Kawaihae Harbor and related industrial uses are located makai of Kawaihae Road opposite of the Ten-Year Master Plan area.

The area is presently served by a system of rural two-lane highways. The low level of development within the South and North Kohala areas result in comparatively light to moderate traffic volumes on most of the roadways. The harbor contributes significantly to the truck activity.

B. Roadway System

At present, Kawaihae Road and Akoni Pule Highway provide access to the developments at the makai edge of the Master Plan area, while the Kohala

Mountain Road traverses the mauka portions of the Long Range Master Plan area. Queen Kaahumanu Highway connects this area to Kona. All are State highways and are typical of rural two-lane arterials.

(a) Kawaihae Road runs between Waimea and Kawaihae in the east-west direction. This two-way two-lane minor arterial has a 22-foot pavement width and intersects with the south end of Akoni Pule Highway, the north end of Queen Kaahumanu Highway, south end of Kohala Mountain Road, and Mamalahoa Highway. The capacity of Kawaihae Road has been estimated at 2,140 vehicles per hour (vph) (Traffic Assessment Report for the Kohala Ranch Project IV, by the Traffic Management Consultant, October 1990) total for both directions. Kawaihae Road has a posted speed limit of 45 mph.

(b) Akoni Pule Highway is a two-lane two-way arterial that runs from Kawaihae to Hawi to the north. It has 12-foot lanes and full shoulders giving it an estimated capacity of 2,430 vph total for both directions.

(c) Kohala Mountain Road is a two-way arterial between Waimea and Hawi. The Kohala Mountain Road has an 18-foot pavement width and an estimated capacity of 1,000 vph total for both directions. The low capacity is due to adverse conditions by way of the road running through a mountainous area with narrow bridges, narrow shoulders and frequent curves. The road has not been considered a high accident facility by the State DOT as most of the accidents were of one vehicle non-collision type.

(d) Queen Kaahumanu Highway is a two-lane two-way major arterial between Kawaihae and Kona providing access to major resorts. The posted speed limit is 55 mph along most sections of the road.

Existing weekday peak hour traffic volumes are relatively low with peak hour volumes typically ranging between 200 to 500 vehicles in each travel direction on the major roadways in the area.

At present, the only traffic signal-controlled intersection in the vicinity of the project is at Kawaihae Road (Lindsay Road) and Mamalahoa Highway (Hawaii Belt Road) in Waimea. Major intersections with stop sign controls include the Kawaihae Road intersections with Kohala Mountain Road, Queen Kaahumanu Highway, and Akoni Pule Highway. Kawaihae Road is the through route at each intersection.

The County of Hawaii, Department of Public Works, has recommended that a major road parallel to and between the Kohala Mountain Road and the Akoni Pule Highway be included as part of the Long Range Master Plan. This road would match the location and standards of the Kohala Ranch "mid-level" road.

C. Impacts Without Project

Traffic growth through year 2003 without the project was estimated in two growth components:

1. A percentage growth factor (7% per year) based on past trends; and
2. Traffic generated by the proposed Kohala Ranch project located north of and adjacent to the Hawaiian Home Lands property.

This analysis has also assumed that the planned Kawaihae-Waimea Bypass would be built to connect Queen Kaahumanu Highway and the Hawaii Belt Road. The planned bypass would be located generally parallel to and approximately 0.5 to 2.0 miles south of Kawaihae Road, and would intersect Queen Kaahumanu Highway near its present intersection with Kawaihae Road. It was assumed that a traffic signal would be installed at the intersection of Queen Kaahumanu Highway and the Kawaihae Bypass Road.

Kawaihae Road would remain in its current alignment from Queen Kaahumanu Highway to Akoni Pule Highway. It was assumed that the bypass would not extend across the Kawaihae Master Plan area prior to development of the area.

Future levels of service were calculated at the intersection of Kawaihae Road and Queen Kaahumanu Highway for year 2003 without the project on key roadway segments: the conclusion was that major roadways in the area would operate at reasonable levels of service. The Kawaihae Bypass would operate at LOS A mauka of Queen Kaahumanu Highway intersection while Kawaihae Road would operate at LOS B north of the same intersection with volume capacity ratio of 0.47 during the AM peak hour. During the PM Queen Kaahumanu Highway would operate at LOS D (V/C= 0.74) while the Kawaihae Bypass would operate at LOS A mauka of Queen Kaahumanu intersection and Kawaihae Road at LOS C north of the same intersection. All in all, the planned roadway improvements would be adequate to accommodate the forecast traffic flows for conditions without the project.

D. Impacts With Project and Mitigation Measures

With development of the Ten-Year Master Plan area, it was assumed that additional portions of the planned Kawaihae Bypass would be built. The portion of the bypass from Queen Kaahumanu Highway to the Hawaii Belt Road is expected to be built with or without the project. Two scenarios were tested for the remainder of the planned bypass from Queen Kaahumanu Highway through the project site.

1. First, it was assumed that the Kawaihae Road would remain in its current configuration where it runs along the shoreline and that a bypass would not be constructed on this northern segment, except where it passes through the property. Without the segment of the bypass between the project site and Queen Kaahumanu Highway, all of the project traffic will have to be routed back down to Kawaihae Road. Analysis indicates that significant congestion would result under this scenario.

2. A second scenario addressed where the bypass would be completed through properties on the south side of the project, connecting with Queen Kaahumanu Highway.

It was assumed that traffic signals would be installed at the key intersections along the Bypass Road where it passes through the project area and at the intersection of Bypass Road with Queen Kaahumanu Highway.

Initial analysis assumed that all major roads leading to the project would be constructed as two-lane roads, with turning pockets at the key intersections to separate left-turns and right-turns from the through traffic movements. Where the bypass turns in mauka direction, it was assumed that a truck climbing lane would be added in the uphill direction.

Additional roadway capacity will be necessary to accommodate the substantial amount of traffic growth forecasted for the project. The configuration proposed differs from the planned improvements in that the bypass would be constructed as a four-lane road through the project and to the south of the project site. Also the number of turn lanes was increased at some locations from single left-turn lanes to double left-turn lanes.

For the AM peak hour:

* The Ten-Year Master Plan area, at full build-out, would generate a total of 3,014 inbound and 2,161 outbound vehicle trips during the AM peak hour.

For the PM peak hour:

* The Ten-Year Master Plan area, at full build-out, would generate a total of 2,929 inbound and 3,683 outbound trips during the PM peak hour.

The analysis indicates that the projected level of service at the intersection of the main entrance road and the Bypass Road is worse than for conditions with the full bypass.

AM Peak Hour Impacts:

* The planned Kawaihae Bypass would help relieve the anticipated congestion between Kawaihae and Waimea, mauka of Queen Kaahumanu Highway intersection. The two-lane Akoni Pule Highway would operate at

LOS C (V/C = 0.89) north of Kohala Ranch Project. The Kawaihae Bypass (two lanes) south of the project and north of Queen Kaahumanu Highway intersection would operate at LOS F (V/C = 1.33). The Queen Kaahumanu Highway with a two-lane width would operate at LOS F (V/C = 1.03). The Akoni Pule Highway would operate at LOS D between Kohala Ranch and the project (V/C = 0.85).

* With the existing two lanes, the Kawaihae Road between Kawaihae and Waimea would operate at LOS A; while the bypass between the same (two lanes plus a climbing lane) would operate at LOS A in the uphill direction (towards Waimea) and at LOS D in the downhill direction (V/C = 0.76).

* The intersection of Kawaihae Road and Queen Kaahumanu Highway would not be affected by whether the bypass is fully or partially constructed, since the merge point would be north of the intersection and all traffic to the south and Waimea (and back) would pass through this intersection. With the planned geometry of two through lanes in all directions, with left turn lanes and free right turns, the intersection would operate at LOS F (V/C = 1.28).

PM Peak Hour Impacts:

* Akoni Pule Highway north of Kohala Ranch would operate almost at capacity at LOS E (V/C = 0.96). Akoni Pule Highway south of Kohala ranch and north of the project would be at LOS F (V/C = 1.14).

* The Kawaihae Bypass south of the merge point (north of the Queen Kaahumanu Highway intersection) would operate at LOS F (V/C = 1.90).

The Queen Kaahumanu Highway would also operate at LOS F (V/C = 1.33).

* Kawaihae Road (mauka of the Queen Kaahumanu Highway intersection) would operate at LOS B (V/C = 0.53). Kawaihae Bypass would operate at LOS B uphill (V/C = 0.48) and LOS D downhill (V/C = 0.71).

* The Kawaihae Road/Queen Kaahumanu Highway intersection would operate at LOS F in the PM peak hour (V/C = 1.62).

E. Mitigation Measures with Alternative Geometry

The scenario with alternative geometry assumed that the Bypass Road would be four lanes wide and fully connected to the south of the project. The four-lane section would be at a point to the north of the project and would continue as a four-lane wide roadway to the Queen Kaahumanu Highway intersection south of the project. Turn pockets would be needed at all of the key intersections. This would include double left-turn lanes for traffic leaving the project at the Main Entrance Road and at the Residential Access Road.

The alternative geometry at the intersection of Queen Kaahumanu Highway and the Kawaihae Bypass Road included six lanes on the southbound approach (double left-turns and double right-turns), a double left-turn for northbound movements from Queen Kaahumanu Highway and of a four-lane cross section on Queen Kaahumanu Highway to the south of this intersection.

The traffic conditions at the intersections with the alternative geometry would improve substantially over the planned improvements: during the PM peak hour, traffic conditions at the project site entrances would be typical of LOS C and LOS D operations, compared to LOS F with the "planned" geometry. Intersection operations during the AM peak hour would improve to the level-of-service LOS A to LOS C range.

If the anticipated levels of area development and background traffic growth occur by Year 2003, then a grade separation for the intersection of Queen Kaahumanu Highway and the Kawaihae Bypass Road may be needed to avoid congested traffic conditions during the peak traffic hours.

5.7 POWER AND COMMUNICATION SYSTEM

Existing offsite facilities include 69 KV and 12 KV Hawaii Electric Light Company (HELCo.) overhead lines and structures and Hawaiian Telephone Company (HTCo.) lines that extend from Kawaihae Road and traverse the project site. Cable television facilities do not exist on the site and must be extended from trunking cable facilities located at Mauna Kea Resort. The closest electrical substation is located at Kohala Estates and the nearest telephone switching station is at Kona Center.

Proposed electrical and communication improvements to support the requirements of this project can be served from existing utility systems, with some necessary offsite work. In general, the offsite improvements required for the development is an ongoing activity for the utility companies and should not create an undue hardship for the respective utilities. HELCo and independent operators have proposed that a new power plant be located within the project area. If the power plant is not built in the area, a new substation will be required by HELCo. to serve the project. HTCo. will also require a remote office to serve this project.

- Electrical. The existing HELCo overhead 69 KV and 12 KV lines that traverse the project site will remain.

  Peak power demand at full build-out is not expected to exceed about 45 megawatts. This includes power demands from residential, commercial and industrial components of the project. Present generating capacity on the island of Hawaii is 161 megawatts with most of this power provided by oil-burning generating units. Island wide, peak power demand is currently about 120 megawatts. Average annual electrical demand of the project when fully developed is not expected to exceed about 240 million kilowatt-hours.

  In order to meet the electrical power needs of the proposed project, expansion of oil-fired generating facilities will more than likely be necessary. This projected demand is expected to result in a 40 percent increase in emissions from the electric utility.

  Based on the forecasted loading, HELCo requires that a new substation be constructed to service the project. The new substation will step down the incoming 69 KV transmission voltage to 12 KV for distribution throughout the development. 12KV distribution feeders from the substation will be connected to service transformers located adjacent to project feeders.

  The electrical system will be an overhead facility consisting of a network of poles and overhead lines. HELCo will construct and maintain the overhead electric system. Cables will be suitable for overhead applications and therefore, are tolerant of both wet and dry conditions.

- Communications. Telephone cross connect pedestals will be provided by HTCo at various locations throughout the site to permit access and telephone service to the project facilities. A new remote office will be required to serve the project. The telephone system will be an overhead facility consisting of a network of overhead lines necessary to serve the project. HTCo will provide and maintain the cables for the overhead telephone system and make all the necessary arrangements for serving each facility's telephone requirements. Cables will be suitable for overhead applications and therefore, are tolerant of both wet and dry conditions.

- Impacts and Mitigation Measures

  On-site facilities for the utility systems will have minimal impact on the environment. Noise, aesthetic considerations, safety hazards, and loading impact will be within normally applied guidelines. The on-site electrical and communication systems will be overhead facilities. Hawaii Electric Light Company and Hawaiian Telephone Company will cable and maintain the respective overhead systems.

  HELCO is requesting 30 acres of land for a new power plant. Before siting of a plant is allowed, further analysis of environmental impacts will be among the issues that have to be addressed.

  If a power plant is not sited in the area, HELCO will need land for a substation. In this case, the HELCO substation plus required HTCO facilities will result in the need for approximately 72,500 square feet (62,500 square feet for the HELCo substation and 10,000 square feet for the HTCo remote office) of developable land on the project site. The siting of these facilities will be coordinated between DHHL and the utility companies as development proceeds.

Street lights will be provided according to County standards. Both the existing electric substation and nearby telephone switching station have adequate capacity to accommodate this development.

Energy conservation and utilization of energy saving devices will be encouraged through guidelines for designers and developers as well as through homeowner information and orientation programs provided by the State.

5.8 EMERGENCY FACILITIES

5.8.1 Police Services

Police services are located in Waimea. The Waimea Police Station's service area covers 688 square miles, from Anaehoomalu to the south to Mahukona to the north. At present, the staff includes 17 patrolmen, three sargeants, one lieutenant, and one captain, with plans to increase staff by 5 additional patrol positions within the next two years. Currently, the Waimea Station averages three to four police officers per shift.

To adequately service the anticipated growth in the South Kohala, Waikoloa Village and Parker Ranch master planned developments, the Waimea Police Station would have to double in size (Captain L. Mahuna, 10/31/91). The County is currently looking at developing a new substation in Waikoloa. Further, the Kawaihae Master Plan has reserved a parcel for a police station, if required, in the future.

5.8.2 Fire Protection Services

Fire protection and emergency (ambulance) medical services are located near the Mauna Lani Hotel and Waimea. The primary fire protection service for the South Kohala district is provided by the South Kohala station, located eight to nine miles from the project site on Queen Kaahumanu Highway. This station also provides advanced life support ambulance unit services. The Waimea Fire Station includes the mauka portion of the project site in its service area.

Expanded fire protection services will be needed when the Ten-Year Master Plan is implemented and a parcel has been reserved for a fire station in the Master Plan area. However, there are no immediate plans for physical plant or staff expansion to increase fire protection service in the South Kohala district (Captain J. Chee, 10/31/91).

As the resident population increases in the project the need for additional personnel will require evaluation in the context of a county department needs assessment. In addition, the water supply system will be designed to meet fire code and fire protection standards, that include necessary fire hydrants.

5.8.3 Health Care Facilities

Health care facilities in the Kohala area are served by two state-operated hospitals, the Kohala Hospital located in Kapaau in North Kohala and the Kona Hospital in Waimea. The Kona hospital is a "full-service" health care facility. The Lucy Henriques Medical Center is a privately owned, non-profit facility and provides outpatient health services. Honokaa hospital in Honokaa may also be used for health care services. These health care facilities serving the project area require upgrading and are presently being handled by the State Department of Health and private operators.

Because the State and private parties are assisting in upgrading the health care facilities, adequate health care facilities are expected when the improvements are completed.

5.9 RECREATIONAL FACILITIES

Recreational facilities in the West Hawaii region consist of golf courses, tennis courts, hiking trails, historic sites, parks, boat harbors and launching ramps and beach parks. The majority of the golf courses and tennis courts occur at the resort developments in the region. White sand beaches situated on the arid, leeward shore are popular throughout the State. The two major public recreation areas are Hapuna Beach State Recreation Area and the Samuel M. Spencer Beach Park. Hapuna is 65 acres in size, and is the major water-oriented recreation area in the County with an exceptionally attractive and wide white sand beach. Spencer Park, near Kawaihae Harbor, has an area of approximately 13 acres and a smaller sandy beach. Both of these recreation facilities permit surfing, swimming, picnicking, skin diving, limited camping and boating. Kamehameha Park in North Kohala has a gym and swimming pool. In addition to these major areas, several other beach areas are available including the Anaehoomalu Bay at the Waikoloa Beach Resort and Puako Beach.

Other major recreational activities or sports include wild game hunting including pheasant, wild boar and Bighorn sheep. Deep sea fishing along the Kona and Kohala coasts produce world records for marlin and tuna. Horseback riding and hiking are two other activities offered in this area. A skeet and trap range opened recently in Waikoloa Village. Annual rodeos are held at Waikoloa Village.

In August 1972, Congress authorized Pu'ukohola Heiau National Historic site; the U.S. National Park Service officially opened a national park there in July 1974. This site contains two major heiaus near Kawaihae and also includes and historic house previously used by John Young, who was made a full chief by King Kamehameha, and who was governor of the Island of Hawaii from 1802 to 1812.

Hiking is available at the Pololu-Honokane Valley Reserve and the Kohala Forest Reserve. Other historic sites include the Lapakahi State Historic Park. Boat launching ramps in the area consist of the Mahukona and Puako boat ramps, and the Kawaihae boat harbor and ramp. Other recreational facilities are available in Waimea at the Waimea District Park, Waimea Playground, Thelma Parker Gym and the Waimea Elementary/Intermediate Playground.

A park associated with the school site is planned for Phase 1 of the Master Plan. The recreational requirements for Kawaihae project residents will be met.

5.10 SCHOOLS

The Honokaa and Waimea schools currently include the project site in their service areas. Assuming a total family-residential unit count of 3,500 at build-out, the proposed planned community will have the following enrollment impact on the schools:

School	Grades	Project Enrollment
Waimea Elementary	K-6	1,200
Waimea Intermediate	7-8	350
Honokaa High	9-12	430
	TOTAL	1,980

High school students from the new project would attend the existing public high school in Honokaa. The schools in the area are operating beyond their capacity and will require legislative appropriations for additional classrooms, according to the State Department of Education (DOE).

The 1,980 students projected to be generated from this planned community will require an additional 79.2 classrooms. At an average cost of $329,668 per classroom, the estimated cost of 79.2 classrooms will be $26,109,705. The developer, according to the State DOE, will be expected to contribute a fair share for the construction of needed classroom facilities (correspondence from DOE, 12/30/91).

The overall Master Plan for Kawaihae shows six school sites. A total of two new elementary schools and one junior high school are included in the 10-year Master Plan area for Kawaihae. A third elementary school will also serve mauka areas on the overall Master Plan site.

The DHHL will closely coordinate the final siting, acreage designations and facility requirements with the DOE to ensure that educational facility needs are adequately met in conjunction with the proposed planned community.

Section 6

RELATIONSHIP TO STATE AND COUNTY LAND USE PLANS, POLICIES AND CONTROLS

SECTION 6

RELATIONSHIP TO STATE AND COUNTY LAND USE PLANS, POLICIES AND CONTROLS

6.1 HAWAII STATE PLAN

The Hawaii State Plan was developed to serve as a guide for future development of the State of Hawaii in areas of population growth, economic benefits, enhancement and preservation of the physical environment, facility systems maintenance and development, and socio-cultural advancement. Guidelines have been provided in the Plan to give direction to the overall development of the State. Chapter 226, Hawaii Revised Statutes, as amended, 1986, states the following purpose of the State Plan:

> "(it) shall serve as a guide for the future long-range development of the State; identify the goals, objectives, policies, and priorities for the State of Hawaii; provide the basis for determining priorities and allocating limited resources, such as public funds, services, manpower, land, energy, water, and other resources; improve coordination of state and county plans, policies, programs, projects, and regulatory activities; and to establish a system for a plan formulation and program coordination to provide for an integration of all major state and county activities." (Chapter 226-1: Findings and Purpose, HRS)

The proposed project is generally consistent with the objectives and policies of the Hawaii State Plan. The following sections analyze relevant goals, objectives, policies and guidelines of the State Plan relative to the proposed project.

A. Section 226-5 Objectives and Policies for Population

This area is planned for the development of residential units for the native Hawaiians by the Department of Hawaiian Home Lands as authorized by the Hawaiian Homes Commission Act of 1920. And, it is in compliance with the objective of the Hawaii State Plan to guide population growth. The Kawaihae Ten-Year Master Plan will contribute to the distribution of future growth expectations of West Hawaii's South Kohala district by providing a well managed community and offering a mix of housing types and community support facilities. The plan will serve to manage population growth and encourage an increase in economic and employment opportunities.

B. Section 226-6 Objectives and Policies for the Economy in General

Development of this project will directly benefit the economy in terms of construction, commercial/retail, public institutional, and real estate opportunities. The economic objectives of increased and diversified employment opportunities and a growing and diversified economic base for Hawaii's people is complied with by developing a new, economically viable community that will increase opportunities for people to reside and work in Kawaihae. Settlement in this relatively undeveloped area will result in direct increase in the economy, because other uses will be developed to support the growing population in the area.

C. Section 226-12 Objectives and Policies for the Physical Environment - Scenic, Natural Beauty, and Historic Resources

The development takes into account the physical attributes of the land by preserving the natural drainageways as open space and maintaining the natural drainage patterns in the area. The planning process attempts to incorporate and preserve natural and archaeological resources into the development scheme. Approximately 20 acres of land focused around existing concentrations of archaeological sites will be designated as preservation areas.

The project will be designed to promote views of the surrounding Kohala Mountains to the east, and the Kohala coastline (including Kawaihae Harbor) to the west. The south slope of Haleakala Crater on Maui is visible on a clear day.

D. Section 226-13 Objectives and Policies for the Physical Environment - Land, Air and Water Quality

Air quality of the area will be impacted by traffic generated from the proposed project, industrial uses, and surrounding developements. Water quality impacts will be minimal due to implementation of an effective potable water system and drainage system.

In some areas of the project site, grading of the land will be necessary for roadways and subdivision development. This action will change some of the natural topography of the site.

E. Section 226-15 Objectives and Policies for Facility Systems - Solid and Liquid Wastes

The facilities system objectives are met by developing these residential lots in consonance with State and County plans. Wastewater generated from this project will utilize a new sewage treatment plant that will be located on the project site, south of Honokoa Gulch and approximately 4,000 feet north of the entrance to Kawaihae Small Boat Harbor.

Solid waste will be disposed of at the County's new West Hawaii Sanitary Landfill that will be located south of the project site in Puuanahulu. An area within project site will be designated for a transfer station. Reuse and recycling methods will be encouraged to minimize impacts on solid waste facilities and to conserve resources. Solar heaters will also be encouraged to conserve energy.

F. Section 226-16 Objectives and Policies for Facility Systems - Water

An exploratory well was drilled in 1990 at an elevation approximately 1,400 feet above mean sea level (msl) on the south side of Honokoa Gulch; however, the water tested as brackish. The State Department of Land and Natural Resources, Division of Water Resource Management (DWRM) has drilled another exploratory well on the north side of Honokoa Gulch at about 1,600 feet msl. Based on the results of the pumping test, the well is capable of producing potable water with a chloride content of 170 ppm at a constant rate of 130 gpm. Additional possible sources of water include development of a desalinization plant and the extension of the North Kohala system.

Preliminary indications are that the project's water system development will probably need to be achieved through all possible sources.

G. Section 226-17 Objectives and Policies for Facility Systems - Transportation

The proposed project will add to traffic volumes around the project site. Measures to mitigate the increased traffic include roadway improvements to off-site roadways and intersections.

H. Section 226-18 Objectives and Policies for Facility Systems - Energy/Telecommunications

Energy and telecommunication facilities necessary for the development of the Kawaihae Ten-Year Master Plan project will be planned and coordinated with the appropriate agencies and public utilities. Presently, HELCO and other groups have shown interest in building a power plant within the proposed industrial area. Energy conservation and the utilization of energy-saving devices will be encouraged through guidelines for designers and developers as well as through homeowner information and orientation programs provided by the State.

I. Section 226-19 Objectives and Policies for Socio-Cultural Advancement - Housing
The proposed project is designed to accommodate a variety of housing types for families whose income ranges represent the general worker population in West Hawaii. The project will be consistent with this section by offering a mix of housing types and costs to suit the needs of a large portion of the housing market. Integral planning of the overall development will provide necessary support facilities for these housing areas.

J. Section 226-20 Objectives and Policies for Socio-Cultural Advancement - Health
Medical and health care facilities are currently located in Kapaau (North Kohala), Kealakekua (South Kona), and Kamuela, with emergency serives provided by the Kohala Hospital and the Kona Hospital. There are anticipated increases of medical and health care services and facilities for West Hawaii as the development of the region continues. In the planning stages is a North Hawaii Hospital located in Kamuela. This new 50-60 bed hospital will be a joint venture project between government and private enterprise, and is planned as a full service facility. Additionally, the proposed recreational facilities, including the golf course and parks within the project vicinity will promote wellness through physical and mental health.

K. Section 226-21 Objectives and Policies for Socio-Cultural Advancement - Education

The Ten-Year Master Plan includes sites for three new elementary schools and one site for a new junior high school.

L. Section 226-23 Objectives and Policies for Socio-Cultural Advancement - Leisure

Recreational facilities will be provided within the project offering a variety of activities including parks and other community recreation centers. These facilities as well as schools provide open space within the project site.

M. Section 226-104 Population Growth and Land Resources Priority Guidelines

Development of the Kawaihae Ten Year Master Plan will result in the permanent loss of open space as it exists, however the master plan of the project is designed with open space areas including parks. The proposed urban use of the land is consistent with the State and County land use policies for this site.

Portions of the project area designated for agricultural use will not require zoning for homestead development.

N. Section 226-106 Affordable Housing, Priority Guidelines for the Provision of Affordable Housing

The primary objective of the project is to provide housing for the people of Hawaiian ancestry. The project will provide the needed housing and infrastructure requirements to allow the Hawaiian beneficiaries the opportunity to return to their land.

6.2 STATE FUNCTIONAL PLANS

The twelve State Functional Plans were adopted by the State Legislature in April 1984. These plans were formulated to specify in greater detail the policies, guidelines and priorities set forth in the Hawaii State Plan. The twelve functional plans include: Energy, Transportation, Water Resources, Historic Preservation, Health, Education, Housing, Conservation Lands, Higher Education, Agriculture and Tourism.

The project is consistent with the policies and objectives of the State Functional Plans. This project provides the needed housing and infrastructure requirements for the people of Hawaiian ancestry and returns them to their land.

6.3 STATE LAND USE LAW

The State Land Use Commission classifies the land mauka of the existing industrial area as "agriculture." The industrial development area is classified as "urban." (See Figure 6-1). Hawaiian Home Lands are exempt from land reclassification requirements for homestead development purposes.

6.4 STATE DOT'S 2010 MASTER PLAN FOR KAWAIHAE HARBOR

The 2010 Master Plan for Kawaihae Harbor, produced by the State Department of Transportation, provides a general long-range guide for the State, based on the knowledge and experience of users of the facilities and their anticipation of future trends. The Master Plan recognizes DHHL's plans for the Kawaihae project site as was described in the May 1986 plans: ". . .plans for this area include the development of residential and farm homesteads, industrial, recreational and commercial uses . . ."

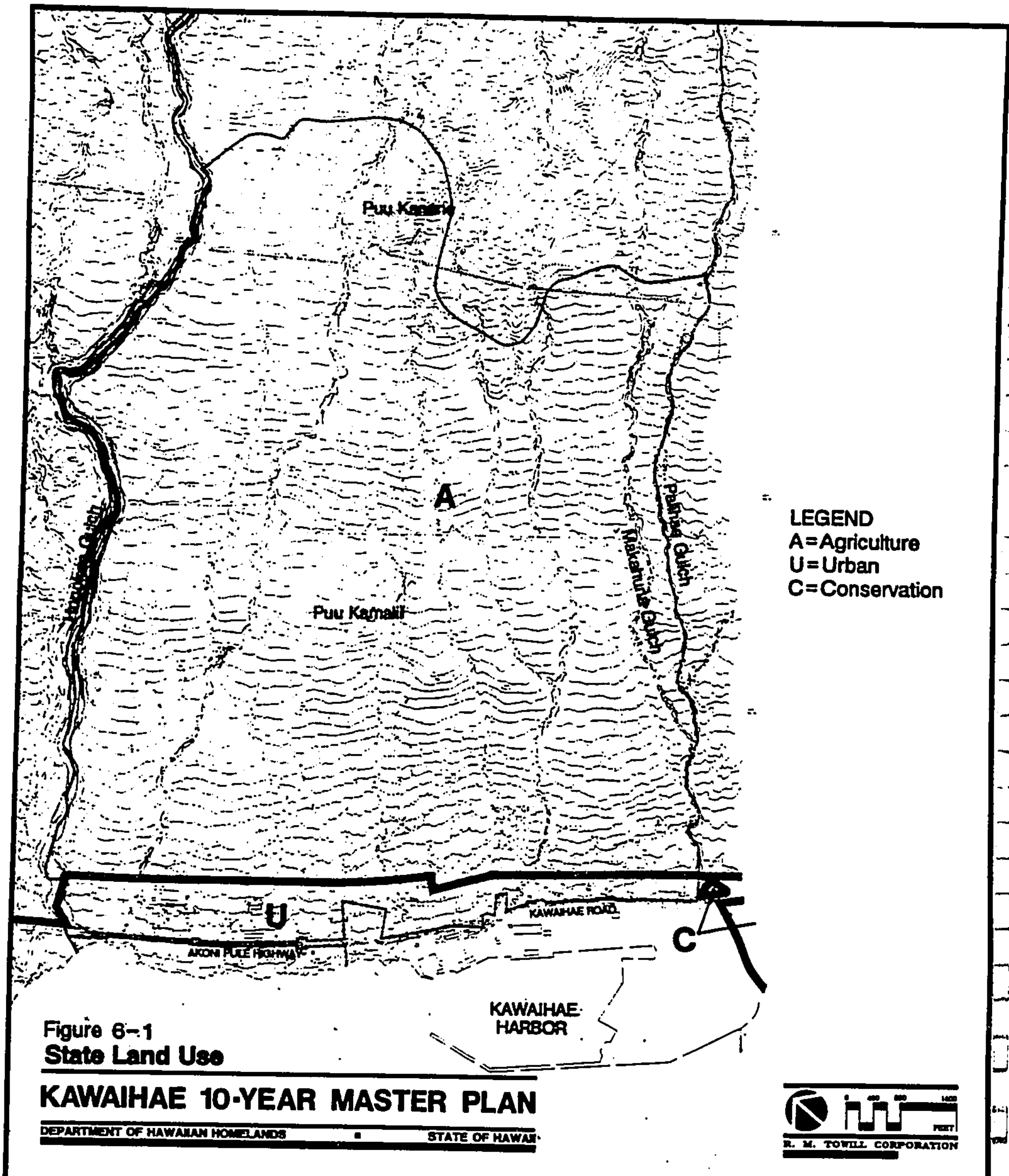


Figure 6-1
State Land Use

KAWAIHAE 10-YEAR MASTER PLAN

DEPARTMENT OF HAWAIIAN HOMELANDS • STATE OF HAWAII

Among the specific recommendations of the 2010 Master Plan for Kawaihae Harbor are to, "Work closely with DHHL to investigate and determine the need for and use of commercial and industrial zoned land adjacent to the harbor to support the maritime-related land requirements."

There will be close coordination between DHHL and DOT in the planning for the proposed industrial land uses within the project area to assure maximum economic benefit and minimal disruption to the existing infrastructure systems in the vicinity.

6.5 WEST HAWAII REGIONAL PLAN

The West Hawaii Regional Plan includes the districts of North Kohala, South Kohala and North Kona. The goals of the state's plan are:

* to coordinate State activities in the region in order to respond more effectively to emerging needs and critical problems;
* to address areas of State concern;
* to coordinate the Capitol Improvements Program within a regional planning framework;
* to provide guidance in State land use decision-making processes.

The West Hawaii Regional Plan relates to the project in the following ways:

* Indicates the development of a government-assisted support community at Kawaihae.
* Indicates the development of secondary support community at Waimea.
* Identifies the location and timing for development of new schools that may

include: Waimea-South Kohala High School, Waimea Intermediate School, Kawaihae Elementary School (K-6).

* Supports DHHL plan for maritime-related activities in the back-up lands at Kawaihae.
* Discourages the use of cesspools. Whenever possible the OSP, DOH, and the County should require the use of regional wastewater treatment systems as a pre-requisite to developing an urban area.

The Kawaihae Master Plan implements the recommendations of the West Hawaii Regional Plan by establishing a plan that will be used to: implement DHHL programs; assess in a comprehensive manner, the land requirements of State agencies and other users of State lands; evaluate the short-term and long-term impacts of a particular use; and introduce predictability to the land disposition process.

6.6 KAWAIHAE DEVELOPMENT PLAN

This project is one of the first developments to implement the Kawaihae Development Plan by providing urban expansion on the Kawaihae Ahupuaa. This Ten-Year Master Plan will be one of the first steps toward achieving the goals of the Kawaihae Development Plan.

6.7 STATE DOT WAIMEA-KAWAIHAE BY-PASS ROAD PLAN

This 1976 Plan focuses on the new highway system parallel and south of the existing Kawaihae-Waimea Road connection. The goals of the plan are to:

* Improve traffic safety in this geographic region;
* Improve service to Kawaihae Harbor;
* Improve general service to the area.

The DOT plan addresses the need for a public roadway facility that would meet the anticipated growth of the Kawaihae area and future developments that cumulatively will generate increased traffic flow between Waimea and Kawaihae. The proposed project bypass road alignment fulfills the above goals of the DOT plan. The only difference between the project alignment and the DOT plan alignment is that in the project area, the bypass road is located at a higher elevation than the State DOT's proposed alignment. The higher alignment was selected for two primary reasons: (1) to create a larger consolidated area for industrial use by using the bypass road as a land use separator between industrial and residential uses, and (2) to avoid most of the area which contains a high concentrations of archaeological sites, particularly burial sites, many of which fall within the DOT alignment.

The State DOT has indicated that the timeframe in which the construction of the bypass road and upgrading of Queen Kaahumanu Highway to freeway standards are going to occur will be outside the anticipated construction period of the proposed Ten-Year Master Plan. The DOT is expecting West Hawaii developers to help pay for the proposed transportation improvements.

6.8 U. S. NATIONAL PARK SERVICE

As discussed earlier in this EIS, the U. S. National Park Service established the Puukohola Heiau as a national historic site, and in 1988 issued a "Development and Concept Plan" in this regard. The goals and objectives of this concept plan were:

* To protect the park's primary resources, Puukohola heiau, Mailekini heiau, and the John Young homestead as part of the re-establishment of the historic scene.

* To provide historic interpretation of the primary resources to visitors at the most effective sites.

* To relocate administrative and maintenance facilities to sites that would have a minimum effect on the historic integrity of the park.

The Ten-Year Master Plan's harbor-related industrial development may result in adverse view intrusions on the park's historic scene. To mitigate this impact, the use of earth tone colors, appropriate landscaping, height limits and grading techniques will be utilized. Relocation of the proposed bypass road is partly due to the need to minimize the potentially adverse impacts the facility would have on the park.

6.9 HAWAII COUNTY GENERAL PLAN

According to the Hawaii County General Plan the project area lies within the "extensive agriculture," "Industrial," "Medium Density Urban," and "Urban Expansion" designations. Except for the extensive agriculture designated areas, the proposed development plans are consistent with the industrial, medium density urban development and urban expansion designations.

The proposed project is consistent with the South Kohala economic, housing, industrial and single family residential "Courses of Action" as outlined in the County General Plan. These "Course of Actions" are listed below:

- The County shall work closely with the State in providing adequate land close to Kawaihae Harbor for industrial activities. (Economic)
- Aid and encourage the development of State lands in this area for housing for all socio-economic levels through leasehold or purchase. (Housing)

- Aid and encourage the development of a wide variety of housing for this area to attain a diversity of socio-economic housing mix. (Housing)
- The County shall encourage the development of a regional industrial park at Kawaihae and centralize limited industrial activities in Waimea. (Industrial)
- Encourage the development of appropriately located and serviced State-owned, Hawaiian Home Lands and privately held lands for house lots. (Single-family Residential)

6.10 COUNTY ZONING

The County zoning designations for the area are "agriculture," "general industrial," and "commercial village," see Figure 6-2. Residential areas are exempt from the County zoning process. However, proposed commercial and industrial land uses will require rezoning requests to the County Planning Department.

6.11 NORTHWEST HAWAII OPEN SPACE AND DEVELOPMENT PLAN (In Progress)

This County of Hawaii Planning Department plan is in its preliminary planning stages. The scope of the plan includes the need to reconcile the competing issues of the use of the DHHL Kawaihae property for the purpose of fulfilling critically needed affordable housing for people of Hawaiian ancestry versus the need to maintain open space in this North Kohala-South Kohala region.

The DHHL and County of Hawaii will closely coordinate their planning efforts to maintain consistent and optimal set of policies for the future of this geographic area.

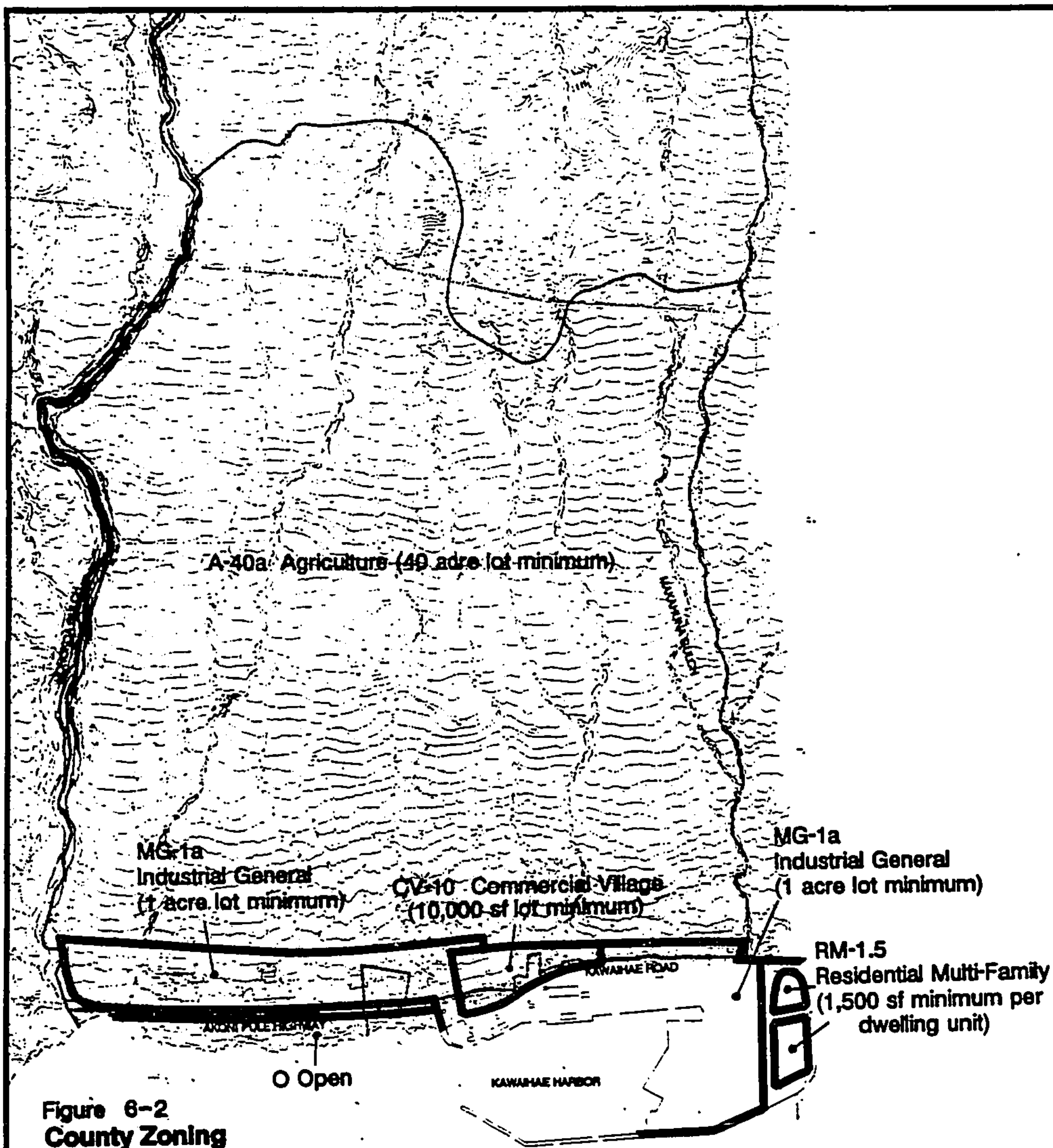


Figure 6-2
County Zoning

KAWAIHAE 10-YEAR MASTER PLAN

DEPARTMENT OF HAWAIIAN HOMELANDS ■ STATE OF HAWAII

R. M. TOWILL CORPORATION

Section 7

ALTERNATIVES

SECTION 7
ALTERNATIVES

The alternatives considered for this evaluation include the "no project" alternative, land use and development concept alternatives, residential densities, and the Kawaihae Bypass alignment location options.

7.1 NO ACTION

The "no action" alternative would result in continuation of existing conditions for the DHHL project site. This site would most likely continue in its undeveloped condition, with some unplanned but inevitable makai industrial area expansion as the Kawaihae Harbor grows.

Advantages of the "no action" alternative are few. These advantages include: no further expenditures of resources by public and private agencies; continued non-use of most of the site; and no adverse impacts on the project site generated by development.

The primary disadvantage of the no-project alternative is that the Department of Hawaiian Home Lands will not be able to fulfill its primary mission of providing affordable housing to native Hawaiian beneficiaries. Without the project the proposed mix of affordable housing opportunities to suit Hawaiian families of various income groups would not be provided. Additionally, losses resulting from this alternative would include lost housing and employment opportunities, as well as lost tax revenues for County and State governments.

7.2 DEVELOPMENT PROGRAM OPTIONS

Following the analysis of the site conditions and development opportunities and constraints, numerous studies were done to investigate the various development options that were feasible given the existing conditions. An initial environmental concept was generated to help define general areas with similar environmental conditions where associated development could occur. This concept revealed that the more developable areas are located on moderately sloping land at the lower elevations as well as along the Kohala Mountain Road. Once this was completed, two preliminary concept studies were developed using varying residential densities to begin to identify basic land use patterns. These concepts were designated "Density Study A," lower density residential development and "Density Study B," higher density residential development. Each of these studies are explained below.

7.2.1 Low Density Residential Development (Density Study A)

Figure 7-1 depicts Density Study A. The primary objective of this study was to determine the range of number of units that could be accommodated based upon established unit densities. Study A placed smaller single family residential development to the lower elevations on moderately sloped areas and maximized the acreage designated for larger residential agricultural lots. A high and low density range of residential dwelling units per acre was established. Based on 2,000 acres for single family, 200 acres for multi-family and 2,455 acres for agricultural lots, a total of 14,380 dwelling units were computed for the assumed high density condition and 5,294 for low density conditions. Additionally, this study illustrated a proposed bypass road with a town center located between it and the existing coastal highway (Akoni Pule Highway). Also shown is industrial use adjacent to Kawaihae Harbor. This large area was designated for industrial use in response to the anticipated need for more land to support the future development and growth of Kawaihae Harbor.

7.2.2 High Density Residential Development (Density Study B)

Density Study B attempted to maximize the number of residential units by increasing the amount of land designated for single family and multi-family dwellings, see Figure 7-2. Acreages were raised to 3,025 acres for single family and 300 acres for multi-family while

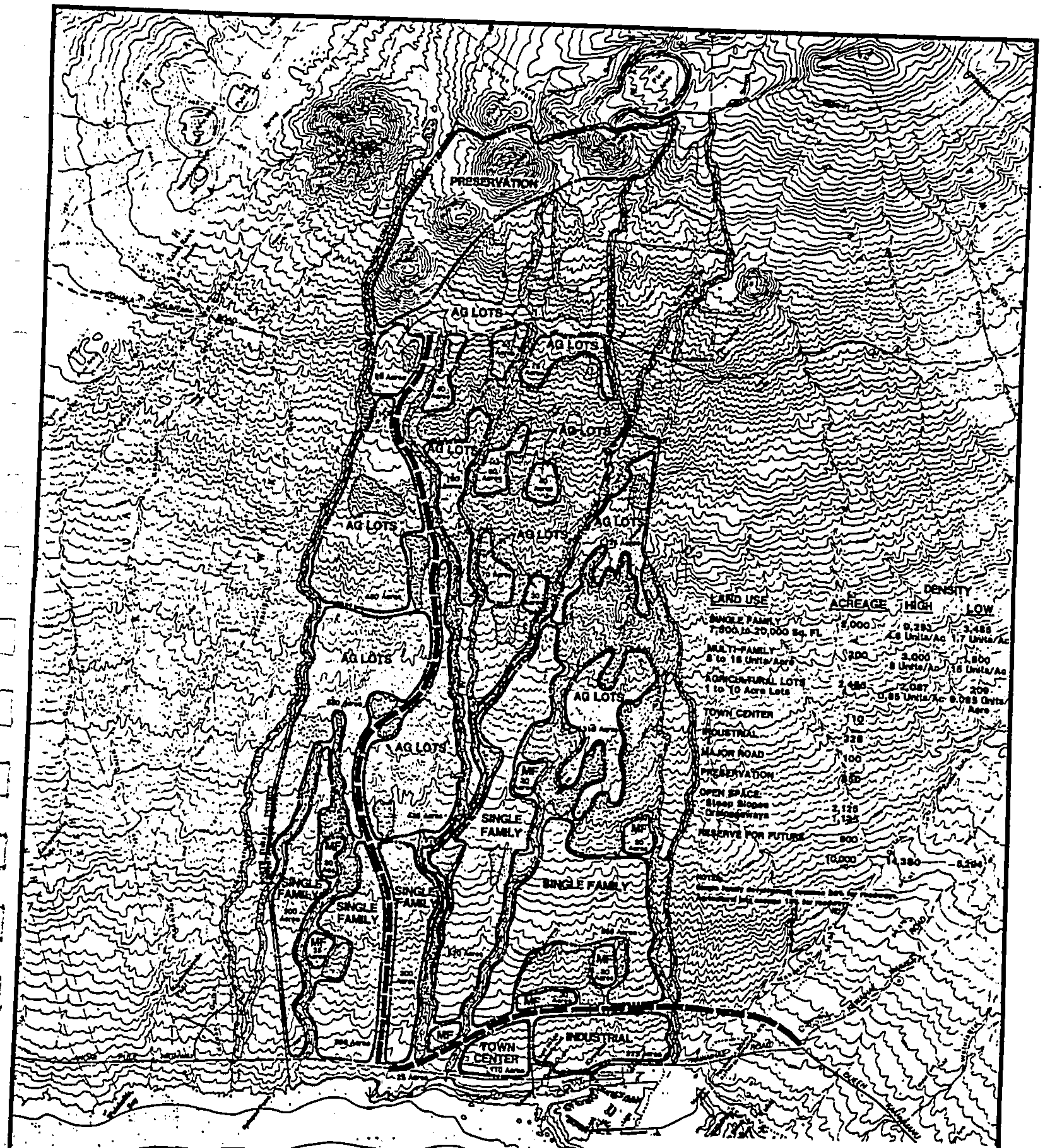
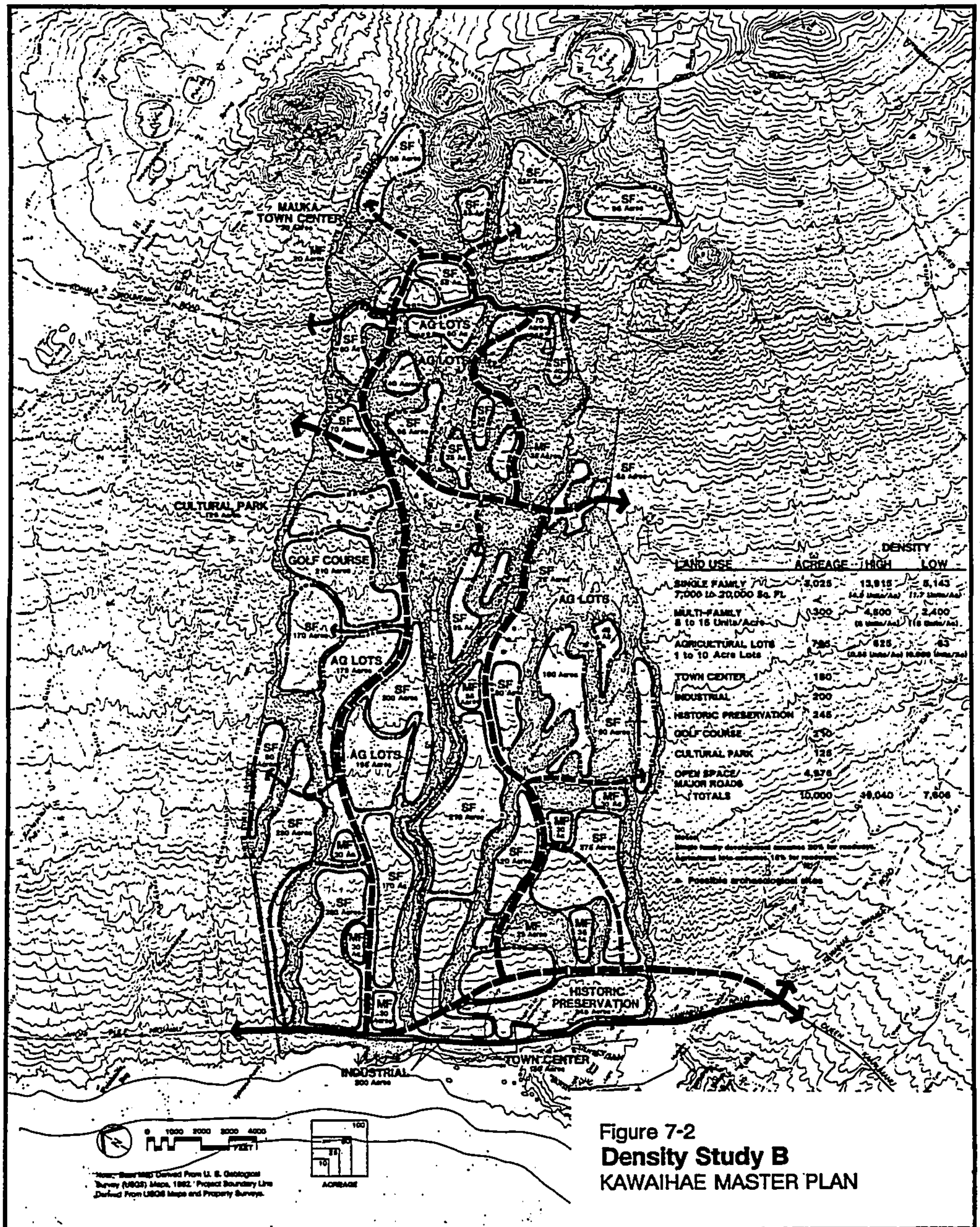


Figure 7-1
Density Study A
KAWAIHAE MASTER PLAN



LAND USE	ACREAGE	DENSITY HIGH	DENSITY LOW
SINGLE FAMILY 7,000 to 20,000 Sq. Ft.	3,025	13,915 (4.6 Units/Ac)	5,143 (1.7 Units/Ac)
MULTI-FAMILY 8 to 15 Units/Acre	300	4,500 (15 Units/Ac)	2,400 (8 Units/Ac)
AGRICULTURAL LOTS 1 to 10 Acre Lots	795	625	63
TOWN CENTER	150		
INDUSTRIAL	200		
HISTORIC PRESERVATION	245		
GOLF COURSE	210		
CULTURAL PARK	125		
OPEN SPACE/ MAJOR ROADS	4,975		
TOTALS	10,000	19,040	7,606

Figure 7-2
Density Study B
KAWAIHAE MASTER PLAN

Page 7-4

lowering agricultural lots to 735 acres. This increased the total unit counts to 19,040 dwelling units for high density conditions and to 7,606 for low density conditions. Other development possibilities depicted on this study included:

- A secondary residential center focused on the Kohala Mountain Road with a related "mauka" town center.
- Two mauka/makai roads linking the lower and upper portions of the project together. Also a mid-elevation north/south road that could possibly provide access to adjacent lands.
- A cultural park and golf course that could provide recreational amenities to the project as well as possible income sources.
- A preservation zone would cover the area where high concentrations of archaeological sites have been found.
- A major town center along a proposed bypass road and an expanded industrial area.

7.3 ALTERNATIVE DEVELOPMENT CONCEPTS

Following the study of development program options, a Draft Concept Plan was developed combining elements of both Density Studies with emerging ideas on development theme, development alternatives and program financing. Figure 7-3 represents the coalescence of initial development options and ideas into a draft plan that portrays the possible long-range development of Kawaihae lands. In the formulation of this initial framework for development, an in-depth analysis of development alternatives was conducted to define a viable approach toward achieving the goals and objectives of the master plan. The following paragraphs will briefly describe the various alternatives considered in shaping the Concept Plan as the basis for the formation of the Kawaihae Long-Range Development Plan and 10-Year Plan.

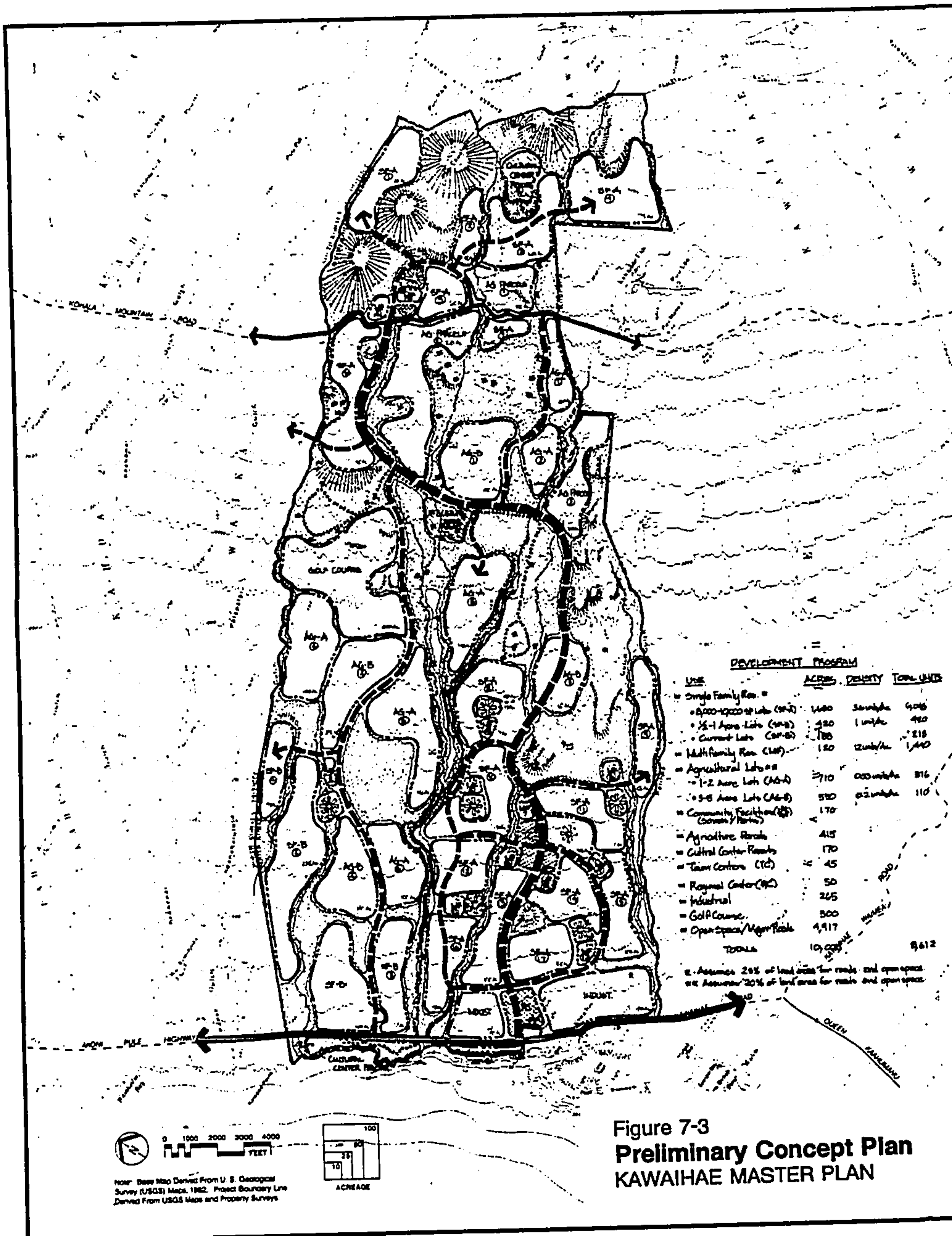


Figure 7-3
Preliminary Concept Plan
KAWAIHAE MASTER PLAN

7.3.1 Single Makai Town Center

An alternative considered early in the planning process was the development of a single town center in the makai portion of the Kawaihae ahupua'a, along the coastal highway. The rationale for this approach was to concentrate development adjacent to existing facilities on terrain most compatible with development. The assumption was that the "mauka" lands, although more hospitable climate wise, were less desirable for development of a major town center due to more complicated terrain conditions and long distances from support facilities and employment centers. Additionally, the number of lots that could be developed in the surrounding area would be limited by the terrain and would entail more costly infrastructure development. The major drawback of a single makai town center is that there would not be adequate commercial or community support facilities that would service other portions of the site, in particular the mauka portion.

7.3.2 Mauka/Makai Communities

In analyzing the physical features of the project site, it became apparent that there were conditions that encouraged the creation of two development centers, one expanding from the existing Kawaihae community and the other along the Kohala Mountain Road. The primary reason for the mauka/makai communities concept stemmed from topographic conditions that presented significant development constraints throughout much of the Kawaihae master plan area. relatively steep and irregular terrain over much of the mid to upper elevations greatly restrict the development flexibilities in those areas. Generally, lands below the 1,200 foot elevation and some areas along the Kohala Mountain Road are the most compatible for higher density development as slopes are more moderate and lands are not severely dissected by natural drainageways. Thus, these two areas were chosen as development centers where higher density residential and related land use activities should occur. The makai portion of the master plan area although climatically very hot and dry, has terrain conditions that are the most suitable for higher density development.

7.3.3 Makai Area Development Options

A key element to making the Kawaihae Master Plan a viable endeavor is the ability to finance the development costs. In the process of shaping the development concept, the issue of the economic feasibility had a major impact on determining the type and location of land use activities. Several land use alternative studies were developed and reviewed with Hawaiian Home Land planners to incorporate the income generating uses into the Master Plan. Of the various income generating activities that present opportunities for application in the Kawaihae Master Plan, the development of industrial/business uses and a golf course offered the most viable alternatives. As the need for introducing income generating activities as early as possible into the development is apparent, it was evident that these alternatives should be incorporated into the development of the makai portion of the master plan site, close to existing infrastructure. An analysis matrix, Table 7-1, was developed to examine the consequences these alternatives would have in being sited in the makai portion of the master plan area. Each of the alternatives are briefly summarized below:

Industrial/Business - There currently exists a significant demand for industrial/business development at Kawaihae, enough to occupy 200-300 acres of land. With this demand and the projected growth of Kawaihae Harbor, it would be desirable to consolidate and concentrate industrial/business in the makai area, adjacent to Kawaihae Harbor. The major drawback for siting industrial/business activities in makai area is the negative visual impact. However, this can be partially mitigated through the use of landscaped buffers, site layout and facilities design criteria (i.e. building materials, height limitations, color schemes, etc.) intended to blend the activities with the surrounding environment.

TABLE 7-1

KAWAIHAE MASTER PLAN

MAKAI AREA LAND USE ANALYSIS MATRIX

CRITERIA	INDUSTRIAL	GOLF COURSE	INDUSTRIAL/GOLF COURSE
Terrain - Slopes	* Slope conditions limit usable land	* Adaptable to most conditions	* Some limitations on development
Drainage	* Increases drainage requirement	* Can be used for drainage control	* Increases requirement, but provides control
Visual Impact	* Undesirable views from adjacent areas (Pu'ukohola, resort and residential areas)	* Desirable open space/project identity	* Both desirable/undesirable
Access	* Highway by-pass to separate uses	* No by-pass required, direct highway access desirable	* Highway by-pass recommended
Archaeology	* Conflict with existing sites * Development will be fragmented	* Preservation of sites can be incorporated into design	* Conflicts with industrial development * Golf course will allow better preservation of some sites
Income - Timing/Phasing	* Long-term income from lease rent * A number of years to build out and lease out	* Potential "up-front" lease premium * Interest from lease premium and on-going membership fees	* Industrial lease rent and golf course fees
Regional Considerations	* Regional Harbor in need of support uses	* Creates additional recreational resource * Competing with other golf courses, including resorts	* Offers limited development of an industrial center * Adds a recreational resource
DHHL Mission Compatibility	* Negative land use element, but provides employment and revenues opportunities	* Reduces residential land, potential income source	* Reduces land available for housing * Provides employment and business opportunities
Harbor Master Plan Compatibility	* Land use is compatible with harbor * Provides support uses	* Restricts harbor expansion	* Allows some expansion for harbor related activities
Waste Water Disposal	* Activity generates additional requirement	* Offers method of effluent disposal	* Adds to disposal requirement, but will also offer effluent disposal

By R. M. Towill Corporation

Golf Course - The most important consideration for this option is whether or not a golf course should be built on Hawaiian Home Lands. It is obvious that a golf course could provide opportunities for income generation to help finance the project; however, there is concern over the acceptability of this non-traditional use of Hawaiian Home Lands. With the assumption that building a golf course for the purposes of income generation is acceptable, one of the more significant benefits of siting a golf course in the makai portion of the master plan area is the positive visual impact. It will provide an attractive community entry feature and compliment nearby historic sites. Also, the preservation of archaeological and burial sites could be accommodated easier in a golf course design. However, a major liability to this alternative is it will restrict the planned future growth of Kawaihae Harbor and complicate the fulfillment of industrial/business land use demands. Either the industrial/business use demands will not be provided for or these activities will be forced to be located further up-slope, potentially fragmenting land uses and increasing the negative visual impact from surrounding areas. Another significant drawback would be the use of the limited amount of lands where the terrain is compatible for building structures. The large area needed for a golf course will also reduce the amount of land that would be available for residential use. In addition, there are concerns regarding the number of competing golf courses along the West Hawaii coast and how they would affect the feasibility of building one on Hawaiian Home Lands.

Industrial/Business/Golf Course - Developing both industrial/business and golf course uses in the makai area will require a larger land area. It will offer opportunities to create a positive visual impact while accommodating some of the industrial/business use demand. However, as with the golf course option, either the industrial/business demand will not be fully provided for or if provided, will be forced to located elsewhere, fragmenting the land use and expanding visually undesirable uses further upslope. Additionally, the requirement for a larger area for these activities will reduce the amount of land available for residential development on terrain best suited for residential uses.

7.3.4 Makai Area Preservation

Consideration was given to preserving most of the lands in the makai area because of the large number of archaeological sites located there. Although this would be the most ideal option from the standpoint of minimizing the impact on the area, it would have a severe negative impact on the overall project. Much needed lands for industrial/business uses would either not be provided for or be forced to be located further upslope. Locating industrial uses too far upslope would negate the advantage of the parcel's proximity to the harbor, specifically, pipelines for off-loading barges directly to storage areas would not be feasible. An extensive archaeological survey of the area did reveal that with the exception of some scattered concentrations of burials, some sites needing further data recovery and a few representative examples of structures, most of the archaeological sites do not warrant preservation.

7.3.5 Bypass Road Options

With the implementation of the Master Plan will come the need for improving access to the area. In responding to this need, three options for improving access to the project area were examined. These options included utilizing Kawaihae Road, building a bypass road following the proposed State Department of Transportation's alignment or building a bypass road with a higher alignment. The following paragraphs discuss each of the options.

No Bypass - This option would not require use of public capital expenditures for building a new access road; however, with the proposed project and projected growth in the region, upgrade of Kawaihae Road would be necessary. Based on traffic projections, Kawaihae Road would have to be widened by two lanes. This presents a problem as the existing right-of-way is only 60' wide and there is no room for further widening without encroaching upon existing development and private property. In addition, with the expansion of industrial activities around Kawaihae Harbor, Kawaihae Road would be routing project traffic through a major industrial area. This would be undesirable from the aesthetics standpoint as well as for circulation. It would also conflict with U. S. Department of the Interior, National Park Service's future plans to consolidate the Pu'ukohola Heiau National Historic Site to encompass the John Young residence which is located on the opposite side of Kawaihae Road.

Low Bypass Alignment (DOT Alignment) - Based on alignment studies done in the mid-1970's, the State Department of Transportation had adopted a Kawaihae Road realignment route which moved the road approximately 500' mauka of the existing road. This alignment merged back into Akoni Pule Highway about 1,000' north of the Highways' intersection with Kawaihae Road. The benefits of this alignment is that it routes traffic around the existing development, eliminates the awkward Akoni Pule Highway and Kawaihae Road intersection, and allows implementation of the National Park Service plan to consolidate the adjacent historic graves. The primary problem with this alignment is that the corridor goes directly through numerous burial sites, including one which is of recent history and contains a number of sites. Also, the lower alignment leaves little room for harbor related industrial use growth without having future industrial expansion extending beyond the new alignment. This would result in the main project traffic being routed through an industrial area and would divide the industrial land use.

High Bypass Alignment - This option routes the bypass road approximately 1,500' to 1,800' mauka of Kawaihae Road and ties back into Akoni Pule Highway about 2,400' north of the highway's intersection with Kawaihae Road. It allows for a significantly larger area for establishing a consolidated industrial/business use area, adjacent to the Kawaihae Harbor. The higher alignment will route traffic around the main concentration of industrial and harbor related activities and serve as a buffer between those uses and the residential development. Additionally, this alignment is routed to avoid the main concentration of burials and other archaeological features, and will allow the consolidation of the historic sites as planned by the National Parks Service.

Irreversible/Irretrievable Commitments - SECTION 8
Unresolved Issues - SECTION 9
Consulted Parties - SECTION 10
Comments on EIS Preparation Notice - SECTION 11
Comments on Draft EIS - SECTION 12

SECTION 8
IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS

The proposed development will require an irretrievable and irreversible commitment of a number of resources for its completion. These resources will include capital, materials, manpower and energy. Financial, material and manpower resources will be irretrievably committed to the planning, design and construction of the improvements. Energy and water are other valuable resources that will be required for the completion and operation of the project.

SECTION 9
UNRESOLVED ISSUES

The concerns that are yet to be resolved are: (1) The question of whether the project will be able to secure the necessary potable water source for implementation; (2) economic feasibility of a unique development wherein the objective is to establish a means for financially supporting the development as much of the development costs cannot be passed on to the potential residents without diminishing affordability; (3) the actual implementation and timing of the proposed State Kawaihae Bypass Road as the public facility is necessary for development of the Ten-Year master Plan to occur; and (4) the feasibility of relocating burials into designated preserve areas.

1. Water Source

A major concern in pursuing the development of Kawaihae is establishing water sources to support the proposed development. At present there is no water source that has been dedicated to the project. An exploratory well drilled in early 1990 yielded brackish water, thus leaving the project without a potable water source. Another well, located at the 1,600-foot elevation north of Honokoa Gulch and close to the adjacent Kohala Ranch residential subdivision was test drilled. The results indicate that the well is capable of producing potable water with a chloride content of 170 ppm at a constant rate of 130 gpm. Other possible sources that are being pursued include desalinization of brackish water and importing water via pipeline from wells located in North Kohala.

The issue of securing necessary water sources is critical to making the master plan a viable one. Resolution of this issue will have a direct impact on if and when the master plan can be implemented.

2. Economic Feasibility

The primary objective of the Kawaihae Master Plan is to develop lands that can be made available to the Hawaiian people for building residences at truly affordable cost. A major concern in trying to fulfill this objective is the establishment of a means for financially supporting the development. As much of the development costs cannot be passed onto the potential residents without diminishing affordability, other income generating uses must be established to make the plan economically feasible. Several uses have thus far been identified as having potential for generating income to help support the implementation of the plan. These are: an expanded industrial park, a regional commercial/business center, a cultural learning center and resort, a golf course, and development of market residential units. Revenue generating activities are also directly linked to job creation -- without a job the individual homestead lessee could not afford a house of any price.

The expansion of the existing industrial area is viewed as almost essential as future plans call for expanding and improving the facilities at Kawaihae Harbor. With the growth of the harbor there will be a need for land to provide more space for harbor related activities. The development of industrial facilities on Hawaiian Home Lands provides an opportunity to cooperatively support the desired growth of the harbor and generate income to help subsidize development costs. In addition, increased industrial activities will help to expand the economic base for the area. There are early indications of great interest on the part of industrial businesses desiring space in the vicinity of Kawaihae Harbor.

In conjunction with the future harbor expansion and related industrial development, the development of a regional commercial/business center would be consistent with an emerging view that Kawaihae will evolve into a regional center. As with the interest in industrial development, a regional commercial/business center will provide income to support development costs and also provide employment opportunities.

The extensive archaeological resources that are present at Kawaihae present an opportunity to develop a cultural resource that would have educational value and provide the basis for a development theme. However, capitalizing on the resources to produce income will be dependent upon the ability to draw interest on the concept. One method of capturing interest is the development of a resort as an adjunct to a cultural learning center activity. The idea of using Hawaiian Homes Lands for developing a cultural resource may be acceptable; however, the introduction of a resort may not. Whether or not this concept is pursued will depend upon the feasibility of establishing and maintaining the cultural centers such that income will be produced.

Two other means of generating income include the use of lands for the development of a golf course and market residential lots. The viability of these approaches will depend on whether or not the use of the lands for these purposes is deemed acceptable.

The success of the Master Plan will rely heavily upon how it is implemented. Because of the large initial costs involved in developing support infrastructure, the initial development phases should be located as close as possible to the existing, though somewhat minimal, infrastructure systems adjacent to the site. Although the primary objective of the master plan is to provide residences, income generating activities will need to be developed in tandem, early-on to assure an inflow of revenues to support continued development costs. The economic feasibility of implementing the Master Plan will be highly dependent upon what income generating activities are developed and when. Involvement of private developers to "foot" some of the early infrastructure development costs is an option that warrants serious consideration. Without the support of income generating uses, implementing of the Master Plan will be difficult.

3. <u>Timing of the DOT Kawaihae Bypass Road</u>

The Traffic Impact Study indicates the need for the implementation of an acceptable Kawaihae Bypass alignment prior to completion of the Ten-Year Master Plan project development. It is still not certain as to whether such a requirement will be fulfilled prior to construction of the project.

4. <u>Archaeological Resources</u>

Archaeological studies of project area show that the southern portion has an abundance of archaeological sites. Although many of the sites may not require preservation once data recovery is completed, there are a significant number of burial sites scattered in the area which may pose significant constraints to development. The project proposes to preserve some of the areas where concentrations of burials are located and relocate the fewer scattered burials into those areas. The issue of allowing relocation of some of the burials to consolidate them in areas to be preserved needs to be resolved as it will have a significant impact on development.

SECTION 10
CONSULTED PARTIES

FEDERAL

U.S. Army Corps of Engineers

Mr. Ernest Kosaka
U.S. Department of the Interior

Mr. Richard N. Duncan, State Conservationist
U.S. Department of Agriculture

Mr. Gordan Y. Furutani, Area Manager
Department of Housing and Urban Development

U. S. Postmaster

STATE

Dr. John C. Lewin, Director
Department of Health

Mr. William W. Paty, Chairperson
Department of Land and Natural Resources

Mr. Murray Towill, Director
Department of Business and Economic Development & Tourism

Mr. Harold S. Masumoto, Director
Office of State Planning

Mr. Rex Johnson, Director
Department of Transportation

Dr. John Harrison, Environmental Coordinator
Environmental Center
University of Hawaii

Mr. Brian J. J. Choy, Director
Office of Environmental Quality Control

Mr. Yukio Kitagawa, Chairperson
Department of Agriculture

Mr. Charles T. Toguchi, Superintendent
Department of Education

Mr. Joseph Conant, Executive Director
Housing Finance and Development Corporation

Mr. Mitsuo Shito, Executive Director
Hawaii Housing Authority

Mrs. Winona Rubin, Director
Department of Human Services

Mr. Renton Nip, Chair
State Land Use Commission

MG Edward Richardson, Adjutant General
Department of Defense

Mr. Russel Nagata, Comptroller
Department of Accounting and General Services

COUNTY

Mr. H. William Sewake, Director
Department of Water Supply

Mr. Norman Hayashi, Director
Planning Department

Mr. Bruce McClure, Chief Engineer
Department of Public Works

Director
Department of Parks

Chief
County Fire Department

Chief
County Police Department

Director
Department of Finance

Mr. Harry Kim, Director
Civil Defense Department

Director
Research & Development

OTHERS

Mr. Thomas Rohr
Kohala Coast Resort Association

Mr. Ken Melrose
Waikoloa Land Company

President
Queen Emma Foundation

Noelani Whittington, Executive Director
Kohala Coast Resort Association

Henry A. Ross

Citizens for Protection of the North Kohala Coastline
c/o Toni Withington
Hawi, Hawaii

Kawaihae Boating Association
c/o Toni Withington
Hawi, Hawaii

Carolyn Pomeroy

Waimana Enterprises, Inc.

Mr. Ben Noeau, President
Kawaihae Homesteaders Association

Mr. Harry Otsuji, Project Manager
Kohala Ranch

Mr. Bill Graham, President
Kohala Community Association

CITIZENS FOR PROTECTION OF THE NORTH KOHALA COASTLINE

P.O. Box 76, Hawi Hawaii 96719 (808) 889-6737

July 17, 1991

RECD JUL 22 1991

Mr. Stephen Kellogg
R. M. Towill Corporation
420 Waiakamilo Road #411
Honolulu, HI 96817

Dear Mr. Kellogg,

We noticed in the OEQC Bulletin that you are starting the draft EIS process for the Kawaihae Ten Year Master Plan. This must mean the plan is far enough along to assess the impacts. We would like to see a copy of the plan, as development of the Kawaihae area will have a major impact on North Kohala and our coastal areas.

Our group consists of 282 families primarily in the North and South Kohala area with a strong interest in preserving the special values of our coastline. I am including our Statement of Purpose.

We would appreciate the opportunity to participate in any way in the preparation of the EIS.

Mahalo,

Toni Withington

Toni Withinton
Chairman, Steering Committee

Steering Committee: Clyde Sproat, Cheryl Sproat, Toni Withington, Elsworth Emeliano, JoanEllen McFee, Sandy Gray

CITIZENS FOR PROTECTION OF THE NORTH KOHALA COASTLINE

P.O. Box 76, Hawi Hawaii 96719 (808) 889-6737

STATEMENT OF PURPOSE

We support an open coast in North Kohala. We are working toward state and/or county shoreline protection which would:

- Preserve and protect the many archaeological and historic sites along the coast,
- Maintain traditional access trails and roads,
- Protect the delicate balance of nature between the land and ocean environments,
- Preserve the spectacular open views of and and from the coastline,
- Prevent exclusive and obtrusive development of this valuable natural resource.

We support the State Legislature and the County Council members who have called for protection of this coastline, and we are working on a bill for the next legislative session which will provide the tools at both levels to accomplish this.

In addition, we are gathering and cataloguing whatever studies, reports, and data we can find relating to our district, and identifiying traditional and current trails in the coastal area. Bringing this information to community groups and young people will receive increasing emphasis in our activities this year.

Until a plan for permanent protection of the coast is in place, we call upon the State and County to adopt interim measures which will maintain the integrity of this resource. We also ask for a program whereby the State or an appropriate nonprofit land trust will be designated to acquire property or development rights from willing sellers and donors.

The fate of Hawaii's only remaining open, easily accessible, scenic and historic coastline is in our hands. We want to enjoy it and pass it on to others to enjoy.

Steering Committee: Clyde Sproat, Cheryl Sproat, Toni Withington, Elsworth Emeliano, Frank Johnson, Sandy Gray

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

HOALIKU L. DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

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

August 21, 1991

Ms. Toni Withington
Citizens for Protection of the North Kohala Coastline
P. O. Box 76
Hawi, HI 96719

Dear Ms. Withington:

Kawaihae Ten-Year Master Plan Environmental
Impact Statement Preparation Notice (EISPN)

We are in receipt of your letter dated July 17, 1991 regarding the preparation of an Environmental Impact Statement for the subject project.

In response to your request to be a consulted party in the EIS process, you will be receiving a copy of the Draft EIS upon publication. Thank you for your interest and participation in the planning process of this important project.

Warmest Aloha,

Hoaliku Drake
Chairman
Hawaiian Homes Commission

cc: OEQC, B. Choy
R. M. Towill Corp., C. Sakoda

RECD JUL 22 1991

July 18, 1991

Stephen Kellogg
R. M. Towill Corp.
420 Waiakamilo Road, #411
Honolulu, HI 96817

Dear Mr. Kellogg,

I noticed in the OEQC Bulletin that there is a Ten Year Master Plan being prepared by the Dept of Hawaiian Home Lands for the Kawaihae area of South Kohala. We are sure that there will be impact on the small established communities in North Kohala. I trust that the EIS document being prepared will address those impacts in depth.

Could you please make a copy of the Draft EIS available to our association for review? Thank you.

Kohala Community Association
Bill Graham, president
Box 608
Kapaau, HI 96755

Bill Graham

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

HOALIKU L. DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

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

August 21, 1991

Kohala Community Association
Mr. Bill Graham, President
Box 608
Kapaau, HI 96755

Dear Mr. Graham:

Kawaihae Ten-Year Master Plan Environmental
Impact Statement Preparation Notice (EISPN)

We are in receipt of your letter of July 18, 1991 in which you requested to be a consulted party in the EIS process.

In response to your request, you will be receiving a copy of the Draft EIS upon publication. Thank you for your interest and participation in the planning process of this important project.

Warmest Aloha,

Hoaliku Drake
Chairman
Hawaiian Homes Commission

cc: OEQC, B. Choy
R. M. Towill Corp., C. Sakoda

WAIMANA ENTERPRISES, INC.

July 11, 1991

BY FAX, ORIGINAL TO FOLLOW IN MAIL

Mr. Stephen Kellogg
c/o R. M. Towill Corporation
420 Waiakamilo Rd., #411
Honolulu, Hawaii 96817

Dear Mr. Kellogg:

Re: Kawaihae Ten-Year Master Plan

Waimana Enterprises, Inc. (Waimana) is interested in commenting on the subject project and would appreciate receiving any documentation you can share with us. We also request Waimana's name be added to your list of interested parties, in order for us to offer comments on the Draft EIS and subsequent documents related to this Long-Range Master Plan for Kawaihae.

As noted above, this letter is being transmitted by facsimile, with the original to follow in the mail. As soon as our copies of the preliminary documents are ready, please call me at 599-4441. I would like to arrange for Waimana to pick-up the packet at your office. Mahalo for your kokua.

Sincerely,

Paula Monden

Paula Monden

cc: Office of Environmental Quality Control
D. Ing (DHHL)

Pauahi Tower Suite 1520 • 1001 Bishop Street • Honolulu, Hawaii 96813
(808) 599-4441 Facsimile (808) 599-4653

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

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

HOALIKU L DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

August 21, 1991

Waimana Enterprises, Inc.
Pauahi Tower, Suite 1520
1001 Bishop St.
Honolulu, HI 96813

Attn: Paula Monden

Dear Ms. Monden:

Kawaihae Ten-Year Master Plan Environmental Impact Statement Preparation Notice (EISPN)

Thank you for your letter dated July 11, 1991 regarding the subject project.

In response to your request to be made a consulted party in the EIS preparation process, you will be receiving a copy of the Draft EIS upon publication.

Thank you for your interest and participation in the planning process of this important project.

Warmest Aloha,

Hoaliku Drake

Hoaliku Drake
Chairman
Hawaiian Homes Commission

cc: OEQC, B. Choy
R. M. Towill Corp., C. Sakoda

P.O. Box 44584
Kawaihae HI 96743
7/19/91

Darrell Ing
DHHL
P.O. Box 1870
Honolulu HI 96805

Dear Mr. Ing,

I request that I be made a consulted party in the matter of the Kawaihae Long Range Master Plan. I live in the area and am active in several groups concerned with the futures of North and South Kohala. Since this project will greatly affect both districts, I would like to stay informed and be able to help inform others. I have not seen the draft environmental assessment, so I am not in a position to make specific comments at this time.

Thank you.

Sincerely,

Carolyn Pomeroy

Carolyn Pomeroy

cc Stephen Kellogg
OEQC

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

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

HOALIKU L. DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

August 21, 1991

Ms. Carolyn Pomeroy
P. O. Box 44584
Kawaihae, HI 96743

Dear Ms. Pomeroy:

Kawaihae Ten-Year Master Plan Environmental
<u>Impact Statement Preparation Notice (EISPN)</u>

We are in receipt of your letter dated July 19, 1991 in which you requested to be a consulted party in the preparation of the Kawaihae Ten Year Master Plan EIS.

In response to your request, you will be receiving a copy of the Draft EIS upon publication. Thank you for your interest and participation in the planning process of this important project.

Warmest Aloha,

Hoaliku Drake

Hoaliku Drake
Chairman
Hawaiian Homes Commission

cc: OEQC, B. Choy
R. M. Towill Corp., C. Sakoda

to: Consultant Stephen Kellogg, c/o R.M. Towill Corporation
420 Waiakamilo Road # 411, Honolulu, Hawaii, 96817.

from: Henry A. Ross, P.O. Box 99, Kapaau, Hawaii, 96755.

re: E.I.S. for the KAWAIHAE TEN-YEAR MASTER PLAN.

22 July 1991

I want to be a consulted party for the above EIS.

I was surprised to be informed by the Planning Department of Hawaii County that as far as could be ascertained they did not receive a copy of your EIS Preparation Notice.

A project of this scope needs careful attention and I have at this moment 2 main concerns that need to be addressed in the EIS. They are: traffic and water (potable and agricultural).

4000 residential units and 60 acres of community support facilities for a town center, schools, parks and churches and 250 acres of business and industrial facilities constitutes a town bigger than North and South Kohala together muster at present. It requires a lot of planning and coordination with existing community needs and other planned developments in the area. It should go without saying that the present infra-structure is totally inadequate right from the start as it is already strained at this moment.

Adjacent and north of this planned development are a number of "luxury" subdivisions such as Kohala by the Sea, Kohala Estates, Kohala Makai and Kohala Ranch that when fully built up will not have adequate road access and drinking water, while agricultural water is totally insufficient now. Add to this the fact that Kohala Ranch is planning a township of 1800 residential units with support facilities in the center of its present 4000 acre ag-subdivisions for which inadequate infrastructure is planned. It does not stretch the imagination much to see that in 10 years time there will be total calamity and gridlock in this whole area.

TRAFFIC.
The Akoni Pule Highway and the Mountain Road are utilized to capacity when the presently approved subdivisions will be populated. Traffic signals on state highways are out - they lead to catastrophies and do not allow for greater capacity. That means that neither Kohala Ranch's small town nor your bigger town can be allowed to use the existing highways at all. Fortunately they are adjacent and a new road can be built to serve both. This is a "midlevel" connector road to run from the small town through the bigger town (that is 3 miles across Hawaiian Homes lands) 1 mile across Queen Emma Foundation land to the intersection of the Kawaihae Road and

the Queen Kaahumanu Highway. The latter is to become a 4 lane anyway (R.M. Towill is drawing the plans for the DOT already) and the Kawaihae Road is also now in the planning stages to be widened and improved with a bypass around Kamuela. In sum total, if planned together properly and not as individual projects, that could be an acceptable solution to this mega problem. None of the developments should get any approvals without their proper contributions for all of the expenses. The existing population was living adequately here and shall not be penalized with any burdens to accommodate newcomers, like being charged "impact fees" the county is planning now or see their state income taxes used to create another Kona like congestion that deminishes their quality of life. These individually planned communities will together house 20,000 people, half the size of Hilo. The EIS should dwell on this. Instead of piecemeal planning we need a super master plan.

WATER.
Part of the area concerned is arid and if any agriculture beyond simple cattle grazing is contemplated the plan must contain provisions for adequate agricultural water at reasonable cost. This must be addressed in the EIS. Drinking water will become a great problem, as nothing is definitively known about the quality of the aquifers in the area. I want to remind the parties here that the 3 well system of Kohala Ranch that is to provide for all the adjacent subdivisions has never been tested for sustainable yield yet. This private water system has had a breakdown in the recent past and the county will not accept a dedication. HHL is on its own here. Drilling into the same aquifer will reduce the yield per well. Adequate test drilling must be indicated in the EIS as a condition sine qua non for any scenario. This may have to extend into HHL areas above the Mountain Road in the same ahupuaa which might be more cost effective than other sources. The WATER RESOURCE DEVELOPMENT AND ACROSS ISLAND TRANSMISSION for which an EIS is being prepared by consultant Okahara Associates of Hilo for the DLNR would seem to be an overly expensive pipedream. It intends to bring Hilo water across the Saddle Road to Kamuela. If it ever gets built it will prove to be extremely expensive, impractical and prone to breakdowns for lack of pumping power (25 megawatt) that cannot be helped by the county's portable generators. The nearby hotels have their own water problems that should be compared in the EIS.

Hawaii County Mayor Lorraine Inouye has selected Townscape Inc. of Honolulu to write the Northwest Hawaii Open Space and Community Development Plan. Unless this plan is given priority over all the above it would seem like a horse behind the cart. I wonder if any party communicates with others at all or is everybody going off on his own tangent to the detriment of existing communities and all the taxpayers. Nothing of this should go before proper coordination has taken place. Why do we have state and county planners? Chaos?

Henry A Ross

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

HOALIKU L. DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

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

August 21, 1991

Mr. Henry Ross
P. O. Box 99
Kapaau, HI 96755

Dear Mr. Ross:

Kawaihae Ten-Year Master Plan Environmental
<u>Impact Statement Preparation Notice (EISPN)</u>

We have received your letter dated July 22, 1991 regarding the preparation of an Environmental Impact Statement for the subject project.

The project impacts on local and regional traffic systems are being studied in a special traffic impact analysis commissioned for the Kawaihae Ten-Year Master Plan Draft EIS. The availability of water is a continuing concern, and we are taking your recommendations with regard to this area under advisement.

The consultants for the Northwest Hawaii Open Space and Community Development Plan will be consulted during the preparation of the Kawaihae Ten-Year Master Plan EIS.

Last but not least, you will be receiving a copy of the Draft EIS as a consulted party. We appreciate your interest and participation in the planning process of this important project.

Warmest aloha,

Hoaliku L. Drake

Hoaliku L. Drake, Chairman
Hawaiian Homes Commission

CC: OEQC; B. Choy
R. M. Towill Corp., C. Sakoda

DEPARTMENT OF BUSINESS,
ECONOMIC DEVELOPMENT & TOURISM

ENERGY DIVISION, 335 MERCHANT ST., RM. 110, HONOLULU, HAWAII 96813 PHONE (808) 587-3800 FAX (808) 587-3820

JOHN WAIHEE
Governor
MURRAY E. TOWILL
Director
BARBARA KIM STANTON
Deputy Director
RICK EGGED
Deputy Director
TAKESHI YOSHIHARA
Deputy Director

91:1009e

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REC'D DEC 19 1991		
RDE		
GSY		
DAM		

December 17, 1991

The Honorable John Waihee
Governor, State of Hawaii
c/o Office of Environmental Quality Control
220 S. King Street, 4th Floor
Honolulu, Hawaii 96813

Dear Governor Waihee:

Subject: Draft Environmental Impact Statement (DEIS) for Kawaihae Ten-Year Master Plan, South Kohala, Hawaii

Thank you for the opportunity to review the subject DEIS. This project proposes a major development for the Island of Hawaii which will include 3,500 homes and ancillary facilities at full build-out. This project will create a substantial additional demand for energy services, the impact of which is not adequately stated in this DEIS.

The electrical load projected for the project is 45 MW which is expected to be met mainly through the expansion of oil-fired generating facilities. This projected demand is expected to result in a 40 percent increase in emissions from the electric utility. In view of the size of the project and the need to "moderate the growth in energy demand through conservation and energy efficiency" (State Energy Functional Plan, p. 13), which will indirectly cut down on emissions, we request that the developer explain, in as much detail as possible, the project's energy impacts and the energy-efficient design/technologies that will be used to help meet its energy requirements.

Page 6.5 of the DEIS states "Energy conservation and utilization of energy saving devices will be encouraged through guidelines for designers and developers as well as through homeowner information and orientation programs provided by the State." In this regard, we would like to call your attention to the Draft Hawaii Model Energy Code "Energy Efficiency Standards for Buildings" and Draft Impact Analysis.

We note that the main text of the DEIS (Section 5.7) did not incorporate sections of Appendix E, Air Quality which would have made understanding of the power demand more clear. Section 5.7 discusses power demand in KW's; while, Appendix E states peak power demand is not expected to exceed 45 MW. Table 5 of Appendix E states that power demand is assumed at 240 million kw-hrs per year. A comparison of existing and projected power demand in the same unit of measurement might make the DEIS more easily understood by the public.

We would recommend that the developer review the Energy Functional Plan which points out that utilities are expected to be implementing demand-side management (DSM) programs. Some of these programs may directly impact on the project.

Sincerely,

Maurice H. Kaya
Energy Program Administrator

MHK/ESU:dkik

cc: Department of Hawaiian Home Lands
R.M. Towill Corporation

JOHN WAIHEE
GOVERNOR

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

CHARLES T. TOGUCHI
SUPERINTENDENT

OFFICE OF THE SUPERINTENDENT

REC'D JAN 14 1992

December 30, 1991

Governor, State of Hawaii
c/o Office of Environmental Quality Control
220 S. King Street, 4th Floor
Honolulu, Hawaii 96813

Dear Sir:

SUBJECT: Kawaihae Ten-Year Master Plan
South Kohala, Hawaii
TMK: 6-1-01: 3; 6-1-2: 60-63, 65, 69-80, 88
6-1-3: 3, 16-20; 6-1-4: 3-20; 6-1-5: 1-8;
6-1-6: 1-16

Our review of the subject Draft Environmental Impact Statement (DEIS) indicates that the proposed development will have a severe impact on the public schools in the area. Based upon approximately 3,500 residential units listed in the report, the proposed planned community will have the following enrollment impact on the schools:

School	Grades	Projected Enrollment
Waimea Elementary	K-6	1,200
Waimea Intermediate	7-8	350
Honokaa High	9-12	430

On page 5-25, the total projected enrollment is 1,980 rather then 1,500. High school students would attend the existing public high school in Honokaa. The Department cannot assure the availability of classrooms to accommodate such an increase in enrollment over the next decade. The schools in the area are operating beyond their capacity and will require legislative appropriations for additional classrooms.

The 1,980 students generated from this proposed planned community will require an additional 79.2 classrooms. We will request that County require the developer to contribute a fair share for the construction of needed classroom facilities. At an average cost of $329,668 per classroom, we estimate that the cost of 79.2 classrooms to be $26,109,705. The developer's fair share will be 50 percent of this cost or $13,054,852.

On page 2-5 of subject report, four potential school sites are shown on the master plan. The Department requires an elementary school site to have a minimum of eight (8) useable acres when it is located next to a public park. Without a park, a twelve-acre site is needed to meet all the zoning requirements and educational specifications for an elementary school. The intermediate school site should be at least 12-useable acres if next to a park as shown on Figure 2-2.

We request that the developer contact the Department to discuss possible future plans and final location of the school sites. Should there be any questions, please call the Facilities Branch at 737-4743.

Sincerely,

Charles T. Toguchi
Superintendent

CTT:jl (CH)

cc: Alfred Suga, Assistant Superintendent of Business Services
Alan Garson, District Superintendent of Hawaii District
Darrell Ing, Department of Hawaiian Home Lands
Coleette Sakoda, R.M. Towill Corporation

AFFIR ACTIO QUAL TUNITY YER

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

HOALIKU L. DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

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

March 3, 1992

MEMORANDUM

TO: Mr. Maurice H. Kaya, Energy Program Administrator
State Department of Business, Economic Development & Tourism

FROM: Hoaliku L. Drake, Chairman
Hawaiian Homes Commission

Hoaliku L. Drake

SUBJECT: Kawaihae Master Plan Draft Environmental Impact Statement

We are in receipt of your letter of December 17, 1991 regarding the subject project. The following has been prepared in response to your comments.

The EIS will contain a description of the project's energy impacts and the energy-efficient design/technologies that will be used to help meet its energy requirements.

Section 5.7 will be revised to more clearly describe the comparison of existing and projected power demand in the same unit of measurement.

Your recommendations regarding the Draft Hawaii Model Energy Code "Energy Efficiency Standards for Buildings" and Draft Impact Analysis, and the Energy Functional Plan regarding the expectation that utilities be implementing demand-side management (DSM) programs, have been noted.

Should your staff have any questions, they may call Darrell Ing, Land Development Division, at 586-3824.

Thank you for your kokua on this project.

cc: OEQC
R. M. Towill Corp.: C. Sakoda

Please send to appropriate parties. FILE

JOHN WAIHEE, GOVERNOR

RECD JAN 10 1992

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

REX D. JOHNSON
DIRECTOR

DEPUTY DIRECTORS
AL PANG
JOYCE T. OMINE
JEANNE K. SCHULTZ
CALVIN M. TSUDA

IN REPLY REFER TO:
STP 8.4565

January 6, 1992

RECEIVED
'92 JAN -8 P3:16
OFC. OF ENVIRONMENTAL QUALITY CONTROL

TO: The Honorable John Waihee
c/o Office of Environmental Quality Control

FROM: Rex D. Johnson
Director of Transportation

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS) KAWAIHAE TEN-YEAR MASTER PLAN

We reviewed the DEIS for the Kawaihae Ten-Year Master Plan and have the following comments:

1. Page 3-31

   We cannot guarantee that the construction of the bypass road and the upgrading of Queen Kaahumanu Highway to freeway standards will be done in the time frame of your project. We are counting on West Hawaii developers to help pay for the proposed transportation improvements. We need for you to help defray some of the infrastructure costs on a fair-share basis. It is vital, therefore, that close coordination with our department be maintained to address the impacts of the proposed development on our facilities and to identify measures to mitigate any adverse impacts.

   The right-of-way requirements for the Kawaihae Bypass Road would probably be more than the 150 feet indicated in the report, due to the steeper grades encountered moving the alignment further mauka.

   The bypass alignment should also be coordinated with the Queen Emma Foundation. Connecting roads between the new bypass road and the existing Kawaihae Road should also be addressed.

   If federal funds are used to provide the required roadway improvements, then the archaeological mitigation plans proposed/documented in Appendix D may be inadequate.

   Drainage via gulches would require enlarging the drainage culverts under the existing Kawaihae Road.

   The report also needs to discuss the water quality at Kawaihae Bay.

2. Page 3-32

   We agree that Kawaihae Harbor will become a regional focal point as West Hawaii grows and provisions must be made to designate sufficient lands to accommodate the growth in harbor-related activities. A joint projection study was prepared by Manalytics for the Department of Hawaiian Home Lands and our department that addressed the projected land area needs.

3. Page 4-4

   We concur that the Kawaihae Boat Harbor will have positive economic impacts.

4. Page 5-9

   The waste water treatment and disposal system should be sized and designed to handle the expansion of the Kawaihae Harbor commercial facilities. Once the plant is constructed, the Department of Health will probably require us to tie-in to the system.

5. Page 5-23

   In the first sentence under section 5.9, add "harbors and" after "boat".

We appreciate the opportunity to comment on your DEIS.

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

HOALIKU L. DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

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

March 3, 1992

MEMORANDUM

TO: The Honorable Charles T. Toguchi, Superintendent
State Department of Education

FROM: Hoaliku L. Drake, Chairman
Hawaiian Homes Commission

SUBJECT: Kawaihae Ten-Year Master Plan Draft Environmental Impact Statement, South Kohala, Hawaii

We have received your letter of December 30, 1991 regarding the subject project.

Regarding your request that the County require the developer to contribute a fair share for the construction of the additional 79.2 classrooms required to accommodate the project's 1,980 students, we will continue to coordinate these policy decisions to assure proper and expedient delivery of the facilities.

We will also continue to work closely with your department to ensure that all potential school sites within the project area are most sensibly located and sized.

Your input throughout the planning process of this project is appreciated. Should you have any questions, please feel free to call me at 586-3800, or your staff may call Darrell Ing, Land Development Division, at 586-3824.

Thank you for your kokua on this project.

cc: OEQC
R. M. Towill Corp., C. Sakoda

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

HOALIKU L. DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

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

March 3, 1992

MEMORANDUM

TO: The Honorable Rex D. Johnson, Director
State Department of Transportation

FROM: Hoaliku L. Drake, Chairman
Hawaiian Homes Commission

SUBJECT: Kawaihae Ten-Year Master Plan Draft Environmental Impact Statement, South Kohala, Hawaii

We have received your memorandum of January 6, 1992 regarding the subject project. The following has been prepared in response to your comments.

1. Page 3-31

Close coordination between the developer and your department will be maintained to ensure timely and proper financing and construction of the bypass road and upgrading of Queen Kaahumanu Highway to freeway standards. The bypass alignment will also be coordinated with the Queen Emma Foundation. Connecting roads between the new bypass road and the existing Kawaihae Road will also be addressed.

If federal funds are used to provide the required roadway improvements, then archaeological mitigation plans will be consistent with appropriate requirements.

A discussion of the water quality of Kawaihae Bay will be included in the EIS.

2. Page 5-9

The capacity of the wastewater treatment plant (WWTP) will be designed and constructed in increments to support the phased growth of the development. The capacity of the facility will be expanded as the demand for capacity increases. The WWTP will be able to accommodate the wastewater from the expansion of the

Kawaihae Habor commercial facilities. However, the Harbors Division will be required to pay a proportionate share of the cost of developing the WWTP and transmission lines.

3. Page 5-23

Your recommended revision to section 5.9 has been noted.

Should you have any questions, please feel free to call me at 586-3800, or your staff may call Darrell Ing, Land Development Division, at 586-3824.

Thank you for your kokua on this project.

cc: OEQC
R.M. Towill Corp.

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

In reply, please refer to:

REC'D JAN 2 0 1992

January 10, 1992 91-451/epo

To: The Honorable John Waihee
Governor, State of Hawaii
c/o Director, Office of Environmental Quality Control
220 South King Street, 4th Floor
Honolulu, Hawaii 96813

From: John C. Lewin, M.D.
Director of Health

Subject: KAWAIHAE TEN-YEAR MASTER PLAN
Draft Environmental Impact Statement (DEIS)
Kawaihae, South Kohala, Hawaii
(Department of Hawaiian Home Lands)

Thank you for the opportunity to review and comment on the subject document. We have examined the Draft Environmental Impact Statement (DEIS) and have the following comments to offer:

Drinking Water

1. The DEIS indicates that the project will include the development of a potable water system. As new sources of water are developed, it will be necessary to comply with the Department of Health's Administrative Rules, Chapter 11-20, "Potable Water Systems." 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 its 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.

2. The Department of Health's Administrative Rules, Chapter 11-20, "Potable Water Systems", Section 4-20-30 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.

3. If the proposed project utilizes a dual water system, the potable and nonpotable water systems must be carefully

designed and operated to prevent cross-connections and backflow conditions. The two systems must be clearly labeled and physically separated by air gaps or reduced pressure principle backflow preventers to avoid contaminating the potable water supply. In addition, all nonpotable spigots and irrigated areas should be clearly labeled with warning signs to prevent the inadvertent consumption of nonpotable water.

Underground Injection Control (UIC)

1. A large portion of the proposed development is situated above the UIC line. Land areas above the UIC line are considered to contain underground sources of drinking water. Thus, these areas should be protected against all sources of groundwater contamination.

2. The DEIS indicates that the project will utilize drainage (drywells) and wastewater effluent injection wells. All injection wells must comply with the Department of Health's Administrative Rules, Chapter 11-23, "Underground Injection Control." It will be necessary to obtain UIC permits to authorize the construction and operation of these wells.

3. Chapter 11-23 prohibits sewage or industrial disposal wells in areas above the UIC line. This restriction will apply to the project's wastewater disposal plans.

4. Injection wells cannot be sited within 1/4 mile of any drinking water source.

If you should have any questions on this matter, please contact Mr. Stuart Yamada (Drinking Water) or Mr. Chauncey Hew (Underground Injection Control) of the Safe Drinking Water Branch at 586-4258.

Solid Waste

1. The proposed development indicates a potential generation rate of 24 tons/day of solid waste which would produce a tremendous impact on the current estimated generation in West Hawaii of approximately 100 to 124 tons/day. As the County is already facing major cost increases and environmental mitigation measures in the development of the new West Hawaii landfill, the developer should investigate all possible on-site reduction and diversion solutions as part of the Final Environmental Impact Statement (EIS). Additionally, the waste reduction issues should be addressed in light of the State's goals of 25 percent by 1995 and 50 percent by 2000 (Act 324-91).

2. The developer should identify the volume of waste generated during construction and propose minimization plans to reduce or divert this waste. An investigation of composting (on-site and off-site) and recycling options should be included.

3. Since the developer is planning to designate an area for a refuse transfer station within the development, at a minimum, consideration should be made for recycling and greenwaste diversion activities. Additionally, as a means of compensation for other major impacts on the County's infrastructure, it may be appropriate to require the provision of waste diversion facilities at the site. Internally, a plan should be developed discussing the spacial, operational and educational requirements for waste reduction programs at multi-family, commercial or golf course operations within the development. The use of a greenwaste compost or soil amendment, manufactured on-island or in the State, during project construction should also be investigated.

If you should have any questions on this matter, please contact Mr. John Harder in our Office of Solid Waste at 586-4240.

In case a golf course is eventually planned for in this area, I am enclosing the Department of Health's "Twelve (12) Conditions Applicable to All New Golf Course Development."

Enc.

c: Safe Drinking Water Branch
Office of Solid Waste
Department of Hawaiian Home Lands
R.M. Towill Corporation

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

HOALIKU L. DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

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

March 3, 1992

MEMORANDUM

TO: The Honorable John C. Lewin, M.D., Director
State Department of Health

FROM: Hoaliku L. Drake, Chairman
Hawaiian Homes Commission

SUBJECT: Kawaihae Ten-Year Master Plan Draft Environmental Impact Statement, South Kohala, Hawaii

We have received your memorandum of January 10, 1992. The following has been prepared in response to your comments and recommendations.

Drinking Water

1. The development of a potable water system for the project shall conform to all the applicable requirements of the Hawaii Administrative Rules, Title 11, Chapter 20, Potable Water Systems. The water system plans will also be submitted to the County of Hawaii's Department of Water Supply for review and approval.

2. The water system will be designed to conform to all State and County requirements on Cross Connection Control. If a dual water system is implemented, approved cross connection control devices will be installed.

Underground Injection Control (UIC)

Drywells for drainage facilities and injection wells for wastewater effluent shall be constructed in compliance with Hawaii Administrative Rules, Title 11, Chapter 23, Underground Injection Control. The sewage disposal injection wells will be constructed below the UIC line and spaced at least 1/4 mile from any drinking water source.

Solid Waste

The developer shall investigate all possible on-site reduction and diversion measures to reduce solid waste in conformance with Act 324-91 regarding Solid Waste Management. A study will be conducted to designate an area adjacent to the refuse transfer station or nearby lands for recycling or composting activities. The developer shall identify and segregate construction waste and investigate composting or recycling options. Vegetal wastes generated during clearing and grubbing operations shall be retained at on-site areas for composting.

Special informational and educational programs and publicity on recycling and greenwaste diversion activities in the community shall also be promoted to encourage waste reduction.

Should you have any questions, please feel free to call me at 586-3800, or your staff may call Darrell Ing, Land Development Division, at 586-3824.

Thank you for your kokua on this project.

cc: OEQC
R. M. Towill Corp., C. Sakoda

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
MANABU TAGOMORI
Dan T. Kochi

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:SKK

REC'D JUL 1 1992

FILE NO.: 92-351
DOC. NO.: 2406E

JAN 18 1992

The Honorable John Waihee, Governor
c/o Office of Environmental Quality Control
220 South King Street, 4th Floor
Honolulu, Hawaii 96813

Dear Governor:

SUBJECT: Draft Environmental Impact Statement for Kawaihae Ten-Year Master Plan - South Kohala, Hawaii

Thank you for giving our Department the opportunity to comment on this matter. We have reviewed the submitted draft EIS and have the following comments.

Brief Discussion:

A draft EIS has been provided describing the Ten-Year Master Plan activities proposed for the Kawaihae area. This will be an extensive development on 10,000 acres on the southwestern slopes of the Kohala Mountains, bounded by Honokoa Gulch; the Puu Kanane to the east; Palihae Gulch to the south; and Kawaihae Road and the coastline to the west.

The various land uses proposed are residential, agriculture, community services, recreational, commercial, business and industrial.

The proposed development would increase the demand for potable water to about 4.7 MGD which would be obtained from wells and/or a desalinization system. A wastewater treatment system to handle 2.5 MGD is planned and disposal would be via injection wells.

DIVISION OF AQUATIC RESOURCES COMMENTS:

The Draft EIS has provided some information on mitigating possible impacts of storm runoff, erosion, waste disposal, drainage, and construction related activities. However, the Department should have the opportunity to review more detailed provisions of forthcoming plans for the development as they are completed, especially if the proposed activities could affect aquatic resource values. Also, any future plans for shoreline modification or the expansion of Kawaihae Boat Harbor, which may affect coastal waters adversely, should be submitted to the Department for review.

Thank you for the opportunity to review this matter. We hope that our comments are of use to you for preparation of the final EIS. Please feel free to call me or Sam Lemmo at our Office of Conservation and Environmental Affairs, at 587-0377, should you have any questions or are in need of assistance.

Very truly yours,

WILLIAM W. PATY

cc: Hawaiian Home Lands
R. M. Towill

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

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

HOALIKU L. DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

RMT		WES	
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RYK		SRK	
REC'D SEP 2 9 1992 RMTC			
RDE			
GSY			
DKM			

September 28, 1992

MEMORANDUM

TO: The Honorable William W. Paty, Chairperson
Board of Land and Natural Resources

FROM: Hoaliku L. Drake, Chairman
Hawaiian Homes Commission

Hoaliku L. Drake

SUBJECT: Kawaihae Master Plan Draft Environmental Impact Statement

This is in response to your letter of January 16, 1992 (File no. 92-351, Doc. no. 2406E) regarding the subject project.

As more detailed plans are prepared, all your affected divisions, including Aquatic Resources, will be consulted. We will closely coordinate subsequent planning efforts with your department.

Should you have any questions, please call me at 586-3800, or your staff may contact Darrell Ing of our Land Development Division at 586-3821.

cc: OEQC, Attn: Mr. Brian Choy
R. M. Towill Corp., Attn: Ms. Collette Sakoda

OFFICE OF STATE PLANNING
Office of the Governor

REC'D JAN 3 0 1992

Ref. No. P-2683

January 22, 1992

'92 JAN 29 A7:54

OFC. OF ENV. QUALITY C.

MEMORANDUM

TO: The Honorable John Waihee
Governor of Hawaii

SUBJECT: Draft Environmental Impact Statement for the Proposed Kawaihae Ten-Year Master Plan, Kawaihae, South Kohala, Hawaii

We have reviewed the subject draft environmental impact statement and have the following comments.

The Kawaihae Ten-Year Master Plan proposes development of affordable housing, community centers and ancillary services that would include industrial and commercial complexes. The master plan integrates the existing Kawaihae Harbor facilities and nearby existing industrial/commercial area and throughways. We are concerned that the proposed marina could degrade water quality and impact marine life. More information and detailing including a mitigation and water quality management plan is needed on the proposed small marina abutting or within Kawaihae Harbor.

Extensive grading, excavation, filling and stockpiling will be performed to facilitate construction of building structures and infrastructure. Mitigation measures should be implemented to minimize run-off and sediment during periods of rain due to the highly erosive and friable soil properties. Prior to development of an area, the applicant should consult with the State Historic Preservation Office, Department of Land and Natural Resources, for the incidence and mitigation of archaeological sites inluding the development of an interpretive management plan.

These measures should also apply to any golf course development including additional information on pesticide and fertilizer use and their potential to contaminate groundwater and coastal waters.

A management plan with inclusion of buffer zones should be established in fringe areas to protect rare and endangered native plant colonies from intrusion and minimize disturbance from bordering agricultural and residential use.

The project proposes construction of a desalinization plant to reclaim brackish water for irrigation and conservation of potable water. We are concerned about the potential run-off and seepage of desalinization waste by-products into groundwater that may eventually enter the waters of Kawaihae Bay and impact marine life. More information is necessary on the methods of containment and disposal of waste by-products generated from the desalinization plant operation, including plans for mitigating the impacts.

In addition, the conceptual relationships between the subject master plan and adjacent land uses (proposed and existing), such as the Kohala Ranch project to the north and the Kawaihae Harbor complex to the west, should be described in more detail. Particular attention should be given to the future support facilitation for the harbor.

Thank you for the opportunity to comment on this Draft Environmental Impact Statement. If you have any questions, please call our Coastal Zone Management office at 587-2883 or Land Use Division at 587-2885.

Harold S. Masumoto
Director

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

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

HOALIKU L. DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

RMT		WES	
DK		KTS	
RYK		SRK	
REC'D SEP 29 1992 RMTC			
RDE			
GSY			
DKM			

September 28, 1992

MEMORANDUM

TO: The Honorable Harold Masumoto, Director
Office of State Planning

FROM: Hoaliku L. Drake, Chairman
Hawaiian Homes Commission
Hoaliku L. Drake

SUBJECT: Kawaihae Master Plan Draft Environmental Impact Statement

This is in response to your memorandum of January 22, 1992 regarding the subject project.

Kawaihae Harbor and Marina

While the DHHL Kawaihae master plan project area does not include Kawaihae Harbor or the proposed marina, we will closely coordinate our development with the agencies and organizations that are responsible for the development of the harbor and the marina.

Construction-related Impacts

Under current DHHL practice, state and county subdivision requirements are complied with during grading, excavation, filling, stockpiling, and construction to minimize any potential adverse impacts resulting from such activities, including potential golf course development. We are cognizant of the need to preserve and protect the quality of our groundwater and coastal water resources.

Archaeological, Botanical Resources

Consultation and coordination with the State Historic Preservation Office, DLNR, which began with our consultants' initial project area surveys, will continue through the development process. We will also continue to coordinate our development planning with DLNR's Forestry and Wildlife Division to ensure protection of any botanical resources from agricultural or residential uses in the vicinity.

Other

Some private entities have expressed interest in constructing and operating a desalinization plant in Kawaihae. However, discussions with potential developers have been only preliminary, and none have provided details of their proposed operations. Any such facilities will be required to prepare their own environmental studies and received all appropriate approvals and permits prior to actual construction.

The Final EIS will contain more discussion regarding the relationships between the subject master plan and adjacent land uses, such as Kohala Ranch and the Kawaihae Harbor.

Should you have any questions, please call me at 586-3800, or your staff may contact Darrell Ing of our Land Development Division at 586-3821.

cc: OEQC, Attn: Mr. Brian Choy

R. M. Towill Corp.
Attn: Ms. Collette Sakoda

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

HOALIKU L. DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

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

March 3, 1992

MEMORANDUM

TO: Mr. Brian J. J. Choy, Director
State Office of Environmental Quality Control

FROM: Hoaliku L. Drake, Chairman
Hawaiian Homes Commission

SUBJECT: Kawaihae Ten-Year Master Plan Draft Environmental Impact Statement, South Kohala, Hawaii

We have received your letter of January 7, 1992 regarding the subject project.

A concise discussion of the unresolved issues will be included in Section 1 of the EIS pursuant to section 11-200-17(b).

A legible copy of the letter from Citizens for Protection of the North Kohala Coastline will be included in Section 11 of the EIS.

If you have any questions, please feel free to call Darrell Ing, Land Development Division, 586-3824.

Thank you for your kokua on this project.

cc: R. M. Towill Corp., C. Sakoda

JOHN WAIHEE
GOVERNOR

BRIAN J. J. CHOY
Director

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
220 SOUTH KING STREET
FOURTH FLOOR
HONOLULU, HAWAII 96813
TELEPHONE (808) 586-4185

REC'D JAN 0 8 1992

January 7, 1992

Mr. Darrell Ing
Department of Hawaiian Homelands
335 Merchant Street
Honolulu, Hawaii 96813

Dear Mr. Ing:

Subject: Draft Environmental Impact Statement for the Kawaihae Ten-Year Master Plan

Thank you for the opportunity to review the subject document. We have the following comments:

1. Pursuant to section 11-200-17(b) Administrative Rules, Department of Health, please include in Section 1 a concise discussion of the unresolved issues.

2. The comment letter from Citizens for Protection of the North Kohala Coastline reproduced in Section 11 is not legible. Please provide a legible copy in the final EIS.

If you have any questions, please call Jeyan Thirugnanam at 586-4185.

Sincerely,

BRIAN J. J. CHOY
Director

BC:jt

c: R. M. Towill Corporation

DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAII
25 AUPUNI STREET • HILO, HAWAII 96720
TELEPHONE (808) 969-1421 • FAX (808) 969 6996

December 23, 1991

The Honorable John Waihee
Governor, State of Hawaii
c/o Office of Environmental Quality Control
220 South King Street
Fourth Floor
Honolulu, HI 96813

REC'D DEC 26 1991

DRAFT ENVIRONMENTAL IMPACT STATEMENT
KAWAIHAE TEN-YEAR MASTER PLAN
TAX MAP KEY 6-1-01:3; 6-1-2:60-63, 65, 69-80, 88;
6-1-03:3, 16-20; 6-1-04:3-20; 6-5-05:1-8;
6-1-06:16

For subdivision approval, all requirements of the Department of Water Supply's Rules and Regulations and Water System Standards shall be complied with. Requirements of the State of Hawaii Department of Land and Natural Resources and State of Hawaii Department of Health relative to water source development shall also be complied with.

H. William Sewake
Manager

QA

cc - State of Hawaii Department of Hawaiian Home Lands
R. M. Towill Corporation

... Water brings progress...

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

HOALIKU L. DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

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

March 3, 1992

Mr. H. William Sewake, Manager
Department of Water Supply, County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Sewake:

Kawaihae Ten-Year Master Plan Draft Environmental
Impact Statement, South Kohala, Hawaii

We are in receipt of your letter of December 23, 1991 regarding the subject project.

In response to your comments, you can be assured that all subdivision requirements of the County's Department of Water Supply's Rules and Regulations and Water System Standards will be complied with. Further, project water source development will comply with State Departments of Land and Natural Resources and Health requirements.

If you have any questions, please feel free to call Darrell Ing, Land Development Division, at 586-3824.

Thank you for your kokua on this project.

Warmest Aloha,

Hoaliku L. Drake, Chairman
Hawaiian Homes Commission

cc: OEQC
R. M. Towill Corp., C. Sakoda

sent copies to appropriate parties

File

Lorraine R. Inouye
Mayor

Bruce C. McClure
Chief Engineer

Laurence E. Capellas
Deputy Chief Engineer

Department of Public Works

County of Hawaii • 25 Aupuni Street, Room 202 • Hilo, Hawaii 96720 • (808) 961-8321 • Fax (808) 969-7138

December 30, 1991

GOVERNOR STATE OF HAWAII
C/O OFFICE OF ENVIRONMENTAL QUALITY CONTROL
220 SOUTH KING STREET 4TH FLOOR
HONOLULU HI 96813

SUBJECT: KAWAIHAE 10-YEAR MASTER PLAN - DRAFT EIS
Location: South Kohala, Hawaii
TMK: 6-1-1: 3; 6-1-2: 60-63, 65, 69-80, 88; 6-1-3: 3, 16-20; 6-1-4: 3-20; 6-1-5: 1-8; 6-1-6: 1-16

Thank you for the opportunity to review the subject document. Our comments are as follows:

ROADWAYS

The distance between the Kohala Mountain Road and the Akoni Pule Highway is over five (5) miles. There should be a major road parallel to these roads within the subject development area. This road should match the location and standards of the Kohala Ranch "mid-level" road. This road should be a part of the Long Range Master Plan.

The County Planning Department has hired a consultant to do a planning study of this region. The Kawaihae Master Plan should be in consonance with the County planning study, especially the infrastructure.

The Mauka-Makai road should be constructed as soon after the 10-year plan as possible. This road is a much needed road for traffic circulation of the region. The design of this road should provide a slope that does not exceed 10%.

The collector struts shall have a 60' minimum right-of-way. If there are any added amenities to the roadway, eg. landscaping, bikeways, horse trails, etc., then the right-of-way should be increased. Use a 7' wide sidewalk area instead of the 10' shown on our present standard details.

Swales of minor streets should be paved where velocity of runoff is erosive.

If this 10-year development is built and populated, what improvements should be made at the intersection of Kawaihae Road and Queen Kaahumanu Highway?

SOLID WASTE

In light of recent state legislation which requires the development of a County integrated waste management plan, we believe that a solid waste management plan should be developed for this project. The plan should address as a minimum the following:

1. Analysis of anticipated solid waste volume and composition.
2. Proposed disposal and/or transportation methods to be employed for various components of the waste stream.
3. Impacts to existing/proposed County solid waste facilities, including financial impacts, and appropriate mitigating measures.
4. A waste reduction component which analyzes techniques to be employed to help the County achieve a reduction goal of 25% by 1995 and 50% by 2000.

for David Murakami
ROBERT K. YANABU, Division Chief
Engineering Division

DHM:byf

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

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

HOALIKU L. DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

March 3, 1992

Mr. Robert Yanabu, Chief, Engineering Division
Department of Public Works
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Yanabu:

Subject: Kawaihae Ten-Year Master Plan, Draft Environmental Impact Statement, South Kohala, Hawaii

We are in receipt of your letter of December 30, 1991 regarding the subject project. The following has been prepared in response to your comments.

ROADWAYS

The Kawaihae Ten-year Master Plan Draft EIS includes a discussion of the County Planning Department's planning study in section 6. We will closely coordinate our and the Planning Department's planning efforts to maintain a consistent and optimal set of policies for the future of this geographic area.

Your recommendations regarding the "mid-level" road, the mauka-makai road, other internal roadways, and detailed engineering design considerations will be taken under advisement. Final design decisions will be closely coordinated with your department and neighboring land owners (Kohala Ranch and Queen Emma Estates).

According to our traffic consultants, Wilbur Smith Associates, the improvements to be made at the Kawaihae Bypass Road and Queen Emma Highway will involve, at minimum, a grade separation and not less than three lanes for key movements if levels of area development and background traffic growth do occur by Year 2001.

SOLID WASTE

The developer shall investigate all possible on-site reduction and diversion measures to reduce solid waste in conformance with Act 324-91 regarding Solid Waste Management. A study will be conducted to designate an area adjacent to the refuse transfer station or nearby lands for recycling or compost activities. The developer shall identify and segregate construction waste and investigate composting or recycling options. Further, special informational and educational programs on recycling and greenwaste diversion activities in the community shall also be promoted to encourage waste reduction.

If you have any questions, please feel free to call Darrell Ing, Land Development Division, at 586-3824.

Thank you for your Kokua on this project.

Warmest aloha,

Hoaliku L. Drake

Hoaliku L. Drake, Chairman
Hawaiian Homes Commission

CC: OEQC
R. M. Towill Corp., C. Sakoda

3749B

University of Hawaii at Manoa

Environmental Center
A Unit of Water Resources Research Center
Crawford 317 • 2550 Campus Road • Honolulu, Hawaii 96822
Telephone: (808) 956-7361

December 23, 1991
RE:0594

Governor, State of Hawaii
c/o Office of Environmental Quality Control
220 South King Street, 4th Floor
Honolulu, Hawaii 96813

Dear Governor:

Draft Environmental Impact Statement (DEIS)
Kawaihae Ten-Year Master Plan
Kawaihae, South Kohala, Hawaii

The Department of Hawaiian Home Lands, State of Hawaii, has proposed a Ten Year Master Plan for the development of a planned community in Kawaihae, South Kohala, Hawaii, to cover approximately 2,100 acres of land mauka of the existing Kawaihae Harbor. Proposed land uses include approximately 3500 residential units, encompassing both medium and low density housing, public schools, parks, church/day care center sites, a town center, business centers, and industrial parks. Infrastructure development will include roadways, utility networks, wastewater facilities, and development of potable water sources.

The Environmental Center has reviewed the referenced document with the assistance of George Taoka, Civil Engineering; Michael Graves, Anthropology; and Elizabeth Muller, Environmental Center.

General Concerns

Although sections of this DEIS are well prepared, particularly in consideration of project alternatives, our reviewers note that the document is substantively deficient in two major areas: archaeology and water resource planning. In view of our specific concerns noted below, we suggest that the document in its present form fails to meet content requirements for an EIS as stated in Title II, Chapter 200, Section 17(g), DOH Administrative Rules. Until the noted deficiencies are remedied, acceptance of this EIS would be inappropriate.

Historical Sites

The proposed project setting is located in a historically sensitive area. The archeological report included in Appendix D does not contain sufficient information to evaluate the significance of the historical properties located within the project area. Substantial additional information concerning the survey techniques and findings is necessary for assessment of the adequacy of the recommendations made by the consulting archeologist.

Potable Water Supply

Successful implementation of this project hinges upon development of a sufficient potable water supply. The DEIS states that a possible source of potable water would arise from drilling 2-4 wells with an estimated yield of 3 million gallons per day (mgd). The EIS should include the data on the capacity and quality of water from the state's test of exploratory wells on the project's proposed location. The impact of the proposed community's potable water demand on the availability of water to parties in the surrounding area also should be addressed. The DEIS states that the remaining 1.7 mgd of potable water necessary to meet the estimated 4.7 mgd need of the proposed community would be provided by either a desalinization plant or importation from North Kohala. The EIS should address the costs and environmental impacts of each of these possible sources.

Conservation Plans

The DEIS mentions promotion of conservation and recycling within the proposed community as a means of limiting the impact and need of natural and renewable sources, such as water, energy and solid waste. The EIS should more clearly state what will be done to promote and utilize such conservation and recycling programs.

Solid Waste

There is presently no landfill space available for the estimated 24 tons of solid waste to be generated per day by the proposed community. The EIS should address the location, capacity and time of availability of the proposed landfill for this project.

Wastewater Treatment and Disposal

There is a limit of effluent wastewater disposal capacity in the project area. The DEIS estimates the production of 2.5 mgd of wastewater in the first phase of development with the possiblity of an increase in later phases. The EIS should state the estimate of wastewater production in the final phase of the project development and how the disposal and treatment needs of this wastewater will be met. If injection wells will be utilized, the EIS should go into more detail concerning the geology and terrain of the injection well sites as well as the wells' capacities.

Traffic Projections

The traffic growth projections on page 3-1 of Appendix H, the Traffic Impact Study, give two different growth trends in traffic flows, 17 percent per year and 7 percent per year. On the basis of subsequent discussion, it is apparent that the latter figure is applicable, but this discrepancy should be resolved explicitly. The calculations of the growth factor for the year 2003 are based upon the 7 percent per year growth trend. We assume this projection emerged from the following mathematical formula: .07 x 12 (years)= .84 (a 84% growth increase). The more widely accepted mathematical formula is 1.07EXP12 =2.41 (a 241% growth increase). The reasoning behind the formula utilized should be more clearly explained.

Thank you for the opportunity to comment on this document.

Yours truly,

John T. Harrison
Environmental Coordinator

cc: DHH (Darrell Ing)
R.M. Towill Corp. (Colette Sakoda)
Roger Fujioka
George Taoka
Michael Graves
Elizabeth Muller

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

HOALIKU L. DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

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

March 3, 1992

Mr. John T. Harrison, Environmental Coordinator
Environmental Center
University of Hawaii at Manoa
2550 Campus Road, Crawford 317
Honolulu, Hawaii 96822

Dear Mr. Harrison:

Draft Environmental Impact Statement (DEIS)
Kawaihae Ten-Year Master Plan

We have received a copy of your letter dated December 23, 1991 regarding the subject project. The following has been prepared in response to your comments.

Historic Sites

A complete, unabridged report on the inventory survey of the archaeological sites at Kawaihae was prepared and submitted by Cultural Surveys Hawaii to the State Department of Land and Natural Resources in July 1991. The full report contains information including survey techniques and findings that provide the necessary rationale to help assess the adequacy of the recommendations made by the consulting archaeologist.

The Final EIS will contain a discussion of the survey methods utilized by the consulting archaeologist. Further, a copy of the complete, unabridged report, "Archaeological Survey and Testing Kawaihae 1 (Komohana), South Kohala, Hawaii," by Cultural Surveys Hawaii is available in our office for review by interested parties.

Potable Water Supply

The Final EIS will include preliminary data on the capacity and quality of water from the state's November 1991 test of exploratory wells on the project's proposed location. The following is a summary of the state's preliminary test findings:

> The 12-inch diameter well was drilled at the 1,652-foot elevation (msl) to a depth of (-) 30 feet (msl). The water surface elevation in the well was at 6.3 feet (msl). A 24-hour pumping test conducted in the uncased hole produced 75 to 78 gpm while the drawdown held steady at 2.1 feet. The water temperature was 29 degrees C and the chloride content ranged between 155 to 160 ppm.

The Final EIS will include the impact of the proposed project's potable water demand on the availability of water to parties in the surrounding area. The EIS will also address the preliminary costs and environmental impacts of each of the alternative or possible potable water sources.

We are aware that private enterprises have expressed interest in constructing a desalinization plant in Kawaihae, however, discussions with potential developers have only been preliminary, and none have provided details of their proposed operations.

Conservation Plans

To promote water conservation, treated sewage effluent will be used to irrigate a future golf course. Other specific considerations to promote and utilize conservation and recycling programs will be included in the EIS.

Solid Waste

The new West Hawaii sanitary landfill in Puuanahulu will service the proposed project. The new landfill is scheduled to be operational by 1993. Based on present and future population projections, the facility will be capable of initially accommodating 70,300 tons of solid waste volumes annually, and receive a total of 134,000 tons of refuse by the year 2015.

Wastewater Treatment and Disposal

The ultimate development of the project is anticipated to generate about 4 mgd of wastewater. The wastewater treatment plant will be designed to be enlarged to accommodate the anticipated growth and injection wells will be the primary method of

effluent disposal.

The geology of the area consists of a thin soil layer underlain by very porous basaltic lava flows of the Hawi and Pulolu Volcanic series of Kohala which were deposited during the middle to late Pleistocene period (Stearns & MacDonald, 1946). Although the injection well sites and capacities are still undetermined, the general geology of the area is similar and the porous strata appear conducive to the proper function of an injection well.

Traffic Projections

The correct growth rate is 7 percent. The reference to 17 percent is a typographical error.

This number (7 percent) was derived using a linear regression analysis. It is a constant in an equation that gives the best-fit line for the data. Because the data was fit to a straight line, it would not be appropriate to apply an exponential equation (as commonly used in assessing the time value of money or the data that displays exponential growth). If the data were fit to an exponential equation, the constant would be lower than 7 percent (about 5.2 percent) and the resulting 12-year forecast would still be close to 84 percent.

Also, a straight line growth equation was used because it is typical for peak-hour traffic growth to level off as an area becomes more populated. This occurs for several reasons. First annual population increases in a growing area will flatten out as an area becomes more congested, driving patterns change and not as high a percentage of drivers drive during the highest one-hour peak; instead, the peak period tends to lengthen.

If you have any questions, please feel free to call Darrell Ing, Land Development Division, at 586-3824.

Thank you for your participation in the planning process of this important project.

Warmest Aloha,

Hoaliku L. Drake, Chairman
Hawaiian Homes Commission

cc: OEQC, B. Choy
R.M. Towill Corp., C. Sakoda

COMMENTS ON DRAFT EIS FOR KAWAIHAE TEN-YEAR MASTER PLAN
BY CAROLYN POMEROY — DECEMBER 29, 1991

Water

The EIS states that availability of water is a serious problem for the project, but the magnitude of the problem was not fully acknowledged. The assertion on Page 5-7 that Kohala Ranch has been successfully pumping potable water in the same region for many years without adverse effects is misleading. The Kohala Ranch Water Company began serving a few homes four or five years ago. Total pumpage for all of 1989 was less than six million gallons — an amount the Kawaihae development will use in a day or two. Consumption is still well below capacity because a large percentage of the lots to be served are undeveloped at the present time.

Kohala Ranch experience can tell us little about Hawaiian Homes in any case, because the Kohala Ranch wells are tapping reserves accumulated over time in diked compartments. Hawaiian Homes does not appear to have such reserves. Even if they did, it would only be a temporary solution — as it is at Kohala Ranch — since pumping in excess of sustainable yield will eventually deplete sources of this type.

The statement on page 2-33 that Kohala Ranch is a possible water source which needs to be pursued is unrealistic. The attached water balance sheet suggests that if the proposed Kohala Ranch rezoning goes through, this source is already severely overcommitted. And the picture may be even worse than shown, because the figures are based on data available prior to the failure of the first HHL exploratory well, and the finding in the second one of a lower head than predicted by the Blackhawk Geosciences study. Under the circumstances, the Kohala Ranch Water Company would not be allowed to make additional off-site commitments even if it wanted to.

It is also unrealistic to assume that DHHL wells will be able to provide three million gallons per day, as proposed on page 5-3. The state and county water plans estimate a sustainable yield for this aquifer of about a million gallons per day per mile of coastline. Since the Kawaihae Hawaiian Home Lands are less than three miles wide at the widest point, the yield can be expected to be less than three mgd. Furthermore, the state and county estimate is for potable and brackish water, and we know that a significant amount of the water under Hawaiian Homes is brackish.

The water demand table on page 5-5 seems to underestimate how much water will actually be needed. Usage at Kawaihae Village would be a better predictor of demand from the low density residential units than would the usual county standard. Average usage at Kawaihae Village for the first half of 1991 was 556 gpd per unit. If there are to be 3,292 low density dwellings in the project, as shown on page 2-4, then their average daily usage will be in the vicinity of 1,830,352 gallons — over half a million gallons more than shown in the table.

The county standard of 600 gpd is based on an assumption of 400 gpd average usage. The extra 200 gpd is to cover unmetered losses and peak seasonal demand. A similar factor applied here would push the needed source capacity to 2,745,528, rather than the 1,975,050 given in the table. If the other figures are similarly low, then the actual demand may be as much as 40% higher than shown.

It will be higher still if ohana construction is allowed. The EIS doesn't address this issue, with respect to water or to any other impacts. Nor is it clear whether water for street plantings is included in any of the categories in the demand table.

Clearly, sources other than Kohala Ranch and DHHL wells are needed, and a more realistic assessment of the possibilities for this should be presented.

If either Kehena Ditch water or brackish water is seen as a possible source, there will have to be a purification or desalinization plant or two parallel distribution systems. Neither of these was discussed in any detail. The fact that several companies have expressed an interest in desalinating water for the project is not enough. Specific proposals should be submitted with the EIS, and should include a discussion of power demands and how they will affect the rest of the county.

On page 5-6 there is a description of the system for transporting water to the project site. It involves piping the water down to the highway north of Honokoa Gulch and back up into the project south of it. Why was there no discussion of taking the water directly south from the DHHL well(s) to a gravity-feed system? It's hard to believe that the latter approach wouldn't be more economical in the long run — even with the need to span the gulches — than the extra pipeline length, pump station construction, and perpetual energy and maintenance costs associated with the former approach. (On the other hand, running the pipeline across Honokoa Gulch would be an aesthetic detriment.)

The reference to importing water at the end of the first paragraph on page 5-3 should say North Kohala, rather than North Kona, and the references on page 9-1 to Kohala Estates would be better applied to Kohala Ranch.

Power

I was hopful that this development could be a showcase for solarthermal electrical power. The amount of incident sunlight in the project area is very high, and I believe that self sufficiency in electrical power from benign natural sources would be very much in keeping with native Hawaiian cultural values. With future advances in technology and changes in the economic/political/resource picture, it might even become a source of revenue. A Federal grant might be obtained to help with start-up costs.

The statistic on page 3-21 that the development would increase electrical demand in the county by 40% was daunting, but I would still like to see consideration given to the possibility of feeding solarthermal electricity into the HELCO grid to help meet baseload demand. In addition to possible philosophical and financial benefits, it would be an educational and PR asset and would help to pioneer solutions to Hawaii's energy problems.

I would urge that architectural guidelines mandate solar water heating for all homes, and for industrial and commercial facilities which use hot water. Perhaps a loan fund could be set up to help homeowners with the initial capital investment, to be paid back out of savings on utility bills. It might be helpful for planners on this project to meet with the County Energy Commission, through the Department of Research and Development, to discuss other energy issues and conservation strategies.

Visual

The commitment to creating desirable and aesthetically sensitive views expressed on pages 3-32 and 3-33 is commendable, but should be strengthened in two ways:

1. Interim standards are needed and should be instituted immediately. While this master plan was being developed, a building of overbearing height was built very close to the highway, with oppressive effect. By contrast, the two buildings to the south of it have much more acceptable setbacks and height profiles.

2. Architectural standards requiring earth-tone colors should be instituted for the entire project. The EIS is not clear as to whether this will definitely be required, or of whom. There can be a great deal of leeway on this, but white and similar light colors are highly visible from a distance. This can be seen at Kohala Ranch, where such requirements exist on paper but are not enforced. The darker buildings tend to disappear from sight at a distance, but certain large white structures are unpleasantly obtrusive, and an increasing number of white rail fences will create a scar on the landscape visible from miles away. The roofs of the industrial buildings at Kawaihae offend in the same way.

I would also like to see consideration given to undergrounding of utilities. I realize this may not be feasible financially, but it wouldn't hurt to obtain comparison figures. There would be safety benefits as well as visual ones in this very dry, windy area. We should not give up on the idea until the most innovative minds have looked at it.

Traffic

The sentence that begins at the end of page 2-16 says that minor streets will allow on-street parking on the shoulders, but from the illustration on page 2-21, it appears that this will mean parking in the pedestrian/bike path.

In general, the traffic analysis lacks clarity. Some of this could be remedied with diagrams, but I don't think this is the only problem.

Page 5-14 contains a statement that without the project, the Kawaihae Road will operate at LOS B north of the intersection of the Kawaihae Bypass and the Queen Kaahumanu Highway. The Kawaihae Road lies to the north of where that intersection will presumably be. Does the statement refer to the whole Kawaihae Road, or only to the segment of it which runs in a northerly direction between the Queen Kaahumanu Highway and Kawaihae?

On the same page, LOS for the Queen Kaahumau Highway is given only for PM peak conditions. What is the AM figure? PM peak traffic is expected to be at LOS D, which does not seem to be consistent with the designation of "reasonable" levels referred to earlier in the same paragraph.
The distinction on page 5-16 between "the configuration proposed" and the "planned improvements" leaves me confused as to what the ensuing discussion refers to, and when it shifts between the 2-lane and 4-lane assumptions for the north-south bypass segment. I don't understand the last paraprah on page 5-16 at all. It says that according to the analysis [which one?], LOS

at the entrance is significantly higher [should this be lower?] than with the full [= 4-lane?] bypass.

On page 5-17 it is stated that during the AM peak hour, the Akoni Pule Highway would be at LOS E north of Kohala Ranch but at LOS D between Kohala Ranch and the project. Since most traffic into and out of Kohala Ranch will be connecting with points south, and since the bypass road south of the Kawaihae project will be at LOS F, it is hard to see how this could be. The pattern for the PM hour seems to make more sense.

The Kawaihae Bypass Road is shown on pages 5-17 & 18 as having a much lower LOS for makai-bound traffic than for mauka-bound traffic during both AM and PM hours. Is this correct?

In the discussion of traffic noise on page 3-25, a distinction is made in the last paragraph between the Akoni Pule Highway and the Kawaihae-Mahukona Road. Since the Akoni Pule Highway is the Kawaihae-Mahukona Road, I assume the author meant Kawaihae instead of Kawaihae-Mahukona.

I am curious as to why effects of project traffic on air quality are referred to on page 3-19 as "indirect", and why the last paragraph on the next page refers to increase of pollutants only in "several locations". Surely automobiles are an integral part of the community and their effects are ubiquitous - ?

As an aside, I fail to understand DOT's reasoning, referred to on page 5-13, that the Kohala Mountain Road is not a high accident facility because most of the accidents involve only one vehicle.

Noise

I do not believe that 65 Ldn should be taken as the criterion of acceptability in discussions of industrial, traffic, or other noise. It may meet HUD standards, but in a letter to Belt, Collins & Associates dated May 4, 1987, acoustical consultants Darby & Associates said that "Federal agencies (HUD, DOT, and EPA) recognize 55 Ldn as a desirable goal for exterior noise in residential areas for protecting the public health and welfare with an adequate margin of safety. Although 55 Ldn is significantly quieter than 65 Ldn, the lower level has not been adopted for regulatory purposes by federal agencies due to economic and technical feasibility considerations.

"In Hawaii, where open-living conditions prevail throughout the year, and where natural ventilation is a prevalent characteristic of residential housing, the more conservative levels of 55 Ldn and 60 Ldn should be used to evaluate potential noise impacts at single and multi-family residences respectively."

Statistics

On page 4-1, a projected jump in county population from 117,500 to 243,000 is labelled as a 48.4% increase. It is, in fact, an increase of about 107%.

The average number of members per household for this project is given on page 4-2 as 2.75. But the factor normally used for planning purposes is in excess of three persons per unit, and if anything, one would expect this project to be above the average. In fact, on page 5-11, a figure of four persons per unit is used. How does this discrepancy affect the various projections?

The table on page 2-4 shows a total of 3614 residences, but elsewhere (e.g. page 5-25) a figure of 3500 is used. With the narrow tolerances of some of the assumptions in this document, it would be better to avoid even small inconsistencies. If ohana construction will be allowed, a more drastic revision is called for.

Sewage

The sewage flow figure shown in the table on page 5-10 for low density residential is wrong. Assuming 3,292 low density units (see page 2-4), it should be 1.317 mgd instead of 0.317. And the figure for the existing lots should be .009 rather than .005. If these were corrected, the total wouldn't be too far off. I haven't looked into whether the nonresidential figures are accurate or not.

The proposed 2.5 mgd plant is cutting it a bit close. If we assume 3614 homes, the projected flow actually exceeds the design capacity. If ohana homes are allowed, it could exceed it by a significant amount.

If sewage effluent is to be put into injection wells, as suggested, might this add to the burden of any desalinization facilities located at the makai side of the project?

No mention is made of what will be done with the sewage sludge.

Solid waste

The calculation on page 5-11 for solid waste output is not correct. If each person creates five pounds of trash per day, the 14,000 or more residents would produce at least 35 tons per day, not 24.

More importantly, the refuse produced by the commercial and industrial components of the project have been omitted entirely. These are not encompassed by the 5-pound per capita figure. And if sewage sludge is to be landfilled off site, this should be accounted for as well.

It doesn't seem quite fair to say, on page 5-11, that because the county's landfill plans are designed to accomodate West Hawaii growth, there will be no significant landfill impacts from this project.

Schools

It is stated on page 5-25 that high school students will go to school in Waimea. There is no high school in Waimea. Did the author intend to say Honokaa, or is there an expectation that a high school will be established in Waimea within the time frame of this project? If so, when? If not, how will the Honokaa and/or North Kohala high school cope with the additional students? How will the intermediate students be accomodated before an intermediate school is built on site? What are the chances that the new

elementary schools will be constructed in a timely manner, and what impact will there be on the Waimea Elementary School in the meantime? Does the traffic analysis take into account all the commuting students?

Recreation

The discussion of recreational facilities starting on page 5-23 omits the gym and swimming pool at Kamehameha Park in North Kohala. The gym referred to on page 5-24 should read "Thelma Parker", not "Thelma Park".

The many questions and uncertainties about this project make the statement on page 5-24 that it will contain no recreational facilities particularly troubling. What are the chances that the on-site schools could include gymnasiums that would serve the community?

Miscellaneous

On page 2-3, the second line says the project is in the southeastern corner of the HHL area. I believe "southwestern" would be more accurate.

In the fourth line on page 4-2, "Puu Kohala" should read "Puukohola".

In the second paragraph on page 4-4, shouldn't "result in" be "result from"?

Honokaa is to the east of the project site, not to the south, as stated on page 5-1.

It seems doubtful that all increase in runoff from impervious surfaces will be handled by drywells, as stated on page 5-1. Is there a comparable existing project with drywells in Hawaii that can be used as a model for this?

Kohala Ranch is adjacent to the Hawaiian Home Lands, but not to the ten-year project, as stated at the top of page 5-14.

Was Waimea omitted from the list of emergency facilities on page 6-5 because the emergency room at Lucy Henriques is not open 24 hours a day?

The reference on page 9-3 to selling "market" residential lots should be elaborated upon. Does this imply that they would be sold to non-Hawaiians? If so, it seems like a dangerous precedent.

Conclusion

My main reaction to this EIS is that is is premature. Before anything else is done, definite plans need to be developed for providing adequate water and for financing the project.

I understand the urgency in returning the Hawaiian people to their land, and if my comments have in any way aided the project in getting on target to succeed in its mission, my efforts will have been repaid.

KOHALA RANCH WATER BALANCE SHEET

I. Supply

A. Estimated sustainable yield.
   1. Per State & County Water Plans: 2.5 million gpd (may include brackish water)
   2. Per Kohala Ranch developer: 2.5 to 3.5 million gpd

B. Minus unmetered line losses: standardly figured at 15%

MAXIMUM AVAILABLE SUPPLY: 2,125,000 to 2,975,000 gpd *

To allow a margin of safety, the State says that usage should not exceed 90% of sustainable yield. If this is heeded, then the figures become:

1,912,500 to 2,677,500 gpd *

* May be less, if State and County are right about brackish water, or if failure of first DHHL well and lower head than expected in second one makes picture even less optimistic than thought. (Note that high head in Kohala Ranch Well #3 merely indicates diked water, and does not affect estimate of sustainable yield.)

II. Demand at build-out

A. Homes in Projects I, II & III: 477 x 5000 = 2,385,000 gpd
   (This does not take into account ohana construction, and it assumes a 10-20% cutback from present average home usage.)

B. Polo and common areas in Projects I, II & III: 30,000 gpd minimum

C. Kohala Estates:
   1. Commitment from Kohala Ranch: 225,000 gpd
   2. Water rights to serve any additional needs of the potential 182 lots and ohana construction, with more affluent buyers coming in, and possible service to Kohala by the Sea.

D. Kohala by the Sea: 42,000 gpd (45,000? 36,000?), and see above

E. Kahua: mauka 51,000 + makai 200,000 = 251,000 + drilling rights

F. Kohala Makai: 417,000 gpd

TOTAL DEMAND WITHOUT PROJECT IV: 3,350,000 gpd <u>minimum</u>

G. If Project IV rezoning is approved
   1. 528 new lots x 2000 to 5000 gpd = 1,056,000 to 2,640,000 gpd
   2. 962 condos x 1000 to 2000 gpd = 962,000 to 1,924,000 gpd
   3. 17.7-acre commercial & misc.: at least 100,000 gpd
   4. common areas: 10,000 to 20,000 gpd?
   5. 27-hole golf course 1,000,000 to 1,400,000 gpd
   (The golf course figures assume some recycling of sewage. The developer's estimate of 25% occupancy x 2.5 persons per unit x 100 gpd of effluent per person would yield 37,250 gpd of effluent, plus whatever the commercial and clubhouse areas would contribute, minus solids and evaporative losses. We believe the 25% estimate is unrealistically low, but it is clear that sewage effluent will not play a very large role in golf course irrigation. Most of the water used in Project IV will be nonrecoverable.)

TOTAL DEMAND FOR PROJECT IV: 3,128,000 to 6,084,000 gpd

TOTAL DEMAND FOR KOHALA RANCH: 6,478,000 to 9,434,000 gpd

NOTE: These figures represent daily demand averaged over an entire year. A larger capacity than this would be required in order to meet peak seasonal demand.

JOHN WAIHEE
GOVERNOR
STATE OF HAWAII

HOALIKU L. DRAKE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

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

March 3, 1992

Ms. Carolyn Pomeroy
P. O. Box 44584
Kawaihae, HI 96743

Dear Ms. Pomeroy:

Draft Environmental Impact Statement
Kawaihae Ten-Year Master Plan
Kawaihae, South Kohala, Hawaii

We have received your letter of December 29, 1991 regarding the subject project. The following has been prepared in response to your comments.

Water

We agree with your contention that Kohala Ranch is not a realistic water source and the statement on page 2-33 will be revised to delete Kohala Ranch as a possible source.

The sustainable yield of DHHL wells are not known at this time. Test results from the second exploratory well is inconclusive and the pilot hole is presently being reamed to a larger diameter. More information regarding the aquifer will be available after the well is prepared and tested.

Criteria established in the "Water System Standard," Vol. I, 1985 of the Dept. of Water Supply, County of Hawaii, was used to compute the water demands for the development. An occupancy of 4 persons per unit was used in the calculations. Water demands to accommodate ohana construction was not considered.

Kehena Ditch was originally considered as a possible source but recent, more stringent EPA regulations governing surface water treatment makes it economically marginal to develop it as a potable water source. Instead this source may be diverted to non-potable uses such as irrigation in a dual water system, and thereby reduce the demand for an equal amount of potable water.

We are aware that private enterprises have expressed interest in constructing a

desalinization plant in Kawaihae, however, discussions with potential developers have only been preliminary, and none have provided details of their proposed operations.

The plan to transport water from the wells to the ten-year master plan site during the initial stages of the project was proposed because the wells are perceived as the most readily available source. However, as other sources such as desalinization plants and/or water from North Kohala wells become available, water from the initial well sources located north of Honokoa Gulch at or above the 1,600 foot elevation will be used to service areas closer to the well site. The future sources would be used to service the low-lying areas and pumped to the higher elevations to accommodate development of the Hawaiian Homelands property. The water system designed for the ten-year master plan is intended eventually to incorporate the future sources.

The words "North Kona" in the first paragraph on page 5-3 will be changed to "North Kohala" and words "Kohala Estates" referenced on page 9-1 will be changed to "Kohala Ranch".

Power

While we agree that amount of incident sunlight in the project area should make it conducive for the utilization of solarthermal power to help service the electrical demand of the Kawaihae ten-year master plan development, current technological requirements would dictate the following in order to meet the project demands:

> 30 acres of land are needed for situating solar panels to produce 5 to 10 megawatts (MW) of power. Thus, about 135 acres are needed for the solar panels to produce the required 45 MW.

This basic parameter at present would indicate that 59.5 percent of the designated industrial land use allocation would have to be dedicated to the provision of the project's basic utility. The intensity of this land use requirement specifically for solarthermal energy development would not make this proposal financially feasible to a developer.

Instead, serious consideration is being given to alternative forms of energy development including a coal-fired power and desalinization co-generation system, which would in totality have a lesser land use requirement plus be more economically feasible.

Visual

Your recommendations regarding the use of interim and long-term architectural standards to retain or improve the visual quality of the area and its surroundings are being taken under advisement.

Based on cost estimates obtained from research into Overhead versus Underground construction of utilities, the estimates indicate that:

- There is no charge to the developer for the construction of overhead lines if Hawaiian Electric Co. can recover the cost in 5 years (which is normally the case).

- The developer will be assessed on the average of $900.00 per lot for the undergrounding of utility lines. Further, the developer will be required to install ducts within the subdivision at approximately $30 per lineal foot. These costs will inevitably be passed on to the future residents of a subdivision.

Traffic

In general, on-street parking on minor streets will be possible on one side thereby assuring safety for pedestrians and bicyclists on the opposite shoulder.

The statement on page 5-14 that describes Kawaihae Road refers to only the segment between Queen Kaahumanu Highway and Kawaihae.

The corresponding AM peak hour Level of Service on Queen Kaahumanu Highway was forecast to be Level of Service C, as shown in Table 2 in Appendix H.

Level of Service D is commonly accepted as a reasonable level of service during the peak hour for highways and arterial streets in planning studies.

The references, "the configuration proposed," and "planned improvements," on page 5-16 refer to the master plan as originally developed by R. M. Towill Corporation. The discussion that follows the questions regarding page 5-16 are associated with the "planned" system. As discussed in Appendix H, the "planned" roadway system assumes a two-lane width on the major roads leading to the project (except Kawaihae Bypass, which would have a three-lane width).

The "planned" improvements were analyzed with a "full bypass" and with a "partial by-pass" (see Appendix H for summary tables). The full bypass analysis assumed that the bypass was completely constructed so that a connection would be made through the adjacent property to the south the project. This connection would require roadway construction on the adjacent property that is not currently funded by the State. On the other hand, the partial bypass analysis assumed that the bypass would be constructed only in part (the part that is on the project site) and the connection would not be constructed through the adjacent property to the south of the site. Under this scenario the existing segments of Kawaihae Road would be used by through traffic until such time as the adjacent property is developed and the bypass is completed.

The last paragraph of page 5-16 compares the full bypass with the partial bypass. For clarification, "higher level of service" should read, "worse level of service" (i.e., a higher volume-capacity ratio).

The roadway level of service north of Kohala Ranch was incorrectly identified as operating at Level of Service E during the AM peak hour. The correct rating should be Level of Service C during the AM peak hour. Also, the corresponding hourly traffic demand identified in Table 7 of Appendix H should be 1,364 and not 2,364 as shown.

The mauka direction on this segment of the bypass would include one regular lane plus one truck climbing lane. The second lane would provide additional passing capacity. In the makai direction, only one lane is planned. The result is that in the uphill (mauka) direction, the capacity was estimated to be about 2,200 vehicles per hour while in the downhill direction, the capacity was estimated to be 1,300 vehicles per hour. Therefore, even though traffic volumes are significantly different between the AM peak hour and the PM peak hour (see Tables 7 and 8 in Appendix H), the better level of service occurs in the direction that has two lanes.

Effects of project traffic on air quality would be "indirect" as described on page 3-19 because of a variety of factors, including different volumes at different periods and varying tradewind conditions. The increase of pollutants can be assumed higher at certain locations because of different volumes of vehicles at certain intersections.

Noise

According to our acoustical consultant, Y. Ebisu & Associates, 65 Ldn is considered an acceptable level for industrial or commercial land uses, since noise levels of 65 to 75 Ldn are normally considered to be compatible with industrial land uses and also with commercial land uses if closure and air conditioning are used for critical spaces (see Figure 1 of Appendix F in the EIS).

The consultant study (Appendix F) also recognizes that 65 Ldn may be too high for determining the acceptability of noise in the residential and commercial lands due to the low background ambient noise levels in the project area. For this reason, adherence to the property line limits of the state DOH were recommended in Chapter VIII of the consultant's report. For residential lots, the state DOH limits equate to approximately 55 Ldn. For commercial and multi-family lots, the state DOH limits equate to approximately 60 Ldn.

Our consultant reiterates the need to use 65 Ldn to evaluate traffic noise along public roadways-- cost considerations plus the scarcity of improved house lots and affordable housing suggest that the use of 55 Ldn is not reasonable for evaluating traffic noise for projects similar to the subject project. Notes from Table 4 of Appendix F that in the absence of shielding effects from berms or sound attenuating walls, setback distances in excess of 300 to 400 feet would be required to reduce highway traffic noise below 60 Ldn. The more reasonable approach used was to adhere to the federal FHA/HUD standard of 65 Ldn for traffic noise, since funding assistance from this agency may be required. Because traffic noise mitigation measures are available through the use of sound attenuating walls, window sound attenuators, or air conditioning, homeowners, at their discretion, could add sound attenuating treatment to further reduce traffic noise without impacting the project as a whole.

Statistics

The population statistics on page 4-1 has been updated and revised, and the text in the Final EIS will reflect this change.

The project market studies prepared by Real Estate Services, Inc. were based on a persons per household ratio of 2.75. However, all engineering infrastructure need projection analyses were based on a ratio of 4 persons per household for residential land uses, and 30 persons per acre for commercial and industrial land uses. Subsequently, the text of the market studies prepared by Real Estate Services, Inc. were revised to reflect a range of 2.75 to 4 persons per household. Because all engineering projections were based on the most conservative ratio (4 persons per household), the "discrepancy" in the market study texts does not affect the various projections in the ten-year master plan.

The targeted amount of residential units for the ten-year master plan is 3500. Thus, while the preliminary master plan unit count may indicate a 3614 unit count, the targeted count will remain the same.

Sewage

The sewage flow figure shown in Table 5-3 on page 5-10 for low density residential is a typographical error. The average daily flow should be 1.317 mgd instead of 0.317. However, the error does not affect the total average flow of 2.571 mgd.

The flow for the 12 existing lots is 0.005 mgd as shown in Table 5-3.

12 (1 ac. lots) x 4 CPA x 100 gcd = 4,800 gal/day = 0.0048 mgd = 0.005 mgd

Ohana construction was not considered in the calculation of average daily flow.

The location of the Wastewater Treatment Plant (WWTP) and desalinization plant has not been confirmed. However, any conflicts or detrimental effects between these facilities will be considered in determining the final sites.

Sewage sludge will be disposed of at the new sanitary landfill.

Solid Waste

The approximate total solid waste output for the residential development indicated on page 5-10 will be revised from 24 to 36 tons per day. (3,600 units x 4/unit x 5 lbs./capita)

The solid waste output for the commercial and industrial components of the project was inadvertently omitted from the total output. These components will be incorporated into the solid waste output projections.

We concur that industrial and domestic solid waste output will have a significant impact on the new West Hawaii sanitary landfill in Puuanahulu.

The developer will investigate all possible on-site reduction and diversion measures to reduce solid waste in conformance with Act 324-91 regarding Solid Waste Management. A study will be conducted to designate an area adjacent to the refuse transfer station or nearby lands for recycling or composting activities. The developer will identify and segregate construction waste and investigate composting or recycling options. Vegetal wastes generated during clearing and grubbing operations will be retained at on-site areas for composting.

Special informational or educational programs and publicity on recycling and greenwaste diversion activities in the community shall also be promoted to encourage waste reduction.

Schools

Contrary to the statement on page 5-25, high school students will attend the existing public high school in Honokaa. According to the state DOE, the department, "cannot assure the availability of classrooms to accommodate such an increase in enrollment over the next decade. The schools in the area are operating beyond their capacity and will require legislative appropriations for additional classrooms."

The DOE recommends that the County require the developer to contribute a fair share for the construction of needed classroom facilities.

The traffic analysis does take into account all the commuting students.

Recreation

Your recommended revisions to pages 5-23 and 5-24 have been noted.

A park associated with a school site is included in the first phase of the master plan. The inclusion of a gymnasium is planned for the second phase.

Miscellaneous

All increase in runoff from impervious surfaces will be handled by drywells as is being done in other West Hawaii residential subdivisions including the Islands at Mauna Lani, Champion Ridge, and Kona Palisades.

Waimea was omitted from the list of emergency facilities on page 6-5 because the emergency room at Lucy Henriques is not open 24 hours a day.

The reference on page 9-3 to market residential lots is a proposed concept by which "up-scale" residential units would be developed for higher income native Hawaiians. The units would be priced to yield a profit for the production of "affordable" residential units. The land parcels would be leased, not sold. Because this is a new concept which would require approval by the Hawaiian Homes Commission, it is presented in the Unresolved Issues

section.

Your recommended revisions to text on pages 2-3, 4-2, 4-4, 5-1, and 5-14 have been noted.

We believe the above responds to your comments and concerns. Thank you for your participation in the planning process of this important project.

Warmest Aloha,

Hoaliku L. Drake, Chairman
Hawaiian Homes Commission

cc: OEQC
R.M. Towill Corp.: C. Sakoda

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF DEFENSE
OFFICE OF THE ADJUTANT GENERAL
3949 DIAMOND HEAD ROAD, HONOLULU, HAWAII 96816

EDWARD V. RICHARDSON
MAJOR GENERAL
ADJUTANT GENERAL

MYLES M. NAKATSU
DEPUTY ADJUTANT GENERAL

RMT		WES	
DK		KTS	
RYK		SRK	
REC'D DEC 13 1991			RMT
RDE			
CSY			
DNY			

December 11, 1991

Engineering Office

Office of Environmental Quality Control
220 S. King Street, 4th Floor
Honolulu, Hawaii 96813

Subject: Environmental Impact Statement
Kawaihae Ten-Year Master Plan

Gentlemen:

Thank you for providing us the opportunity to review the above mentioned Environmental Impact Statement.

We have no comments to offer at this time regarding the project.

Sincerely,

Jerry M. Matsuda

Jerry M. Matsuda
Lieutenant Colonel
Hawaii Air National Guard
Contracting and Engineering Officer

Enc.

c: Department of Hawaiian Home Lands
R. M. Towill Corporation

DEPARTMENT OF THE NAVY
COMMANDER
NAVAL BASE PEARL HARBOR
BOX 110
PEARL HARBOR, HAWAII 96860-5020

IN REPLY REFER TO
11011
Ser 00F2/0168
23 JAN 1992

REC'D JAN 27 1992

State of Hawaii
Office of Environmental Quality Control
220 South King Street, 4th Floor
Honolulu, HI 96813

Gentlemen:

KAWAIHAE TEN-YEAR MASTER PLAN

We have reviewed the subject DEIS and have no comments to offer. Since we have no further use for the DEIS, it being returned to your office.

Thank you for the opportunity to review the draft.

Sincerely,

W.K. Liu

W.K. LIU
Assistant Base Civil Engineer
By direction of
the Commander

Copy to:
Dept of Hawaiian Home Lands
(Attn: Mr. Darrell Ing)
R. M. Towill Corp.
(Attn: Ms. Colette Sakoda)

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
LAND USE COMMISSION
Room 104, Old Federal Building
335 Merchant Street
Honolulu, Hawaii 96813
Telephone 548-4611

ESTHER UEDA
EXECUTIVE OFFICER

RECD DEC 16 1991

December 12, 1991

Mr. Brian Choy, Director
Office of Environmental
Quality Control
Central Pacific Plaza
220 S. King Street, 4th Fl.
Honolulu, Hawaii 96813

Dear Mr. Choy:

Subject: Draft Environmental Impact Statement (DEIS) for the Kawaihae Ten-Year Master Plan, Kawaihae, South Kohala, Hawaii

The Department of Business, Economic Development and Tourism has referred the subject DEIS to our office for response.

We have reviewed the subject DEIS for the Kawaihae Ten-Year Master Plan and confirm that the Ten-Year Plan Area is designated within the State Land Use Urban and Agricultural Districts.

We have no other comments to offer at this time. We appreciate the opportunity to comment on this matter.

If you have any questions, please call me or Bert Saruwatari of our office at 587-3822.

Sincerely,

Esther Ueda

ESTHER UEDA
Executive Officer

EU:to

cc: DBED
Darrell Ing
Colette Sakoda

APPENDIX A

TOWN CENTER MARKET ASSESSMENT
By Real Estates Services, Inc.

DEPARTMENT OF HAWAIIAN HOME LANDS
KAWAIHAE MASTER PLAN

'TOWN CENTER'

TABLE OF CONTENTS

DEPARTMENT OF HAWAIIAN HOME LANDS
KAWAIHAE MASTER PLAN

'TOWN CENTER'

AUGUST 9, 1991

The following are the assumptions and conclusions concerning the 'Town Center' proposed for the lower portion of the Kawaihae Master Plan area.

KAWAIHAE TOWN CENTER

A 'Town Center' serves as the commercial, social and recreational core of a community. Currently, these types activities are limited in the Kawaihae area; only a small commercial complex exists with limited competitive alternatives. With increased population and accompanying demand, the need is evident for expanded commercial activities.

The growth in population and the demand for commercial uses are the focus of the planning for the Town Center. There are other aspects to a 'Town Center' over and above commercial enterprises. In addition to commercial uses (including retail, professional office and others), there are public uses (including police, fire, postal, library and others) and community uses (including open space, recreational, meeting facilities and others).

The assumptions and recommendations concerning the various uses are reviewed and summarized according to the following categories: Commercial (Retail and Office), Public and Community. Since the proposed site for the Town Center is near the makai portions of the Kawaihae property and this site is conducive to supporting the nearby maritime and business commercial uses, an additional category dealing with maritime and business commercial uses will be included in the review (even though the specific uses may be more supportive of the neighboring industrial use, rather than the needs specific to the Kawaihae residential community).

The planning for commercial development considers phasing and expansion of an initial 'Neighborhood' center to incrementally increase in size to a 'Community' center level. This expansion is based on population growth in the immediate and surrounding areas, as well as the expansion of the Harbor facilities and the need for maritime/business related commercial and support facilities.

ASSUMPTIONS:

The commercial demand estimates and 'Town Center' recommendations are based on several assumptions. The estimates assume that: (1) The population estimates in the M-K Series are accurate; (2) the number of houses and 'typical' family sizes to be built in the Kawaihae project (3,500 homes in ten years) will be accomplished; (3) other regional development will accommodate regional commercial demands; (4) development standards (ie. infrastructure design and implementation) reflect County standards; and (5) commercial development at Kawaihae is timed to anticipate and meet market demands.

SUMMARY OF CONCLUSIONS/RECOMMENDATIONS

The following summaries and supporting assumptions and conclusions represent the overall commercial property recommendations for the first phase of development of 3,500 homes at Kawaihae. It is understood that a subsequent phase will include mauka lands at Kawaihae; that area is expected to have its own 'Town Center' and other supporting commercial properties.

Land Use	Estimated Demand (Acres) Minimum	Maximum
Commercial		
Community Center (1)	20.00	30.00
Neighborhood (2)	7.50	7.50
Convenience (2) (3-4 @ .75 ac)	2.25	3.00
Regional Center	none	none
Reserve	5	10

Note: (1) The proposed Community Center (Town Center) is proposed to be situated at the makai portion of the property.

(2) The proposed commercial uses will be situated within the mid-level portion of phase 1 of the project.

SUMMARY OF USES - TOWN CENTER

The following are 'summaries of findings, conclusions and recommendations as indicated in this report as they relate to the phased development of the 'Town Center' situated at the makai portion of the Kawaihae Planning Area. These figures further detail the land area recommendations listed previously.

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Total
Residential	700	700	700	700	700	3,500
Population	2,500	2,500	2,500	2,500	2,500	12,500
Commercial (SqFt)						
Retail	50,000		40,000		30,000	120,000
Office	5,000		5,000		5,000	15,000
Business	10,000		10,000		10,000	30,000
Public						
Police	1 Ac					
Fire	1 Ac					
Postal	(x)					
Library			(x)			
Office	(x)		(x)			
Community						
Park	5 Ac					
Meeting	5,000 SF					
Reserve	25 Ac		15 Ac		5 Ac	5 Ac
Other Project Commercial (SqFt)						
Retail/Office					45,000	45,000
Convenience		6,000		6,000	6,000	18,000

Note: (x) The 'Public' facilities are anticipated to be situated within the commercial development of the Town Center. They are not necessarily anticipated to be isolated structures, but rather incorporated and/or free-standing structures in the commercial complex.

Reserve: It is recommended that approximately 5 to 10 acres be held in reserve for commercial and related expansion (over and above the proposed uses illustrated above) should the market dictate the need. The descending acreage illustrated in the 'Reserve' category above assumes that reserve land will be used by the above development recommendations. At the conclusion of the proposed Town Center development an additional 5 to 10 acres remain available for further expansion, if market conditions indicate the need.

Other Project Commercial: This category of commercial space are recommended commercial activities outside of the Town Center. These include a Neighborhood Center within the project and 3 to 4 Convenience sites.

ASSUMPTIONS AND CONCLUSIONS

POPULATION PROJECTIONS

Since a driving force affecting the development and phasing of the 'Town Center' is the demand for commercial products and services, a review of the population projections and assumptions is in order. These population assumption and projections are based on the findings in the June 1, 1991 "Market Research and Analysis" report prepared for the Department of Hawaiian Home Lands concerning the Kawaihae planning area.

ASSUMPTIONS:

> Population and housing demand assumptions consider two main components. These estimates assume that: (1) The population projections illustrated in the State's M-K Series reflect the most predictable population estimates for the region; and (2) the M-K Series estimates do not necessarily include the DHHL's goal to build 3,500 housing units at Kawaihae (part of the total 14,000 housing units to be built statewide) over the next ten years.

Most analysis considers the State's M-K Series estimates as the primary source of projected population for the region. Based on these assumptions, the following are the population estimates for the market area:

DISTRICT BREAKDOWN OF POPULATION PROJECTIONS
BASED (IN PART) ON STATE M-K SERIES

	1990	1995	2000	2005	2010
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	56,700	64,800	73,000	82,300	93,800

These summaries do not include the population increases that would result from the development of the Kawaihae site. They reflect projected regional trends of population growth. It is understood, and an underlying assumption in this report, that the DHHL has a goal of building approximately 3,500 housing units at Kawaihae over the next ten years. Using the 'typical' household size of approximately 2.75 to 4 persons per household, this indicates a population increase at the Kawaihae project of approximately 9,500 to 15,000 persons.

The establishment of a 'Town Center' is based on several assumptions. The 10-year plan for Kawaihae includes approximately 3,500 new residential units with approximately 9,500 to 15,000 people. DHHL will depart from traditional practice and participate in the development of some of these residential units. (Previously, homestead sites were awarded and beneficiaries were responsible for the construction of their homes.) DHHL will cooperate with HFDC and others, and homes will be built through their joint effort.

Obviously, these new homes will not be developed simultaneously but will be constructed in phases. In addition, the area must first be serviced with various levels of infrastructure (ie. roads, water source and distribution and other basic development items), then residential phase development can commence.

According to preliminary scheduling expectations indicated by R.M. Towill Corporation (the lead planning consultant), the residential development plan is addressed in five (5) phases over the initial ten-year period. Each phase is proposed to involve approximately 700 residential units. Phases will be developed sequentially over the ten-year development period.

The initial infrastructure necessary to commence residential development is anticipated to require approximately 2 years to complete before residential development can occur. The residential phases of development will begin at the expiration of this time and after the bulk of the infrastructure is in place.

According to the anticipated time schedule, the residential development will be completed in ten years. This means that the five phases of residential development will be accomplished in approximately 8 years (commencing after the initial 2 years of infrastructure development).

COMMERCIAL PROPERTY DEMAND

Assuming the estimated direct population increase of approximately 9,500 to 15,000 persons, the indicated direct market demand for commercial space includes a community center (an indicated approximate 120,000 square feet of direct demand), a mauka neighborhood center (approximately 45,000 square feet in size) and several (possibly 3 to 4) free-standing convenience stores with associated support uses (ie. possible gas station and offices, each on approximately 3/4 acres of land) over the initial ten-year development term.

The location of the initial commercial community Town Center is assumed to be near the makai project perimeter on a major roadway to conveniently accommodate the additional regional demand. This would serve the immediate and a portion of the regional demands. Reserve lands should be set aside, adjacent to the center, for possible future expansion, if the market indicates it is needed.

The neighborhood center should be located mauka, within the developed and growing residential area of the Kawaihae planning area. This center will create competitive and convenient shopping opportunities for the Kawaihae residents in the planning area.

It is not anticipated that there is sufficient local and regional demand for the construction of a large-scale regional shopping center on the site within the initial 10-year term. Since an additional Town Center is anticipated for the mauka phase of development, direct and indirect demand can be accommodated there.

Several factors limit the immediate development, and long term planning, of a regional shopping center at Kawaihae. The immediate limiting factor is population (both actual numbers of people and population distribution).

A regional center requires approximately 50,000 in surrounding population in order to justify its development. M-K Series estimates do not indicate this level of population in the foreseeable future, or within the planning horizon, in the Kawaihae area. A more likely area for the regional shopping center development in the market area of Kawaihae is in Kailua-Kona where the greater concentration of people is and is expected to be.

There are several sites in North Kona under consideration for expansion to a regional center capacity. The regional population is centralized in this area and it is likely that Kona's commercial expansion will satisfy the foreseeable regional needs. North and South Kohala residents fall within the regional market for a North Kona regional shopping center.

Several properties are now under consideration for expansion or development of a complex to satisfy the regional demand in the form of a regional shopping center. Lanihau Shopping Center in Kailua-Kona has announced a significant expansion of its existing community facility. In addition, Bedford Properties, owner of the Kona Coast Shopping Center (across Palani Road from Lanihau) has proposed an almost doubling of its size. Kamehameha Investment (a development arm of Bishop Estate) has requested an expansion of its Keauhou Shopping Village.

Queen Liliuokalani Trust has indicated an interest in developing a major commercial center on its property at the intersection of Palani Road and the Queen Kaahumanu Highway.

They are in the midst of land use change requests to accomplish this plan. A shopping center has been proposed at the 'Dillingham' property on Kuakini Highway just south of Kailua-Kona.

The commercial space demand at Kawaihae is not isolated to the retail aspect of commercial space. A segment of the commercial demand is seen in the expansion of the Kawaihae Harbor and the need for maritime, business and support facilities serving the harbor needs. Commercial office space, situated conveniently near the harbor and the Town Center, is part of this overall commercial demand.

For the purposes of this analysis, and consistent with the evaluation of studies concerning commercial property demand, the market area for the Kawaihae property is primarily centered in the specific Kawaihae area, and secondarily includes the districts of North and South Kohala and North Kona.

COMMERCIAL RETAIL AND OFFICE DEMAND

It is recommended that initial planning include a neighborhood center magnitude commercial development in the Town Center core that will expand to a community center level as the market increases with increased population and demand. This expansion would be based on population growth in the immediate and surrounding areas, as well as the expansion of the harbor facilities and the need for maritime/business related commercial and support facilities.

The Hawaii County General Plan defines a Neighborhood Center as:

Neighborhood Center
- Provide: Convenience goods, e.g., foods, drugs, and personal services.
- Major Shops: Supermarket and/or drug store.
- Number of Shops: 5 to 15
- Acreage: 5 to 10 acres.
- Approximate Size: 50,000 square feet GLA
- Approximate Market: 3,000 people.

A center of this size and scope (approximately 50,000 square feet) will likely accommodate the demand after the initial phase of residential development is completed (ie. approximately 700 homes with a resulting population increase of approximately 2,000 to 3,000 people.) Included in the estimated direct demand from residential development, this sized center could also accommodate some of the regional demand.

In addition to a traditional supermarket, likely initial commercial tenants would include a family style restaurant (or fast food franchise), automobile service/gasoline station and possibly a hardware and/or general merchandise store.

Affiliated commercial office space is limited to support and professional services. A limited area (approximately 5,000 square feet) of office space should be included in the initial phases of commercial development within and around the center.

Initial commercial office uses include real estate, insurance and legal professional offices. These users will likely provide satellite services at Kawaihae while maintaining base facilities in other locations (Kailua-Kona, Waimea, Hilo or Honolulu).

As the Kawaihae planning area continues to develop with subsequent phases of residential development, the 'Neighborhood Center' should expand with the growing demand and reach the scale of a 'Community Center'.

The Hawaii County General Plan defines a Community Center as:

Community Center
Provide: Convenience goods, plus "soft line" items, such as clothing, and "hard line" items, such as hardware and small appliances.
Major Shops: Variety or junior department store.
Number of Shops: 20 to 40.
Acreage: 10 to 30.
Approximate Size: 50,000 SF to 150,000 SF GLA
Approximate Market: 15,000 people.

The market indicates that demand from the subsequent phases of residential development should be satisfied with the construction of an additional 70,000 square feet of commercial retail space within the Town Center over a number of years. This commercial expansion should occur with the completion of the 3rd and 5th phases of residential development; bringing the total commercial area to approximately 90,000 square feet and then approximately 120,000 square feet. Some of this additional space will satisfy new tenants, while some will involve expansion of existing tenants space.

The final level of expansion of the commercial retail/office development would occur as the fifth phase of residential development occurs. At this point the local area population is expected to number approximately 9,500 to 15,000 people, housed in 3,500 homes.

At the conclusion of the fifth phase of residential development, and after completion of the commercial properties, approximately 120,000 square feet will make up the retail commercial facet of the 'Town Center' development.

At this point, a major supermarket facility should be the established anchor tenant. This facility will be supported by a variety of other retail outlets, including: food service, hardware, clothing and other uses.

Complementing the retail space are three phases of commercial office development integrated into the center. As indicated in the summary chart, office development is scheduled to coincide with the retail development. This can be accomplished by placing most office spaces on the second floor of the two story retail/commercial complex.

Included in this recommendation, though not a specific use in the Town Center, is the scheduling of the convenience store construction. The recommendation indicates the construction of a neighborhood center (approximately 45,000 square feet) and possibly 3 to 4 convenience stores within portions of the residential development in the 'alternating' years of phase development (ie. build the neighborhood center near the end of the phased development [approximately phase 5] and convenience stores during phases 2 and 4).

MARITIME/BUSINESS COMMERCIAL

Depending on the timing of the harbor facilities expansion, the related maritime commercial and other business needs could be in the 20,000 square foot to 30,000 square foot level of total related professional and support office space in addition to the recommended office space associated with the centers.

In order to maintain a competitive advantage over neighboring properties and as a means to satisfy the probable demand, a systematic schedule of office and related development should take place during the various phases of residential development. As part of the initial phase of residential development, a small office facility devoted to maritime/business office use should be considered.

The probable tenants include major harbor users and support office use. Companies such as Matson, Young Brothers, Hamakua Sugar, Kawaihae Terminals and others currently have limited facilities at Kawaihae. As demand for space in and around the harbor increases with the harbor's increased capacity, these entities should be encouraged to locate in a central office complex out of the high demand harbor area, yet central to the overall harbor operations. Included in this list of potential tenants is the State Department of Transportation.

As in the case above, maritime/business support development and related business space development is scheduled during the odd numbered phases of residential development. This schedule, however, should coincide more directly with the expansion of the Kawaihae Harbor, and not be specifically conditioned on the development of houses or the Town Center complex.

The specific sizing and scheduling of the maritime/business space depends primarily on the adjoining harbor development and associated demand. While general harbor expansion plans are known, until more specific information is made available and known about its actual scheduling and expansion, DHHL plans for maritime/business space sizing and timing should be flexible.

PUBLIC FACILITIES

Public facility development encompass three primary areas: emergency, support and office. These are outlined below.

Under the 'emergency' category, the primary areas of concern are police, fire and ambulance facilities. Land should be held in reserve to accommodate these needs in and around the Town Center. The specific timing for construction depends primarily on the perceived needs and capacities of the local government.

The second aspect of public facilities are categorized under the 'support' heading. Two primary components under this include postal service and library services. Space should be made available in the initial phase of commercial retail development to accommodate the Kawaihae Post Office. This could either be a free-standing structure or space within the center. Subsequent phases of the Town Center development should include an allocation for a public library facility.

The primary focus under the 'office' category include space allocation for DHHL offices (if they so desire) and allocation for 'satellite' office space for County and State departments. Space allocation and construction of this space should occur in the initial and second phase of commercial development.

COMMUNITY USES

The Town Center should include a variety of community uses. These consist of parks, meeting facilities and reserve land for expansion, as needed. These are commented on below.

Parks encourage residents and others to congregate in the Town Center. Bringing people to the Town Center will help support the commercial aspects of the center, as well as allow people to recreate and socialize in a central area.

Many communities have meeting facilities. Good examples of this are the Parker Ranch Kahilu "Town Hall" and DHHL's "Kuhio Hale" in Waimea. A similar facility should be constructed

during the initial residential and commercial phases of development.

The final category of 'community' uses is the reserve category. The theory behind this use is to assure adequate expansion for a variety of uses, should the need arise. A common failure of commercial and related development is to inadequately prepare for unexpected demand and future growth opportunities.

The initial land area held in reserve is estimated to be approximately 25 acres. Some of this 'reserve' land is actually planned for future commercial and related development (ie. the second phase of commercial development would be on some of this reserve land.)

It is recommended that additional lands surrounding the Town Center be held in reserve for future needs (ie. commercial, office, etc.). The summary of uses found on page 5 of this report illustrates a descending order to reserve land allocation (portions of the reserve are used in subsequent commercial and related development).

In the interim, this land could be used in a variety of ways. Obvious uses are as park land or simply undeveloped open space. It is recommended that approximately 5 to 10 acres be held in final reserve once all recommended and planned commercial and related development is completed in the Town Center.

COMMERCIAL DEMAND SUMMARIES

The following are summaries of commercial property demand in the similar market area of the Kawaihae project. By most definitions in each of the studies, the market area includes North and South Kohala and North and South Kona. The specific market area includes this broad range of districts with primary emphasis on the South Kohala district. Each of the studies include the specific estimated demand conclusion. The figures listed are the respective study conclusions. Each of the projects are either in various stages of implementation or continue in active planning.

KEALAKEHE MASTER PLAN
Kealakehe Plan - Market Analysis Commercial Space

	Low	High
1995	23,900 SF	32,100 SF
2000	38,400 SF	52,100 SF
2005	55,400 SF	74,600 SF
2010	66,000 SF	88,900 SF

Kealakehe Plan - Market Analysis Office Space

	Low	High
1995	3,100 SF	4,200 SF
2000	5,000 SF	6,800 SF
2005	7,200 SF	9,700 SF
2010	8,600 SF	11,600 SF

PARKER RANCH 2020 PLAN
Parker Ranch 2020 Plan

	Waimea
1990	193,400 SF
1995	311,500 SF
2000	393,500 SF

KPMG - PEAT MARWICK
Puako Mauka - Market Analysis

	Assume 25 % of Regional Demand Resident Demand	Total Demand
1990	37,000 SF	51,000 SF
1995	73,000 SF	101,000 SF
2000	95,000 SF	136,000 SF

KPMG - PEAT MARWICK
Puako Mauka - Market Analysis

	Assume 30 % of Regional Demand Resident Demand	Total Demand
1990	45,000 SF	73,000 SF
1995	89,000 SF	144,000 SF
2000	116,000 SF	195,000 SF

HALLSTROM APPRAISAL GROUP
Signal Puako - Market Analysis

Summary calculations for commercial property demand were based on an island average of 88.87 square feet of commercial space per household. Their analysis concludes a latent commercial demand of 20,000 to 35,000 square feet. Project related and regional demands indicate a demand for approximately 257,732 square feet over the initial ten (10) years of their development (encompassing a land area of approximately 17.75 acres), and a similar amount over the balance of the development. This equates to an overall demand of approximately 515,000 square feet of commercial space demand on a total land area of approximately 35 acres over the next 15 to 20 years.

MING CHEW
Department of Hawaiian Home Lands - Kawaihae - Office Demand

	N/S Kona	N/S Kohala
1985-1990	50,000 SF	60,000 SF
1991-1995	60,000 SF	60,000 SF
1996-2000	40,000 SF	70,000 SF
Total	100,000 SF	190,000 SF

BIBLIOGRAPHY OF REPORTS REVIEWED

The following is a listing of some of the reports, analysis and studies considered in the review of the project. Many of the findings in these reports have been listed in the enclosed report. While others may have not been cited, they were reviewed in the analysis of this project.

Hawaiian Home Lands, Kawaihae Plan, Ming Chew Associates, May 1986

Hawaii County General Plan, Hawaii County Planning Department

Assessment of the Major Infrastructure Needs for the Northwest Hawaii Region, Hawaii County Planning Department

West Hawaii Regional Plan, Office of State Planning

Kealakehe Market Analysis, KPMG Peat Marwick, January 1988

Market Assessment for Kealakehe Planned Community, Kealakehe, North Kona, Hawaii, KPMG Peat Marwick, July 1990

Market Analysis for Proposed South Kohala Resort, Ming Chew Associates, May 1987

Environmental Impact Statement for the South Kohala Resort (including Community Resources, Inc. community survey and analysis)

Population Projection Analysis 1985 to 2005 for the Island of Hawaii, The Queen's Medical Center, Honolulu, Hawaii January 1988

Market Assessment of a Proposed Support Community in South Kohala on the Island of Hawaii, Peat Marwick, August 1985

Analysis of Market Potentials for Selected Parker Ranch Properties Located in Waimea, Hawaii, Natelson-Levander-Whitney, June 1985

Economic and Fiscal Impact Assessment for Resort Development at the Awake'e Resort, North Kona, Hawaii, Peat Marwick, October 1986

Market Study and Highest and Best Use Analysis for the 470.13-Acre Oceanfront Holdings Located at Kohanaiki, North Kona, Hawaii, The Hallstrom Appraisal Group, Inc., May 1985

Analyzing the Market and Environmental Impacts of the Golf Industry in Hawaii, Hawaii Real Estate Research and Education Center, College of Business Administration, University of Hawaii, February 1990

Market Analysis for Proposed Resort at Kaupulehu, Ming Chew Associates, August 1985

Market Study for the Proposed Signal Puako Mixed-Use Community, The Hallstrom Appraisal Group, Inc., September 1987

Economic and Fiscal Impact Assessment for the Planed Mahukona Resort Community, North Kohala, Hawaii, KPMG Peat Marwick, April 1990

Analysis of Market Potentials for Selected Queen Liliuokalani Trust Properties Located in the District of North Kona, Island of Hawaii, Natelson-Lavender-Whitney, Inc. November 1989

APPENDIX B

GEOTECHNICAL ENGINEERING RECONNAISSANCE
By Geolabs-Hawaii

GEOTECHNICAL ENGINEERING RECONNAISSANCE
KAWAIAHAE 10-YEAR MASTER PLAN
KAWAIAHAE, SOUTH KOHALA, HAWAII

W.O. 2730-00 SEPTEMBER 13, 1991

FOR

R.M. TOWILL CORPORATION

C.W. ASSOCIATES INC.
DBA GEOLABS-HAWAII
2006 KALIHI STREET
HONOLULU, HAWAII 96819

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CW ASSOCIATES, INC. dba
GEOLABS-HAWAII
Geology Soils and Foundation Engineering

September 12, 1991
W.O. 2730-00

R.M. Towill Corporation
420 Waiakamilo Road
Suite 411
Honolulu, Hawaii 96817-4941

Attention: **Mr. Stephen Kellogg, Manager**

Gentlemen:

Submitted herewith, is our report entitled "Geotechnical Engineering Reconnaissance, Kawaihae 10-Year Master Plan, Kawaihae, South Kohala, Hawaii".

Our work was performed in accordance with the scope of services outlined in our proposal of April 29, 1991.

Detailed discussion and recommendations are contained in the body of this report. If there is any point that is not clear, please feel free to contact our office.

Very truly yours,

C.W. ASSOCIATES, INC.
dba GEOLABS-HAWAII

Bob Y.K. Wong, P.E.
President

(dk/data/reports.002/as - 2730cov.def)

2006 Kahhi Street • Honolulu, Hawaii 96819
Telex 7431732 GEOHI • Facsimile 847-1749 • Phone (808)841-5064

GEOTECHNICAL ENGINEERING RECONNAISSANCE

KAWAIHAE 10-YEAR MASTER PLAN

KAWAIHAE, SOUTH KOHALA, HAWAII

W.O. 2730-00 SEPTEMBER 12, 1991

SUMMARY OF RECOMMENDATIONS

It is our opinion that development of the master plan area is feasible from a geotechnical engineering point-of-view. The volcanic basalt formation underlying the site should provide adequate support for the proposed site improvements.

There are no economic minerals in exploitable concentrations or quantity and there are no fossil fuel deposits at the project site.

Geologic hazards, i.e., seismic activity, volcanic activity, inundation and ground subsidence, do not present any unusual problems for the subject project in comparison to any other development in this area of West Hawaii.

The exploration revealed that the site is underlain by a surface layer of dry friable silt (volcanic ash) varying from two (2) to four (4) feet in thickness below the existing subgrade. This material generally exhibits a low dry strength and is susceptible to erosion. The surface ash layer is underlain by volcanic rock formations with varying degrees of hardness to the maximum depths explored.

INTRODUCTION

We have conducted a geotechnical engineering reconnaissance in support of the preparation of an Environmental Impact Statement for the development of the subject property.

This report summarizes our work on the project and presents our preliminary findings pertinent to the proposed development of the site. The work was performed in general accordance with our fee proposal to R.M. Towill Corporation, dated April 19, 1991.

PURPOSE AND SCOPE

The purpose of our reconnaissance was to obtain an overview of the subsurface soils and rock conditions within the proposed master plan development area in order to provide data for the formulation of preliminary geotechnical engineering recommendations pertinent to the Environmental Impact Statement for the proposed project and the preliminary design of the proposed development and its various elements, including grading, roadway and associated infrastructure installation. The exploration was limited to the portions of the site accessible to four-wheel drive vehicles.

The findings and recommendations presented herein are of a preliminary nature. Therefore, they are not sufficient for final civil design nor should they be considered sufficient for detailed cost analyses of the subject project or its elements.

The scope of our reconnaissance consisted of the following tasks and work efforts:

1. Mobilization of a refraction seismograph with operators to and from the project site.

2. Performance of ten (10) geophysical surveys (seismic refraction) at selected locations within the accessible portions of the proposed development area.

3. Excavation and logging of fifteen (15) shallow test pits within the accessible portions of the site using a combination loader/backhoe.

4. Detailed site reconnaissance, coordination of the field work and logging of the test pits by a Senior Geologist from our firm.

5. Engineering analyses of the field data for the formulation of preliminary geotechnical engineering recommendations pertinent to the preliminary design and construction of the proposed access roads, site grading and appurtenant utility installation.

6. Preparation of this report presenting our findings and recommendations.

7. Coordination of our overall work on the project and design team consultation by a Principal Engineer of our firm.

8. Miscellaneous work efforts such as drafting, word processing and clerical support.

GENERAL SITE DESCRIPTION

The project site is situated in the District of South Kohala on the island of Hawaii to the northeast of Kawaihae Harbor. The site is bounded by the Pacific Ocean to the west, Honokoa Gulch to the north, vacant land to the east and Makahuna and Palihae Gulches to the south. Most of the proposed development area is vacant land which has been used for pasturage of livestock. Along the lower portions of the site fronting Akoni Pule Highway, there are existing commercial, industrial and residential developments.

The ground surface elevations range from sea level to about 1,400 feet above Mean Sea Level. The terrain generally slopes in a westerly direction at a ratio of about five horizontal to one vertical (5H:1V) and drainage is in a westerly direction along relatively well defined drainage paths.

The site is generally vegetated with a thin cover of grasses and there are isolated stands of algaroba (Keawe) trees. Under the grass cover, the ground surface is covered with boulders and cobbles creating a very rugged surface. In the southerly portion of the site, a recent range fire had burned away most of the vegetation leaving barren boulder and cobble fields.

Along the northerly boundary, Honokoa Gulch forms a sharp topographic break. Visual observations of the gulch indicate that the sides of the gulch are nearly vertical with heights on the order of about 600 feet.

In the existing developed commercial and industrial areas, some grading work has been done or is currently in progress. This grading work appears generally to be the placement of fills on the existing slopes.

PROJECT CONSIDERATIONS

It is proposed to develop the project site as a master planned community. It is anticipated that the development will include site improvements such as residential subdivisions, community centers and industrial or commercial areas.

The project is in the early planning and Environmental Impact Statement preparation stage, therefore, specific details of the proposed site improvements were not available for the preparation of this report.

SUBSURFACE CONDITIONS

Regional Geology

The project site is situated on the southwestern flank of Kohala Mountain which is the oldest of the five (5) shield volcanoes forming the island of Hawaii. Kohala Mountain was built during the Pleistocene Epoch by basaltic lava flows from the Pololu and Hawi Volcanic Series.

Typically, the lava flows of the Pololu series are composed of tholeitic olivine basaltic lava flows grading to oceanite. Generally, such flows are characterized as thinly bedded with a high degree of porosity.

During the later stages of the active phase of Kohala Mountain, vents of the Hawi Volcanic Series opened. These events, extruding lavas of andesitic and trachytic composition, built cinder cones along the main rift zones of the mountain and extruded lavas which covered most of the Pololu rocks. These andesitic rocks generally form thicker and denser flows.

Based on our field observations, there is an alignment of cinder cones trending through the site. This may be evidence of a minor rift tending through the site.

An early geologic map by Stearns and Macdonald indicates that the rocks exposed at the surface of the site are Pololu lavas. However, visual observation of the sidewalls of Honokoa Gulch along the northerly boundary of the site leads to the opinion that there is a thin layer of Hawi lavas overlying at least portions of the site.

This same map shows a nearby inferred fault trending in a southwest to northeast direction. The inferred location of this fault is approximately 3,000 feet north of the site.

There is no apparent or visible evidence of movement or activity along this fault since the Pleistocene.

During our field exploration, it was noted that there is a surface layer of ash soil mantling the site. This ash soil is blanketed with many exposed cobbles and boulders. It is believed that this surface ash, the boulders and cobbles are airfall deposits from a large explosive eruptive event which may have occurred on either Mauna Kea or Mauna Loa.

The ash soil at the project site differs from Pahala Ash found in other portions of the island of Hawaii in that the in-situ moisture content is somewhat lower and the soil exists in a friable state as opposed to the plastic soil found in more humid areas such as along the Hamakua Coast and the mauka areas of North and South Kona.

Soil Conditions

The site and its vicinity were previously mapped by the U.S. Department of Agriculture Soil Conservation Service as part of an overall soil survey of the island of Hawaii. In this survey, the Soil Conservation Service mapped the site as having the following soil types:

Kawaihae very rocky very fine sandy loam (KOC) - These soils consist of very stony excessively drained soils formed in volcanic ash. They are characterized by moderate permeability and a moderate to high susceptibility to erosion.

Puu Pa extremely stony very fine sandy loam (PVD) - These soils consist of very stony soils formed in volcanic ash underlain by fragmental a'a lava. They are characterized by moderate permeability and a moderate to high susceptibility to erosion.

Field Exploration

The subsurface conditions at the site were explored by the performance of ten (10) geophysical surveys (seismic refraction) and by the excavation of fifteen (15) shallow test pits within the accessible portions of the master planning area. It should be noted that the rugged surface conditions limited access in areas which had not been cleared as jeep roads or trails and that the friable ash soil prevented travel along some of the trails.

In general, our exploration encountered a surface layer, varying between two (2) to four (4) feet in thickness, of reddish-brown silt (Pahala Ash) grading to weathered basalt formation with increasing depth. Below this surface layer, our exploration indicated in-situ volcanic formations consisting of interbedded basalt and clinker to the maximum depths explored.

The typical estimated seismic velocities for the various materials underlying the site are:

Material Type	Seismic Velocity (feet per second)
Pahala Ash or Loose Clinker	< 2000
Dense Clinker or Vesicular/Jointed Basalt	1500 to 3500
Dense Basalt	> 3500

Generally, basalt formations with seismic velocities of less than 7500 feet per second are considered to be rippable with a large bulldozer. However, ripping is dependent upon the jointing of the formation, the configuration of the rippers and the skill of the operator. It has been our experience that, for economical production, formations

with velocities exceeding 3500 feet per second are generally more efficiently excavated with some amount of blasting.

Groundwater was not encountered in the test pits during our exploration.

Detailed descriptions of our field exploration along with the geophysical survey results and test pit logs are presented in Appendix A of this report.

DISCUSSION AND RECOMMENDATIONS

General

Based on our reconnaissance and analyses, it is our opinion that development of the proposed master plan area is feasible from a geotechnical engineering point-of-view.

The volcanic formation encountered at the project site should provide adequate bearing for the proposed site improvements provided that our recommendations are followed. The dry friable ash soil encountered at the surface throughout most of the site generally has low strength characteristics and is susceptible to erosion. Therefore, some modification to standard grading design and construction procedures will be required for this project.

Whenever possible, the ash soil should be stockpiled for use as topsoil rather than used as embankment fill material. Efforts should be made to construct the majority of the embankment of the more competent excavated basalt and clinker materials, if reduced to less than 12 inches in size.

The excavated ash soils may be utilized as fill provided that special consideration is given to its placement.

Geologic Resources and Impacts

Hawaii is typically poor in economic geologic resources. There are no economic minerals in exploitable concentrations or quantity and there are no fossil fuel deposits in the islands. Exploitable earth resources in Hawaii are generally limited to groundwater, geothermal energy and the volcanic rock itself.

Groundwater Resources

At the project site, groundwater occurs as a basal water table in saturated volcanic rocks at or very near to sea level. No data is available specifically concerning the quality of the groundwater below the project site, however, it is believed that some highly brackish water occurs as a thin lens floating over saline groundwater.

Geothermal Resources

Resources of geothermal energy are generally limited to active rift zones. To date, viable geothermal reserves have only been encountered in the East Rift Zone of Kilauea on the eastern side of the island of Hawaii.

The project site is situated on the flank of Kohala Mountain which has apparently be inactive since the Pleistocene Epoch. No known signs of active geothermal or hydrothermal activity are evident on Kohala Mountain.

Therefore, it is unlikely that exploitable energy reserves would be encountered below the project site.

Rock Material Resources

The rock material underlying the site has some potential as an economic earth resource if quarried for use as fill material and/or a source of aggregate material. However, there is nothing extraordinary about the quality of the rock underlying the site with respect to the material available in the region of the project site.

Geologic Hazards

In general, geologic hazards which should be considered for developments on the island of Hawaii are seismic activity, volcanic activity, inundation and ground subsidence. It is our opinion that these considerations do not present any unusual problems for the subject project in comparison to any other development in this area of West Hawaii.

Seismic Activity

Seismic activity includes earthquakes, and faulting. Stresses within the earth causes subterranean rocks to strain to the breaking point. When these stresses are released by the breaking of the rock, the resulting vibrations cause an earthquake.

When there is displacement of the rocks along the plane of breakage, a fault results. In strike-slip faults, the displacement is horizontal along the fault and in dip-slip faults, the displacement is vertically along the fault.

Unless a structure is situated directly on the fault line, damage to the structure results when the stresses induced in the structure by acceleration resulting from the vibrations of an earthquake exceed the strength of the structure.

Except for the island of Hawaii, the Hawaiian Islands are not a highly active seismic area. On the island of Hawaii, earthquakes are relatively frequent but are generally of relatively low magnitude and cause a low intensity of damage (Macdonald and Abbott, 1970). The fault shown in the vicinity of the site on the geologic map by Stearns and Macdonald is an inferred fault, i.e, there is sufficient geological evidence to suspect that there is a fault in that location but insufficient evidence to pinpoint its location or nature. There is no apparent evidence that the fault has been active since the Pleistocene Epoch.

Under the Uniform Building Code, the island of Hawaii has been designated as Seismic Zone 3 which indicates a relatively significant potential for strong ground motion generated by seismic events. The Uniform Building Code also establishes minimum seismic design criteria for any structures constructed in such a zone for resistance to deformation and damage resulting from such strong ground motion. Therefore, any structures that will be built as part of the development will be designed with consideration of the hazards of seismic activity.

Volcanic Activity

As previously discussed, the project site is situated on the southern flank of Kohala Mountain - one of the five (5) volcanic mountains forming the island of Hawaii. The island of Hawaii is the youngest of the Hawaiian islands and three (3) of the five (5) volcanoes have been active during historic time. It appears that Kohala Mountain was last active during the Pleistocene Epoch.

Based on the available geologic evidence, it appears that the level of volcanic hazard threat to the project site is low since Kohala Mountain has been dormant for such an extended period of time.

Inundation

Inundation, or flooding, can originate from surface water sources or from tsunami. The project site is sufficiently inland and at a high enough elevation that the possibility of inundation by tsunami is infinitesimal.

The surface soils/rocks at the project site are highly permeable and well drained. There are well-defined drainage paths upslope and through the site. The majority of precipitation falling on the site either infiltrates immediately or moves towards and through the drainage paths.

Ground Subsidence

Other than faulting during seismic activity, ground subsidence is generally the result of either consolidation of soft or loose subsoils or of the collapse of voids in the subsurface.

The project site is underlain by volcanic rock formation at the surface or at very shallow depths below the surface. This rock formation is highly competent material and is capable of supporting large structural loads. Therefore, ground subsidence resulting from the consolidation of soft or loose subsoils is generally not a consideration for the subject project.

Voids, or lava tubes, are sometimes encountered in volcanic rock formation. However,it is common engineering practice to probe the subgrades of building foundations during construction to check for potential voids below the building.

If voids are encountered, they are filled to reduce the potential of collapse of the foundations.

Site Preparation

Prior to commencement of grading, the areas to be graded should be cleared of all vegetation and deleterious materials. Due to the relatively high potential for erosion of exposed ash soils, clearing and grubbing should be scheduled as closely as possible ahead of the grading work, i.e., leaving the vegetation in place in given areas until shortly before the grading in that area is to commence. The resulting grub and spoil material should be disposed of properly off-site or stockpiled for use in landscaping.

Ash soils generally have relatively low strength and if the in-situ moisture contents are high enough, they are thixotropic, i.e., they lose strength when remolded. Therefore, it is our recommendation that the ash soil should not be used as fill in roadway and structural areas. The ash soil may be either stockpiled for use as topsoil or thoroughly blended into rockfill material, as discussed below.

Due to the dry and sometimes windy site conditions, moisture conditioning of fill material will be necessary. It is advisable to institute a dust control program during grading operations. Generally, it is suggested that the soil be moistened as it is exposed and excavated to minimize the occurrence of fugitive dust.

Soft or yielding areas encountered during clearing and grubbing below any areas designated to receive fill should be over-excavated to firm natural material and the resulting depression backfilled with well compacted engineered fill.

Previously Graded Areas

During our field reconnaissance, it was noted that some portions of the project site along Akoni Pule Highway have been developed for commercial and industrial purposes. This existing development involved some grading work.

It is not known where the fill placed for these existing developments was placed as engineered fill or not. The quality of the fill portions of this earthwork in the previously graded areas could not be determined without detailed exploration.

It is recommended that any further development in this area be conducted as engineered developments.

Excavation

The field reconnaissance and visual observations made at the site and in its vicinity indicate that the site is underlain by competent basalt formation at relatively shallow depths.

It is anticipated that some hard excavation and/or ripping may be encountered for any excavation greater that about three (3) feet in depth below the existing ground surface. Very hard excavation may be encountered in localized cemented areas or when ledges are encountered.

Cemented clinker and ledge basalt formation will most likely require some hard excavation such as heavy ripping, hoerams or blasting.

Generally, the excavation method should be left to the contractor. Excavation by ripping is dependent upon the jointing of the formation, the configuration of the rippers and the skill of the operator. Blasting should be considered to expedite the excavation process. Generally, consideration should be given to the economics of blasting to initially reduce the size of the excavated rock material and to facilitate excavation as opposed to extended periods of heavy ripping at high equipment rates. However, care should be exercised to avoid overshooting which could disrupt the clinker or rock formation resulting in a loss of strength.

__Fill Placement__

The dry friable ash soil encountered at the surface throughout most of the site generally has low strength characteristics and is susceptible to erosion. Therefore, some modification to standard grading design and construction procedures will be required.

Whenever possible, the ash soil should be stockpiled for use as topsoil rather than used as embankment fill material. Efforts should be made to construct the majority of the embankment of the more competent excavated basalt and clinker materials, if reduced to less than 12 inches in size.

In general, the excavated soil and rock materials, less than 12 inches in size, may be considered to be suitable for use as fill material. The material, if reduced to less than six (6) inches in size, should be adequate as a source of trench and structural backfill, if needed. Imported material, if required, should be free of boulders, organic debris or other deleterious materials and be non-expansive.

The excavated rock material may not contain sufficient fines to produce a well-graded material, therefore, the surficial ash soil could be mixed into the rocky excavated material to increase the percentage of fines and to create a better graded fill material. However, where possible it is preferable to utilize the ash material as topsoil.

In the event it is necessary to utilize the ash soils as fill, the ash should be moisture conditioned to within a few percent of its optimum moisture content and placed in the upper two feet below finish subgrade and compacted to a minimum of 90% of its maximum dry density as determined by ASTM Test Method D 1557-78. Whenever feasible, the ash should be mixed as thoroughly as possible with granular materials. The ash soils should not be placed as fill for constructed slopes nor in roadway and structural areas.

Generally, embankment fills should be placed in level lifts not exceeding twelve (12) inches in loose thickness and compacted to a minimum of 90% maximum dry density as established by ASTM D-1557-78. Trench and structural backfills should be placed in level lifts not exceeding eight (8) inches in loose thickness and compacted to a minimum of 90% maximum dry density per ASTM Test Method D-1557-78. The upper two (2) feet of fills and backfills below road and structure subgrade level should be compacted to a minimum of 95% maximum dry density.

Alternately, large boulders or rock fragments could be utilized as rockfills or boulder fills provided that they are not nested and that they are well tracked with a heavy bulldozer to lock the rock fragments and bouldery materials into grain-to-grain contact. A choking layer at least eighteen (18) inches thick for yard areas and a minimum of twenty-four (24) inches thick for road or structural areas should be used to cap the rockfill to reduce the potential of loss of fines from the upper portion of the fill. The choking layer should consist of a relatively well graded select granular material with an average maximum size of about six (6) inches and an absolute maximum size of twelve (12) inches. Care must be exercised to avoid placement of any boulders in locations which would conflict with future utility lines. In general, boulder or rock fragments larger than 24 inches in size should be placed at depths greater that four (4) feet below finish subgrade level.

Conventional compaction testing is generally not practicable in fills composed of excavated volcanic material. Instead, a testing program to determine the number of passes of a compactor needed to achieve the desired level of compaction should be conducted at the start of the grading phase of the project. On the basis of this testing program, the number of passes may then be used as the field criterion for adequate compaction.

Any fills to be placed on slopes having ratios steeper than five horizontal to one vertical (5H:1V) should be keyed and benched into the underlying consolidated clinker or basalt formation to lessen potential instability of the new fill (see Plate 3). The keys and benches should not be based in the upper ash soil or in loose clinker. Ash soils should not be utilized as fills in constructed slopes.

Slopes

Provided that the above specified fill placement procedures and granular materials are utilized, design fill slopes of two horizontal to one vertical (2H:1V) or flatter are recommended. For fills constructed of ash soils, a maximum design slope ratio of three horizontal to one vertical (3H:1V) is recommended. Fill slopes should generally be constructed by overfilling and cutting back to the design slope ratio.

For cut slopes, the following ratios are recommended:

a. Ash Soil - 3:1 (H:V)
b. Clinker - 1-1/2:1 (H:V)
c. Dense Basalt - 1:1 (H:V)

Any cuts or fills greater than 20 feet in height should have a bench at the midpoint of the slope.

It is recommended that cut slopes exposing ash soils be immediately protected by planting or other means to minimize the potential of erosion of the exposed soils.

Honokoa Gulch

As described above, Honokoa Gulch forms the northerly boundary of the site and has nearly vertical sides on the order of 600 feet in height. Our field observations indicate that the walls of the gulch are competent basalt rock formation. Therefore, the slopes should be stable.

The current concept plan indicates that residential development will front the gulch. The proximity of such a steep slope to residential development presents an exposure to potential injury. Consideration should be given to establishing a buffer zone, setback or other physical boundary between the top of the gulch and the residences to minimize the potential of such injury. We suggest a buffer zone having a width of about 75 to 100 feet which could be used as open space or a passive park.

Infrastructure Installation

It is anticipated that underground utilities will be installed as part of the development work. Based on the results of our test pit excavations and seismic surveys, it is anticipated that relatively easy excavation will be encountered in the upper ash and clinker soils for utility line trenching, grading to more difficult as the underlying rock layers are encountered. Very hard excavation is anticipated in the dense basalt formation.

Trench backfills should be placed in level lifts not exceeding eight (8) inches in loose thickness and compacted to a minimum of 90% maximum dry density per ASTM

Test Method D-1557-78. The upper two (2) feet of backfills below road or structural subgrade level should be compacted to a minimum of 95% maximum dry density.

Foundation Support

Based on the types of facilities shown on the conceptual plans provided to us, it is our anticipation that most of the structures involved in the proposed development will be lightly loaded one- and two-story structures. In general, it is our opinion that relatively shallow spread or strip footing foundations may be used to support proposed structures within the development area provided that our recommendations on site preparation and grading are followed. It is anticipated that the foundations for the proposed structures will bear on in-situ volcanic rock formation or engineered rockfill.

It is recommended that site specific explorations be conducted for each increment of the proposed development. These explorations are recommended to allow the formulation of design recommendations pertinent to the particular grading plan and type of structures involved.

Pavements

It is our anticipation that asphaltic concrete pavements will be used for the access roads within the development area. We recommend the following A.C. pavement sections for vehicular traffic:

Main Access and Collector Roads

3 Inches Asphaltic Concrete
6 Inches Base Course
9 Inches Total Pavement Thickness
on Compacted Subgrade

Secondary Roads and Maintenance Roads

2 Inches Asphaltic Concrete
6 Inches Base Course
8 Inches Total Pavement Thickness on
Compacted Moist Subgrade

These pavement sections assume that the subgrade material will consist of in-situ volcanic formation or rockfill. If the subgrade consists of ash soils, six (6) inches of select borrow (subbase course) should be added to the above sections.

CBR and density tests and/or field observations should be performed on the actual subgrade soils encountered during construction and that the above section be revised, if necessary. The recommended sections do not consider construction traffic and assume that adequate drainage will be provided in the paved areas.

Drainage

It is anticipated that some form of drainage system will be required to handle runoff flows within the development area. The current practice in the County of Hawaii is to construct drywells to intercept and dispose of the flows.

Based on observations made during our reconnaissance, it is believed that the rocks of the Pololu Volcanic Series underlying the site have rapid permeability characteristics and will serve as a good formation for disposal of the runoff water.

Where the Pololu rocks are overlain by Hawi Volcanic Series rocks, it may be necessary to penetrate through the Hawi formation to the underlying Pololu rocks. Based on visual observations, it is anticipated that the Hawi formation may have a thickness on the order of 20 to 25 feet in the areas where it occurs within the development area.

It should also be noted that drywells are currently regulated as injection wells under the Hawaii State Department of Health's Underground Inject Control (UIC) program. Permits to construct and to operate the drywells will be required under the UIC program.

Additional Exploration

This exploration was performed in support of the preparation of the Environmental Impact Statement of the subject project. Our field reconnaissance was based on conceptual schemes and was performed to provide preliminary design information for the initial construction cost estimation, site grading design and foundation design of the subject project. In addition, our reconnaissance was limited to the accessible portions of the proposed development area. As such, the locations of the test pits and refraction surveys may not coincide with the final location of the structural elements of the proposed project and the analyses used to formulate the findings and recommendations presented herein may not be sufficient or proper for the final project design.

Therefore, it is recommended that additional exploration and geotechnical engineering analyses be performed when the design details for the subject project are available. Of particular interest in such additional exploration work would be refinement of recommendations pertaining to grading, foundation design, slab-on-grade design, pavement sections and construction criteria.

Design Review

Plans and specifications for the proposed construction should be forwarded to the geotechnical engineer for review and written comment prior to construction. This review is needed to determine adherence to the earthwork and foundation recommendations given herein. If this review is not made, the geotechnical engineer cannot assume responsibility for misinterpretation of the recommendations.

Construction Monitoring

It is recommended that the geotechnical engineer be retained to provide geotechnical engineering services during construction of the excavation and foundation phases of the work. This is to observe compliance with the design concepts, specifications or recommendations and to allow design changes in the event that subsurface conditions differ from that anticipated prior to start of construction. The recommendations given in this report are contingent upon such observations.

Any imported material required should be non-expansive, tested and approved by the geotechnical engineer prior to hauling to the site.

If actual exposed rock/soil conditions encountered during construction are different from those assumed or considered in this report, then appropriate modifications to the design should be made.

LIMITATIONS

The analyses and recommendations submitted in this report are based in part upon information obtained from field data points, such as geophysical surveys and test pits. Variations of conditions between the field data points may occur; and the nature and extent of these variations may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations given in this report.

The locations of the field data points were approximately determined by triangulation and measurement from reference points shown on the topographic plans provided by R.M. Towill Corporation. The physical location of the field data points should be considered accurate only to the degree implied by the method used.

The stratification lines shown in graphic representations of the field data points depict the approximate boundaries between soil types, and, as such, may denote a gradual transition. The strata lines shown on profiles or cross-sections are based upon interpolation between field data points and may not represent actual subsurface conditions.

This report had been prepared for the exclusive use of R.M. Towill Corporation for specific application to the proposed Kawaihae 10-Year Master Plan in North Kohala, Hawaii in accordance with generally accepted geotechnical engineering principles and practices. No other warranty, expressed or implied, is made.

This report has been prepared solely for the purpose of assisting the planner and engineer in the preliminary design of the proposed project. Therefore, this report may not contain sufficient data, or the proper information, for use in contract bid estimation. A contractor wishing to bid on this project is urged to retain a competent geotechnical engineer to assist in the interpretation of this report and/or in the performance of additional site specific exploration for bid estimating purposes.

The owner/client should be aware that unanticipated soil conditions are commonly encountered. Unforeseen soil conditions, such as perched groundwater, soft deposits, hard layers or cavities, may occur in localized areas and may require additional probing or corrections in the field (which may result in construction delays) to attain a properly constructed project. Therefore, sufficient contingency fund is thus recommended to accommodate these possible extra costs.

APPENDICES AND PLATES

The following appendices and plates are attached and complete this report:

Appendix A	-	Field Exploration
Plates A-1 thru A-7	-	Test Pit Logs
Plates A-8 thru A-27	-	Seismic Refraction Surveys
Appendix B	-	Laboratory Testing
Plates B-1 thru B-4	-	Laboratory Test Results
Plate 1	-	Project Location Map
Plate 2	-	Site Plan
Plate 3	-	Sketch of Keying and Benching

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Respectfully submitted,

C.W. ASSOCIATES INC.
dba GEOLABS-HAWAII

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APPENDIX A

Field Exploration

The subsurface conditions at the site were explored by the performance of ten (10) seismic refraction surveys at the approximate locations shown on the Site Plan, Plate 2. The seismic refraction surveys were conducted using a 12-channel signal enhancement seismograph with a 12-pound sledge hammer as a seismic energy source.

Refraction seismography is based on the transmission of elastic energy (compressional) waves through geologic materials. Generally, the denser or more consolidated a material is, the faster the transmission of the compressional waves. These waves are refracted at interfaces between materials.

The refracted waves are received by geophones on the surface and recorded by the seismograph. The recorded data is downloaded to a portable computer either for processing in the field or for storage and later processing. The processing involves the interpretive selection of the arrival times of the refracted waves.

After the interpretive selection of arrival times, the technique permits mathematical calculations which will yield approximate depths or thicknesses of materials below the survey and give their approximate compressional wave velocities. The velocities are averaged along the travel path of the compressional waves. The calculated velocities may be empirically related to the excavation characteristics of the materials. The following legend explains the terms shown on the Seismic Refraction Survey Results, Plates A-8 through A-27.

Velocity = Compressional wave velocity in feet per second

Dip = Dip of the top of the layer in degrees

Depth = Depth below ground surface in feet

In addition to the geophysical surveys, the subsurface conditions at the site were explored by the excavation of fifteen (15) test pits to depths ranging between 1.6 and 7.0 feet below the existing ground surface. The test pits were excavated using a Case 580E rubber-tired backhoe mobilized to the site.

The materials encountered in the test pits were examined and classified in general accordance with ASTM Test Method D-2488-84, Description and Identification of Soils (Visual-Manual Procedure), by a geologist from our firm. The logs of the test pits are shown on Plates A-1 through A-7.

TEST PIT LOGS

Kawaihae 10-Year Master Plan
Kawaihae, North Kohala, Hawaii

Test Pit No.	Depth	Description
1	0.0 - 1.0	Reddish brown **SILT** with matted roots, some boulders and cobbles, stiff, very dry, friable **(PAHALA ASH)**
	1.0 - 3.5	Reddish brown **SILT** with some boulders and cobbles, stiff, very dry, friable **(PAHALA ASH)**
	3.5	Gray **BASALT**, weathered, hard, backhoe refusal
		Test Pit terminated at 3.5 feet on August 20, 1991. No groundwater encountered.
2	0.0 - 1.0	Reddish brown **SILT** with matted roots, some boulders and cobbles, stiff, very dry, friable **(PAHALA ASH)**
	1.0 - 2.0	Reddish brown **SILT** with some boulders and cobbles, stiff, very dry, friable **(PAHALA ASH)**
	2.0 - 3.0	Grayish brown Sandy **SILT**, very stiff, dry to damp, slightly friable **(Saprolite)**
	3.0	Brownish gray **BASALT**, weathered, hard, backhoe refusal
		Test Pit terminated at 3.0 feet on August 20, 1991. No groundwater encountered.

Test Pit Logs (Continued)

Test Pit No.	Depth	Description
3	0.0 - 1.0	Reddish brown **SILT** with matted roots, some boulders and cobbles, stiff, very dry, friable **(PAHALA ASH)**
	1.0 - 4.0	Reddish brown **SILT** with some boulders and cobbles, stiff, very dry, friable **(PAHALA ASH)**
	4.0 - 7.0	Light brownish gray Silty **GRAVEL** with Sand, medium dense, dry **(Weathered Clinker)**
	7.0	Brownish gray **BASALT**, weathered, hard, backhoe refusal
		Test Pit terminated at 7.0 feet on August 20, 1991. No groundwater encountered.
4	0.0 - 1.0	Reddish brown **SILT** with matted roots, some boulders and cobbles, stiff, very dry, friable **(PAHALA ASH)**
	1.0 - 3.5	Reddish brown **SILT**, stiff, very dry, friable **(PAHALA ASH)**
	3.5 - 6.5	Light gray Silty **SAND**, dense, dry **(Saprolite)**
	6.5	Gray **BASALT**, weathered, hard, backhoe refusal
		Test Pit terminated at 6.5 feet on August 20, 1991. No groundwater encountered.

Test Pit Logs (Continued)

Test Pit No.	Depth	Description
5	0.0 - 1.0	Reddish brown **SILT** with matted roots, some boulders and cobbles, stiff, very dry, friable **(PAHALA ASH)**
	1.0 - 2.5	Reddish brown **SILT** with some boulder and cobbles, stiff, very dry, friable **(PAHALA ASH)**
	2.5 - 4.0	Light brownish gray Silty **SAND** with many cobbles, dense, dry **(Saprolite after Pahoehoe)**
	4.0 - 4.5	Gray **BASALT**, highly weathered, hard, backhoe refusal at 4.5 feet
		Test Pit terminated at 4.5 feet on August 20, 1991. No groundwater encountered.
6	0.0 - 2.5	Reddish brown **SILT** with matted roots, some boulders and cobbles, stiff, very dry, friable **(PAHALA ASH)**
	2.5 - 6.0	Light brownish gray mottled Sandy **GRAVEL** with Silt, dense, dry **(Saprolite)**
	6.0	Gray **BASALT**, weathered, hard, backhoe refusal
		Test Pit terminated at 6.0 feet on August 20, 1991. No groundwater encountered.

Test Pit Logs (Continued)

Test Pit No.	Depth	Description
7	0.0 - 2.0	Brown **SILT** with many cobbles and some boulders, stiff, very dry, friable **(PAHALA ASH/CLINKER)**
	2.0	Gray **BASALT**, hard, backhoe refusal
		Test Pit terminated at 2.0 feet on August 20, 1991. No groundwater encountered.
8	0.0 - 1.5	Reddish brown **SILT** with matted roots, some boulders and cobbles, stiff, very dry, friable **(PAHALA ASH)**
	1.5 - 3.5	Reddish brown **SILT** with some boulders and cobbles, stiff, very dry, friable **(PAHALA ASH)**
	3.5	Gray **BASALT**, weathered, hard, backhoe refusal
		Test Pit terminated at 3.5 feet on August 20, 1991. No groundwater encountered.
9	0.0 - 1.0	Brown **SILT** with many cobbles and some boulders, stiff, very dry, friable **(PAHALA ASH/CLINKER)**
	1.0	Gray **BASALT**, hard, backhoe refusal
		Test Pit terminated at 1.0 feet on August 21, 1991. No groundwater encountered.

Test Pit Logs (Continued)

Test Pit No.	Depth	Description
10	0.0 - 2.0	Reddish brown **SILT** with roots, some boulders and cobbles, stiff, very dry, friable **(PAHALA ASH)**
	2.0 - 6.0	Gray and brown Sandy **GRAVEL** with Silt, medium dense, dry **(Clinker)**
	6.0	Gray **BASALT**, weathered, hard, backhoe refusal
		Test Pit terminated at 6.0 feet on August 21, 1991. No groundwater encountered.
11	0.0 - 0.5	Brown **SILT** with matted roots, some boulders and cobbles, stiff, very dry, friable **(PAHALA ASH)**
	0.5 - 2.0	Brown **SILT** with some boulders and cobbles, stiff, very dry, friable **(PAHALA ASH)**
	2.0 - 4.0	Brown Silty **GRAVEL** with Sand, medium dense, very dry **(Clinker)**
	4.0 - 4.5	Brownish gray **BASALT**, weathered, medium hard, backhoe refusal at 4.5 feet
		Test Pit terminated at 4.5 feet on August 21, 1991. No groundwater encountered.

Test Pit Logs (Continued)

Test Pit No.	Depth	Description
12	0.0 - 1.0	Reddish brown **SILT** with matted roots, some boulders and cobbles, stiff, very dry, friable **(PAHALA ASH)**
	1.0 - 2.5	Reddish brown **SILT**, stiff, very dry, friable **(PAHALA ASH)**
	2.5	Gray **BASALT**, hard, backhoe refusal
		Test Pit terminated at 2.5 feet on August 21, 1991. No groundwater encountered.
13	0.0 - 1.0	Reddish brown **SILT** with matted roots, some boulders and cobbles, stiff, very dry, friable **(PAHALA ASH)**
	1.0 - 3.0	Reddish brown **SILT**, stiff, very dry, friable **(PAHALA ASH)**
	3.0 - 3.5	Brown and gray mottled **BASALT**, highly weathered, soft
	3.5	Gray **BASALT**, weathered, hard, backhoe refusal
		Test Pit terminated at 3.5 feet on August 21, 1991. No groundwater encountered.

Test Pit Log (Continued)

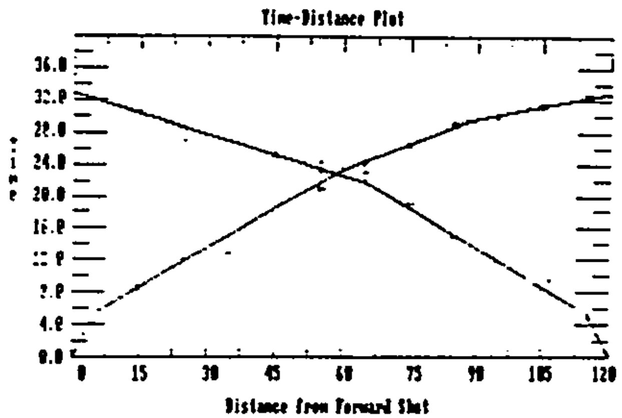
Test Pit No.	Depth	Description
14	0.0 - 0.5	Brown to reddish brown **SILT** with matted roots, occasional boulders, stiff, very dry, friable **(PAHALA ASH)**
	0.5 - 2.0	Brown to reddish brown **SILT** with occasional boulders, stiff, very dry, friable **(PAHALA ASH)**
	2.0	Gray **BASALT**, hard, backhoe refusal
		Test Pit terminated at 2.0 feet on August 21, 1991. No groundwater encountered.
15	0.0 - 1.0	Brown to reddish brown **SILT** with matted roots, occasional boulders, stiff, very dry, friable **(PAHALA ASH)**
	1.0 - 3.5	Brown to reddish brown **SILT** with occasional boulders, stiff, very dry, friable **(PAHALA ASH)**
	3.5	Gray **BASALT**, hard, backhoe refusal
		Test Pit terminated at 3.5 feet on August 21, 1991. No groundwater encountered.

--- Geo Logic REFRACT 2.29 30 Aug 1991 WO 2730-00 Kawaihae Master Plan---

Geologic model parameters: N layers = 4, R velocity = 0

Forward files: 2730AF

Reverse files: 2730AR



FORWARD DATA: Variance = 6.5E-01

L	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
1	930	0	0.0	0	0.0
2	3095	228	3.8	1	5.0
3	4444	489	9.6	2	59.8
4	9430	>E3	20.0	1	87.3

REVERSE DATA: Variance = 6.5E-01

L	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
1	930	0	0.0	0	0.0
2	3095	228	3.8	1	5.0
3	4308	481	8.8	2	55.0
4	5801	449	12.0	1	55.0

SEISMIC REFRACTION SURVEY "A"

PLATE A-8

KAWAIHAE MASTER PLAN

GEOLABS–HAWAII
Foundation & Soil Engineering · Geology

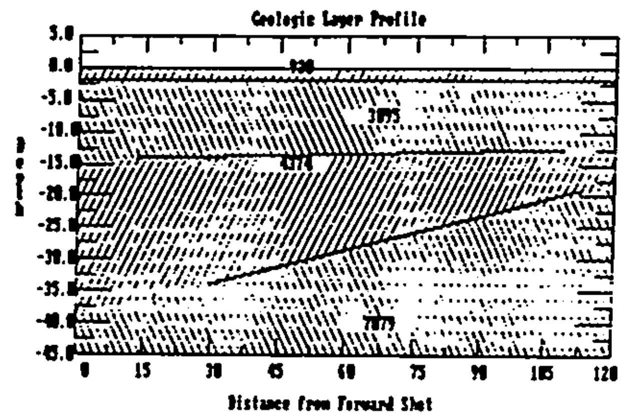
DATE SEPTEMBER 1991 | W.O. 2730-00

-- Geo Logic REFRACT 2.29 30 Aug 1991 WO 2730-00 Kawaihae Master Plan---

Geologic model parameters: N layers = 4, R velocity = 0

Forward files: 2730AF

Reverse files: 2730AR



Geologic Model Profile for 4 Layers

Layer	Velocity	Dip Angle	Fwd Shot Depth	Fwd Shot Elev	Averaging Interval	Rev Shot Depth	Rev Shot Elev
1	930	0.00	1.8	-1.8	1- 119	1.8	-1.8
2	3095	0.00	14.5	-14.5	13- 109	12.6	-12.6
3	4374	0.91	39.3	-39.3	30- 112	18.3	-18.3
4	7079	10.06	---	---	---	---	---

SEISMIC REFRACTION SURVEY "A"

PLATE A-9

KAWAIHAE MASTER PLAN

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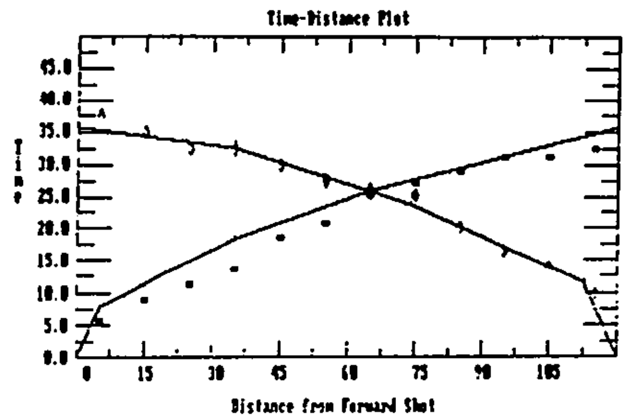
--- Geo Logic REFRACT 2.29 30 Aug 1991 WO 2730-00 Kawaihae Master Plan----

Geologic model parameters:
N layers = 4
R velocity = 0

Forward files: 2730BF

Reverse files: 2730BR



FORWARD DATA: Variance = 5.3E+00

L	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
1	635	0	0.0	0	0.0
2	2923	608	6.2	3	5.0
3	3844	751	9.0	4	35.0
4	5809	939	14.8	3	65.0

REVERSE DATA: Variance = 1.4E+00

L	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
1	635	0	0:0	0	0.0
2	3152	696	9.2	3	7.3
3	4481	988	13.5	4	45.9
4	11709	>E3	25.2	3	84.9

SEISMIC REFRACTION SURVEY "B"

PLATE A-10

KAWAIHAE MASTER PLAN
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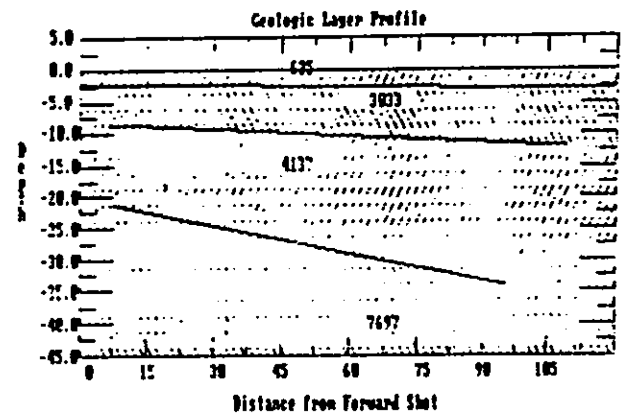
--- Geo Logic REFRACT 2.29 30 Aug 1991 WO 2730-00 Kawaihae Master Plan----

Geologic model parameters:
N layers = 4
R velocity = 0

Forward files: 2730BF

Reverse files: 2730BR



Geologic Model Profile for 4 Layers

Layer	Velocity	Dip Angle	Fwd Shot Depth	Fwd Shot Elev	Averaging Interval	Rev Shot Depth	Rev Shot Elev
1	635	0.00	2.0	-2.0	0- 119	3.0	-3.0
2	3033	-0.46	8.3	-8.3	7- 109	12.4	-12.4
3	4137	-1.97	19.9	-19.9	8- 98	37.4	-37.4
4	7697	-8.38	---	---	---	---	---

SEISMIC REFRACTION SURVEY "B"

PLATE A-11

KAWAIHAE MASTER PLAN
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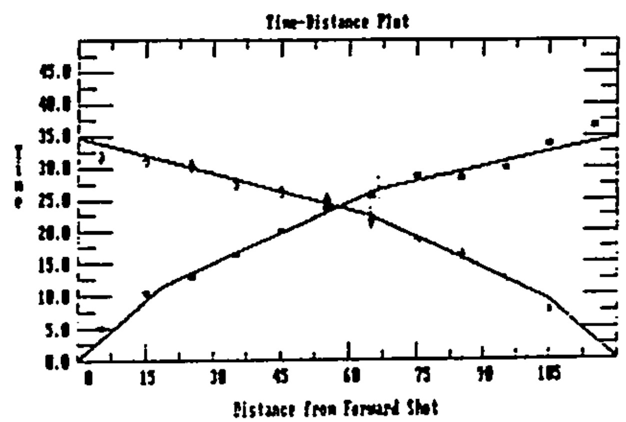
--- Geo Logic REFRACT 2.29 30 Aug 1991 WO 2730-00 Kawaihae Master Plan----

Geologic model parameters:
N layers = 3
R velocity = 0

Forward files:
2730CF

Reverse files:
2730CR



FORWARD DATA: Variance = 1.4E+00

L	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
1	1631	396	0.0	2	0.0
2	3172	127	5.5	1	18.4
3	6511	840	16.2	2	66.5

REVERSE DATA: Variance = 8.4E-01

L	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
1	1631	396	0.0	2	0.0
2	3077	120	4.3	1	15.0
3	5232	557	11.7	2	55.4

SEISMIC REFRACTION SURVEY "C"

PLATE A-12

KAWAIHAE MASTER PLAN
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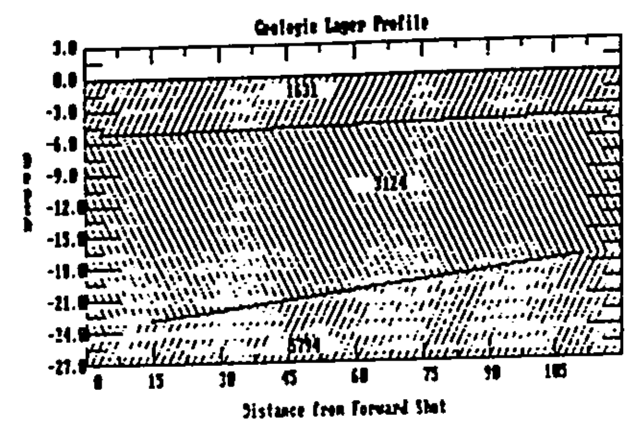
--- Geo Logic REFRACT 2.29 30 Aug 1991 WO 2730-00 Kawaihae Master Plan----

Geologic model parameters:
N layers = 3
R velocity = 0

Forward files:
2730CF

Reverse files:
2730CR



Geologic Model Profile for 3 Layers

Layer	Velocity	Dip Angle	Fwd Shot Depth	Fwd Shot Elev	Averaging Interval	Rev Shot Depth	Rev Shot Elev
1	1631	0.00	5.3	-5.3	3- 118	4.1	-4.1
2	3124	0.54	23.9	-23.9	15- 111	16.9	-16.9
3	5794	3.36	---	---	---	---	---

SEISMIC REFRACTION SURVEY "C"

PLATE A-13

KAWAIHAE MASTER PLAN
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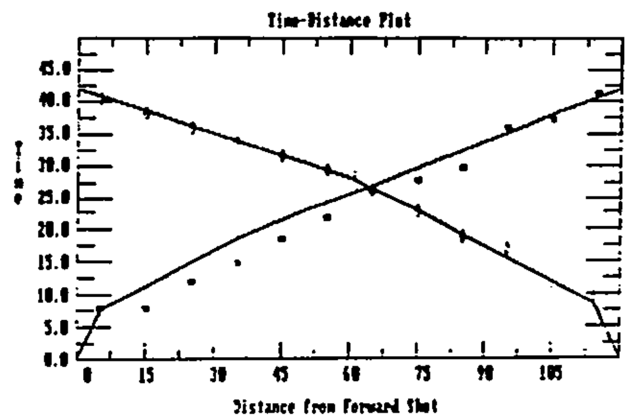
--- Geo Logic REFRACT 2.29 30 Aug 1991 WO 2730-00 Kawaihae Master Plan---

Geologic model parameters:
N layers = 3
R velocity = 0

Forward files: 2730DF

Reverse files: 2730DR



FORWARD DATA: Variance = 4.8E+00

L	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
1	667	0	0.0	0	0.0
2	2736	368	5.7	2	5.0
3	3622	211	8.8	1	35.0

REVERSE DATA: Variance = 4.2E-01

L	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
1	667	0	0.0	0	0.0
2	2786	381	6.5	2	5.7
3	4259	289	13.8	1	58.8

SEISMIC REFRACTION SURVEY "D"

PLATE A-14

KAWAIHAE MASTER PLAN

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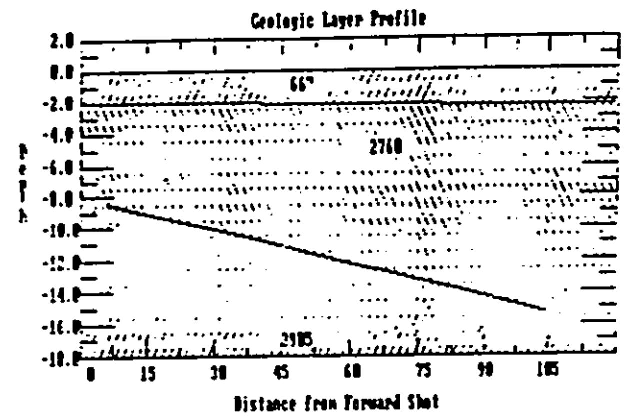
--- Geo Logic REFRACT 2.29 30 Aug 1991 WO 2730-00 Kawaihae Master Plan---

Geologic model parameters:
N layers = 3
R velocity = 0

Forward files: 2730DF

Reverse files: 2730DR



Geologic Model Profile for 3 Layers

Layer	Velocity	Dip Angle	Fwd Shot Depth	Fwd Shot Elev	Averaging Interval	Rev Shot Depth	Rev Shot Elev
1	667	0.00	1.9	-1.9	0- 119	2.2	-2.2
2	2760	-0.13	7.9	-7.9	6- 105	16.3	-16.3
3	3905	-4.01	---	---	---	---	---

SEISMIC REFRACTION SURVEY "D"

PLATE A-15

KAWAIHAE MASTER PLAN

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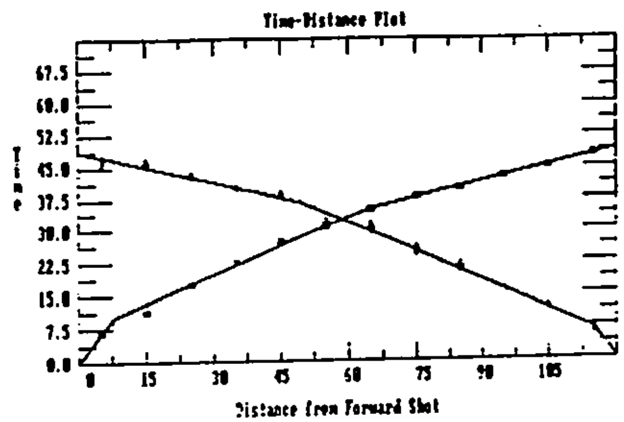
--- Geo Logic REFRACT 2.29 30 Aug 1991 WO 2730-00 Kawaihae Master Plan----

Geologic model parameters:
N layers = 3
R velocity = 0

Forward files:
2730EF

Reverse files:
2730ER



FORWARD DATA: Variance = 3.7E-01

L	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
1	784	0	0.0	0	0.0
2	2267	91	6.4	1	7.6
3	4066	135	19.0	1	64.7

REVERSE DATA: Variance = 6.8E-01

L	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
1	784	0	0.0	0	0.0
2	2173	83	4.1	1	5.0
3	4114	138	19.3	1	70.2

SEISMIC REFRACTION SURVEY "E"

PLATE A-16

KAWAIHAE MASTER PLAN
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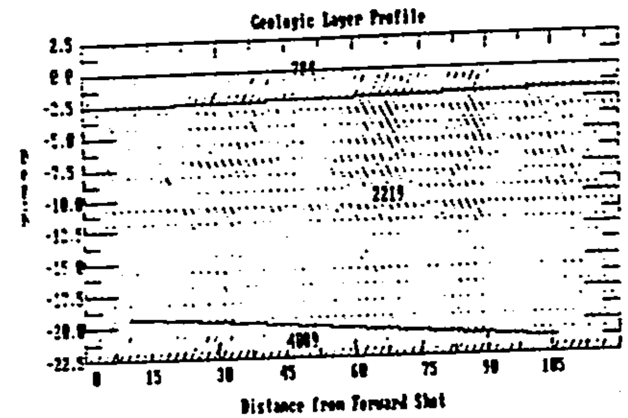
DATE SEPTEMBER 1991 | W.O. 2730-00

--- Geo Logic REFRACT 2.29 30 Aug 1991 WO 2730-00 Kawaihae Master Plan----

Geologic model parameters:
N layers = 3
R velocity = 0

Forward files:
2730EF

Reverse files:
2730ER



Geologic Model Profile for 3 Layers

Layer	Velocity	Dip Angle	Fwd Shot Depth	Fwd Shot Elev	Averaging Interval	Rev Shot Depth	Rev Shot Elev
1	784	0.00	2.7	-2.7	1- 119	1.7	-1.7
2	2219	0.46	18.9	-18.9	11- 106	21.6	-21.6
3	4089	-1.27	---	---	---	---	---

SEISMIC REFRACTION SURVEY "E"

PLATE A-17

KAWAIHAE MASTER PLAN
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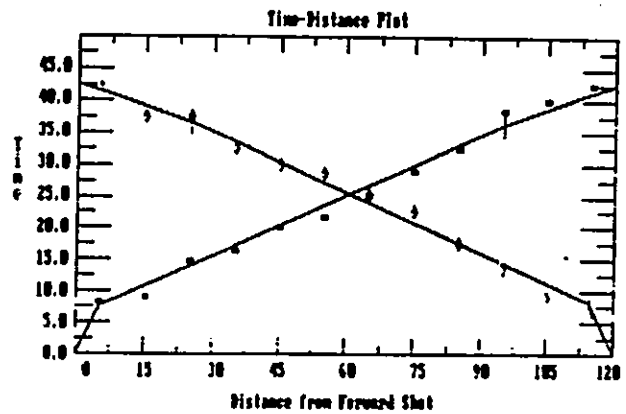
DATE SEPTEMBER 1991 | W.O. 2730-00

--- Geo Logic REFRACT 2.29 30 Aug 1991 WO 2730-00 Kawaihae Master Plan---

Geologic model parameters: N layers = 3 R velocity = 0

Forward files: 2730FF

Reverse files: 2730FR



FORWARD DATA: Variance = 1.6E+00

L	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
1	667	0	0.0	0	0.0
2	3131	122	5.9	1	5.0
3	4013	>E3	12.6	9	95.0

REVERSE DATA: Variance = 1.5E+00

L	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
1	667	0	0.0	0	0.0
2	3174	125	6.4	1	5.4
3	4084	>E3	13.1	9	95.0

SEISMIC REFRACTION SURVEY "F"

PLATE A-18

KAWAIHAE MASTER PLAN

GEOLABS–HAWAII
Foundation & Soil Engineering Geology

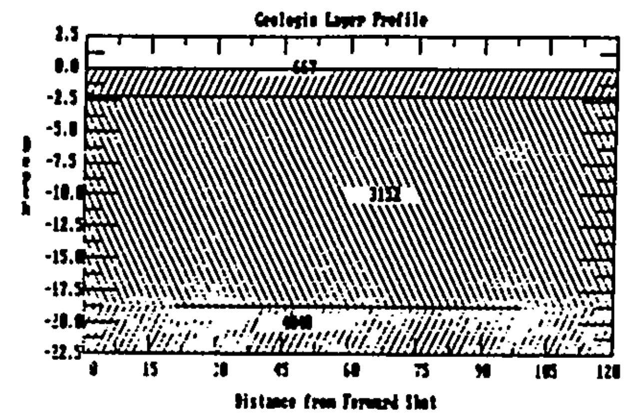
DATE SEPTEMBER 1991 | W.O. 2730-00

--- Geo Logic REFRACT 2.29 30 Aug 1991 WO 2730-00 Kawaihae Master Plan---

Geologic model parameters: N layers = 3 R velocity = 0

Forward files: 2730FF

Reverse files: 2730FR



Geologic Model Profile for 3 Layers

Layer	Velocity	Dip Angle	Fwd Shot Depth	Fwd Shot Elev	Averaging Interval	Rev Shot Depth	Rev Shot Elev
1	667	0.00	2.0	-2.0	0- 120	2.2	-2.2
2	3152	-0.09	18.6	-18.6	21- 99	18.8	-18.8
3	4048	-0.08	---	---	---	---	---

SEISMIC REFRACTION SURVEY "F"

PLATE A-19

KAWAIHAE MASTER PLAN

GEOLABS–HAWAII
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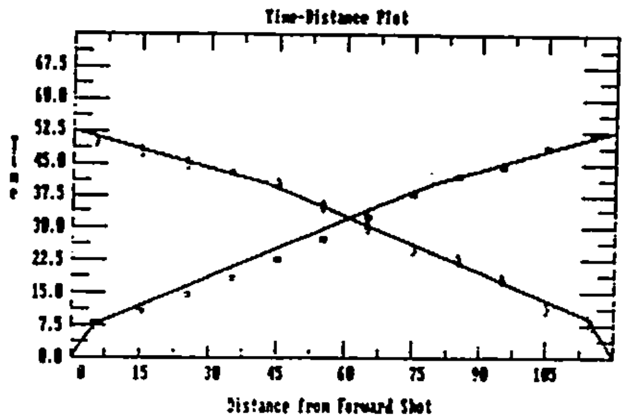
DATE SEPTEMBER 1991 | W.O. 2730-00

--- Geo Logic REFRACT 2.29 30 Aug 1991 WO 2730-00 Kawaihae Master Plan---

Geologic model parameters:
N layers = 3
R velocity = 0

Forward files: 2730GF

Reverse files: 2730GR



FORWARD DATA: Variance = 2.6E+00

L	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
1	645	0	0.0	0	0.0
2	2268	103	5.5	1	5.0
3	3412	205	17.2	2	78.7

REVERSE DATA: Variance = 5.4E-01

L	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
1	645	0	0.0	0	0.0
2	2301	108	6.3	1	5.6
3	3426	207	17.3	2	77.3

SEISMIC REFRACTION SURVEY "G"

PLATE A-20

KAWAIHAE MASTER PLAN
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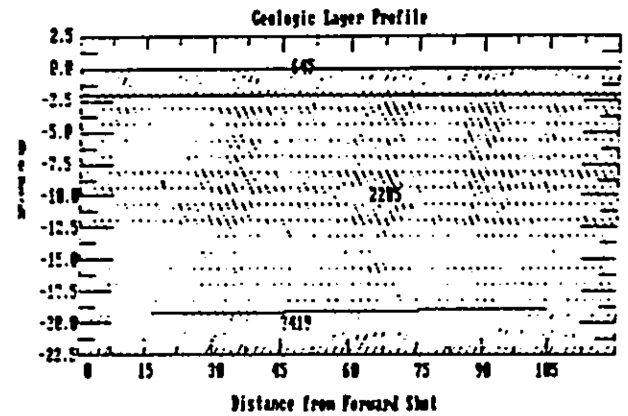
DATE SEPTEMBER 1991 | W.O. 2730-00

--- Geo Logic REFRACT 2.29 30 Aug 1991 WO 2730-00 Kawaihae Master Plan---

Geologic model parameters:
N layers = 3
R velocity = 0

Forward files: 2730GF

Reverse files: 2730GR



Geologic Model Profile for 3 Layers

Layer	Velocity	Dip Angle	Fwd Shot Depth	Fwd Shot Elev	Averaging Interval	Rev Shot Depth	Rev Shot Elev
1	645	0.00	1.9	-1.9	1- 119	2.1	-2.1
2	2285	-0.12	19.5	-19.5	16- 105	18.8	-18.8
3	3419	0.34	---	---	---	---	---

SEISMIC REFRACTION SURVEY "G"

PLATE A-21

KAWAIHAE MASTER PLAN
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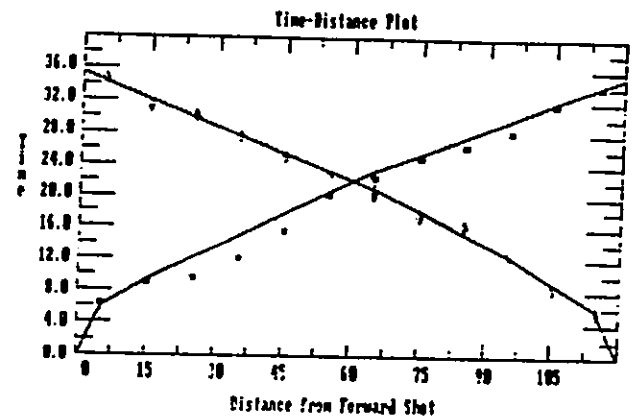
DATE SEPTEMBER 1991 | W.O. 2730-00

--- Geo Logic REFRACT 2.29 30 Aug 1991 WO 2730-00 Kawaihae Master Plan----

Geologic model parameters:
N layers = 4
R velocity = 0

Forward files: 2730HF

Reverse files: 2730HR



FORWARD DATA: Variance = 2.0E+00

L	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
1	851	0	0.0	0	0.0
2	2939	667	4.2	2	5.0
3	3573	525	5.1	2	15.0
4	4639	250	9.3	1	65.0

REVERSE DATA: Variance = 4.2E-01

L	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
1	851	0	0.0	0	0.0
2	2939	667	4.2	2	5.0
3	3656	548	5.8	2	25.0
4	4584	242	8.8	1	55.0

SEISMIC REFRACTION SURVEY "H"

PLATE A-22

KAWAIHAE MASTER PLAN

GEOLABS-HAWAII
Foundation & Soil Engineering Geology

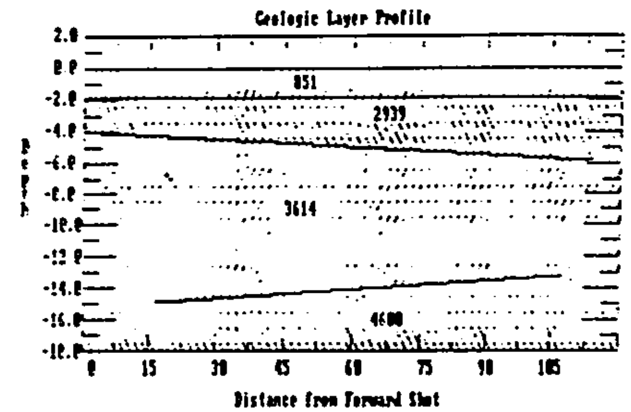
DATE ...

--- Geo Logic REFRACT 2.29 30 Aug 1991 WO 2730-00 Kawaihae Master Plan----

Geologic model parameters:
N layers = 4
R velocity = 0

Forward files: 2730HF

Reverse files: 2730HR



Geologic Model Profile for 4 Layers

Layer	Velocity	Dip Angle	Fwd Shot Depth	Fwd Shot Elev	Averaging Interval	Rev Shot Depth	Rev Shot Elev
1	851	0.00	1.9	-1.9	1- 119	1.9	-1.9
2	2939	-0.00	4.0	-4.0	3- 114	5.9	-5.9
3	3614	-0.92	15.3	-15.3	17- 107	13.0	-13.0
4	4800	1.08	---	---	---	---	---

SEISMIC REFRACTION SURVEY "H"

PLATE A-23

KAWAIHAE MASTER PLAN

GEOLABS-HAWAII
Foundation & Soil Engineering Geology

DATE SEPTEMBER 1991 W.O. 2730-00

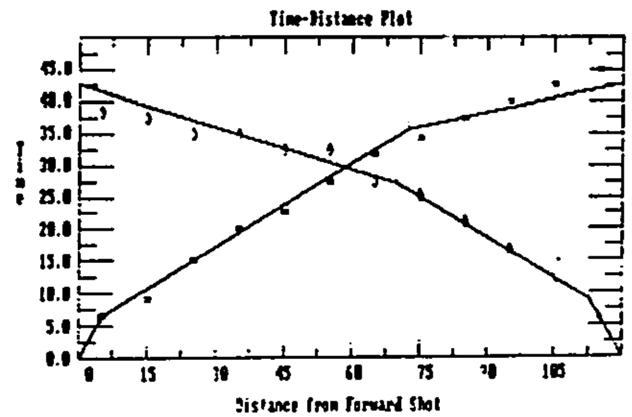
--- Geo Logic REFRACT 2.29 30 Aug 1991 WO 2730-00 Kawaihae Master Plan---

Geologic model parameters:
N layers = 3
R velocity = 0

Forward files:
27301F

Reverse files:
27301R

Time-Distance Plot



FORWARD DATA: Variance = 2.0E+00

L	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
1	800	0	0.0	0	0.0
2	2292	74	4.1	1	5.0
3	6982	>E3	25.3	3	72.4

REVERSE DATA: Variance = 1.0E+00

L	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
1	800	0	0.0	0	0.0
2	2375	79	5.9	1	7.1
3	4531	525	16.0	3	50.3

SEISMIC REFRACTION SURVEY "I"

PLATE A-24

KAWAIHAE MASTER PLAN

GEOLABS–HAWAII
Foundation & Soil Engineering Geology

DATE SEPTEMBER 1991 | W.O. 2730-00

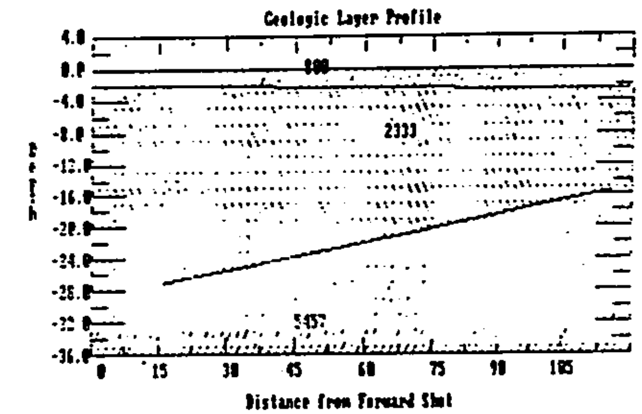
--- Geo Logic REFRACT 2.29 30 Aug 1991 WO 2730-00 Kawaihae Master Plan---

Geologic model parameters:
N layers = 3
R velocity = 0

Forward files:
27301F

Reverse files:
27301R

Geologic Layer Profile



Geologic Model Profile for 3 Layers

Layer	Velocity	Dip Angle	Fwd Shot Depth	Fwd Shot Elev	Averaging Interval	Rev Shot Depth	Rev Shot Elev
1	800	0.00	1.7	-1.7	1- 119	2.5	-2.5
2	2333	-0.37	29.0	-29.0	16- 115	15.3	-15.3
3	5457	6.56	---	---	---	---	---

SEISMIC REFRACTION SURVEY "I"

PLATE A-25

KAWAIHAE MASTER PLAN

GEOLABS–HAWAII
Foundation & Soil Engineering Geology

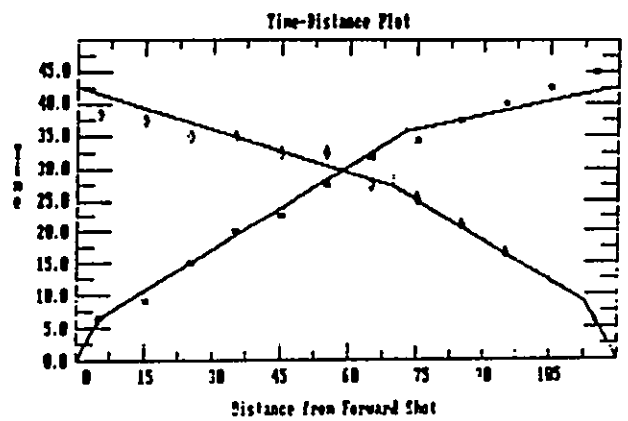
DATE SEPTEMBER 1991 | W.O. 2730-00

--- Geo Logic REFRACT 2.29 30 Aug 1991 WO 2730-00 Kawaihae Master Plan---

Geologic model parameters:
N layers = 3
R velocity = 0

Forward files: 27301F

Reverse files: 27301R



FORWARD DATA: Variance = 2.0E+00

L	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
1	800	0	0.0	0	0.0
2	2292	74	4.1	1	5.0
3	6982	>E3	25.3	3	72.4

REVERSE DATA: Variance = 1.9E+00

L	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
1	800	0	0.0	0	0.0
2	2375	79	5.9	1	7.1
3	4531	525	16.0	3	50.3

SEISMIC REFRACTION SURVEY "I"

PLATE A-24

KAWAIHAE MASTER PLAN

GEOLABS–HAWAII
Foundation & Soil Engineering Geology

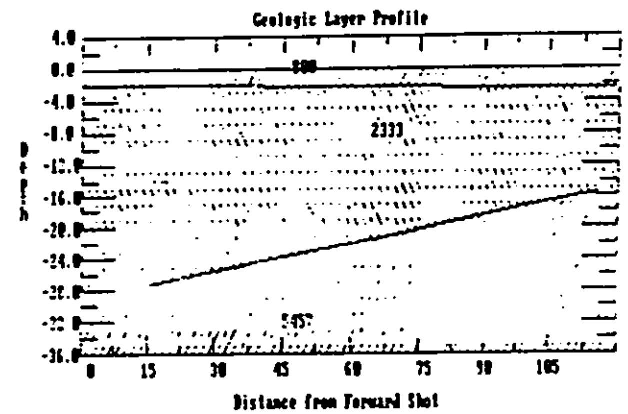
DATE SEPTEMBER 1991 WO 2730-00

--- Geo Logic REFRACT 2.29 30 Aug 1991 WO 2730-00 Kawaihae Master Plan---

Geologic model parameters:
N layers = 3
R velocity = 0

Forward files: 27301F

Reverse files: 27301R



Geologic Model Profile for 3 Layers

Layer	Velocity	Dip Angle	Fwd Shot Depth	Fwd Shot Elev	Averaging Interval	Rev Shot Depth	Rev Shot Elev
1	800	0.00	1.7	-1.7	1- 119	2.5	-2.5
2	2333	-0.37	29.0	-29.0	16- 115	15.3	-15.3
3	5457	6.56	---	---	---	---	---

SEISMIC REFRACTION SURVEY "I"

PLATE A-25

KAWAIHAE MASTER PLAN

GEOLABS–HAWAII
Foundation & Soil Engineering Geology

DATE SEPTEMBER 1991 WO 2730-00

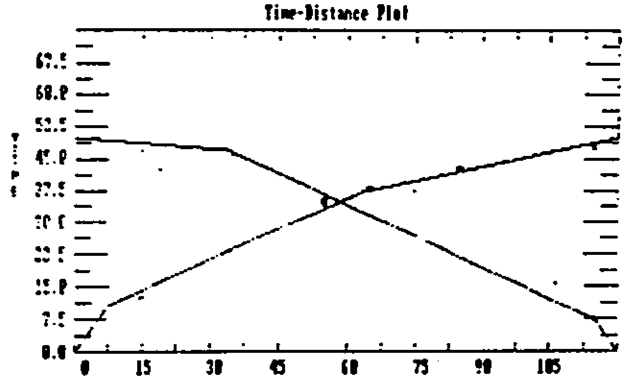
--- Geo Logic REFRACT 2.29 30 Aug 1991 WO 2730-00 Kawaihae Master Plan----

Geologic model parameters:
N layers = 3
R velocity = 0

Forward files: 2730JF

Reverse files: 2730JR

Time-Distance Plot



Distance from Forward Shot

FORWARD DATA: Variance = 1.7E+00

L	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
1	690	0	0.0	0	0.0
2	2138	116	7.0	1	7.2
3	4454	370	22.4	2	63.1

REVERSE DATA: Variance = 3.7E+00

L	Apparent Velocity	+/-	Intercept Time	+/-	Crossover Distance
1	690	0	0.0	0	0.0
2	2057	108	4.8	1	5.0
3	12479	>E3	39.7	2	86.0

SEISMIC REFRACTION SURVEY "J"

PLATE A-26

KAWAIHAE MASTER PLAN
GEOLABS–HAWAII
Foundation & Soil Engineering Geology
DATE SEPTEMBER 1991 | W.O. 2730-00

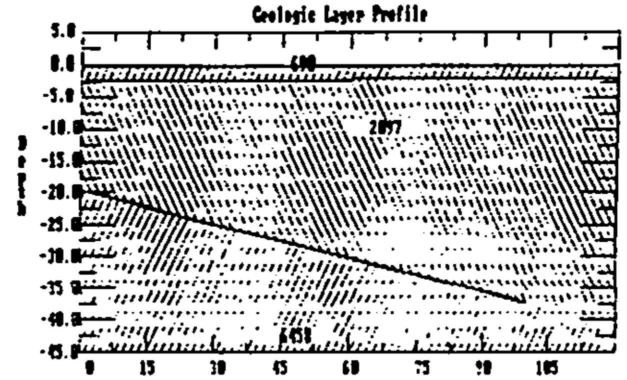
--- Geo Logic REFRACT 2.29 30 Aug 1991 WO 2730-00 Kawaihae Master Plan----

Geologic model parameters:
N layers = 3
R velocity = 0

Forward files: 2730JF

Reverse files: 2730JR

Geologic Layer Profile



Distance from Forward Shot

Geologic Model Profile for 3 Layers

Layer	Velocity	Dip Angle	Fwd Shot Depth	Fwd Shot Elev	Averaging Interval	Rev Shot Depth	Rev Shot Elev
1	690	0.00	2.6	-2.6	1- 119	1.8	-1.8
2	2097	0.39	19.4	-19.4	3- 100	40.4	-40.4
3	6458	-10.08	---	---	---	---	---

SEISMIC REFRACTION SURVEY "J"

PLATE A-27

KAWAIHAE MASTER PLAN
GEOLABS–HAWAII
Foundation & Soil Engineering Geology
DATE SEPTEMBER 1991 | W.O. 2730-00

APPENDIX B

Laboratory Testing

Laboratory testing was performed on selected samples obtained during our field exploration. A laboratory testing program was developed to schedule appropriate tests to aid in determining pertinent engineering properties of the soil and/or rock materials sampled.

Classification Tests

Frequently, the classification of a material provides a correlative index to certain engineering properties of the material

Atterberg Limits tests (ASTM Test Method D 4318-84) are used to determine the plasticity of the fine-grained portion of soils. The Plasticity Index of the material is used to classify the soil under the Unified Soil Classification System. The results of this test are shown on Plate B-1.

Sieve Analysis tests (ASTM Test Method D 422-63) are performed to determine the grain size distribution in the Unified Soil Classification System and to provide indices on other engineering properties. The results of this test are summarized on Plate B-1.

Physical Property Tests

Tests are performed to develop a correlative index of certain physical parameters of a soil. These physical parameters may be used in engineering analyses pertaining to the performance or suitability of a soil.

Proctor (ASTM D 1557-78) tests and California Bearing Ratio (ASTM D 1883) test were performed on selected samples as an aid to evaluating their embankment fill and pavement support characteristics. The results of these tests are summarized on Plates B-2 through B-4.

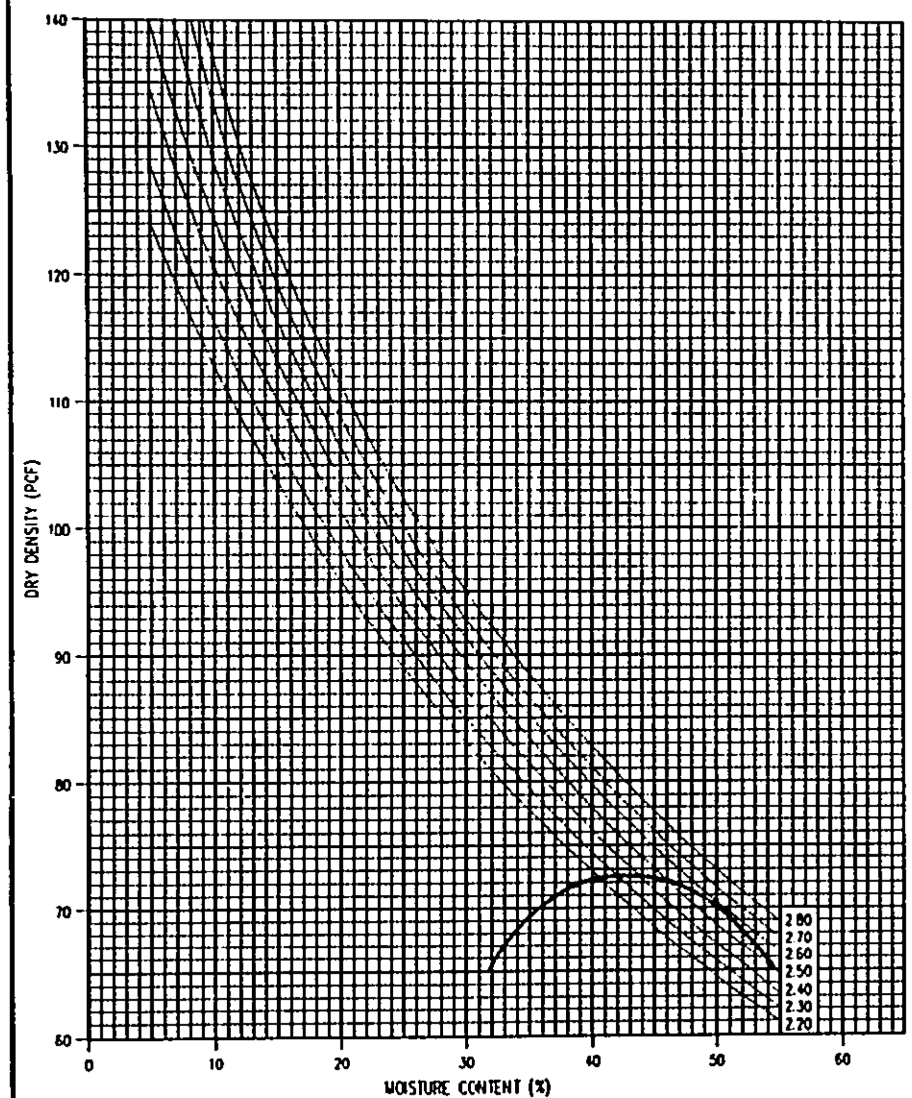
W.O. 2730-00 SEPTEMBER 1991

(d:\wp51\data\reports.002\as - 2730appa.def)

SUMMARY OF LABORATORY TEST RESULTS

LOCATION	TEST PIT 3		TEST PIT 8		
SAMPLE NO.	BAG A		BAG B		
DEPTH BELOW WATER (FEET)	4.0-7.0		0.0-1.5		
DESCRIPTION	LIGHT BROWNISH GRAY SILTY GRAVEL WITH SAND		REDDISH BROWN SILT		
GRADING ANALYSIS					
(% Passing) Sieve					
2-1/2"					
2"	100				
1-1/2"	86				
1"	84				
3/4"	76				
#4	60				
#10	49				
#20	42				
#40	38				
#100	32				
#200	29.3				
ATTERBERG LIMITS					
Air Dried or Natural			NATURAL		
Liquid Limit			66		
Plastic Limit			61		
Plasticity Index			5		
UNIFIED SOIL CLASSIFICATION	GM		MH		
NATURAL MOISTURE CONTENT %	17.6		24.1		
EXPANSION AND CBR TESTS					
(Surcharge - 51 P.S.F.)					
Molding Moisture Content %	37.1		43.9		
Molding Dry Density, P.C.F.	79.9		74.1		
Swell Upon Saturation, %	0.04		0.04		
CBR at 0.1" Penetration	60		17.5		
COMPACTION TEST					
(Test Designation)					
Dry to Wet or Wet to Dry			DRY TO WET		
Max. Dry Density (P.C.F.)			72.5		
Optimum Moisture (%)			42.5		

W.O. 2730-00 DATE: SEPTEMBER 1991 PLATE B-1



PROJECT: KAWAIHAE 10-YEAR MASTER PLAN
LOCATION: KAWAIHAE, SOUTH KOHALA, HAWAII
SAMPLE NO.: BAG B DEPTH:
SOIL DESCRIPTION: REDDISH BROWN SILT

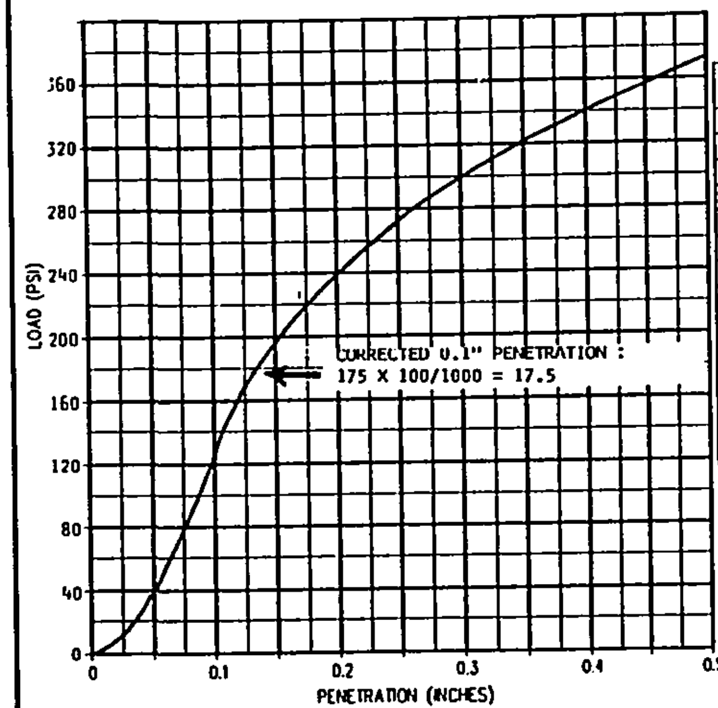
PLATE B-2

MAXIMUM DENSITY & MOISTURE CURVES

GEOLABS-HAWAII

DATE SEPTEMBER 1991 W.O. 2210-00

PROJECT: KAWAIHAE 10-YEAR MASTER PLAN
LOCATION: KAWAIHAE, SOUTH KOHALA, HAWAII
TEST LOCATION: BAG B
DEPTH:
SOIL DESCRIPTION: REDDISH BROWN SILT



CBR PENETRATION DATA

PENETRATION (INCHES)	LOAD (LBS)	LOAD (PSI)
0.025		
0.050		
0.075		
0.100		
0.125		
0.150		
0.175		
0.200		
0.250		
0.300		
0.350		
0.400		
0.450		
0.500		

AGGREGATE 3/4" MINUS
HAMMER WEIGHT 10 LBS
HAMMER DROP 18 INS.
NO. OF BLOWS 56
NO. OF LAYERS 5

TEST RESULTS

MOLDING MOISTURE (%) 43.9
MOLDING DRY DENSITY (P.C.F.) 74.1
CBR @ 0.1" PENETRATION 17.5
DAYS SOAKED 4
SWELL (%) 0.4
DATE 09-06-91 BY J. HO

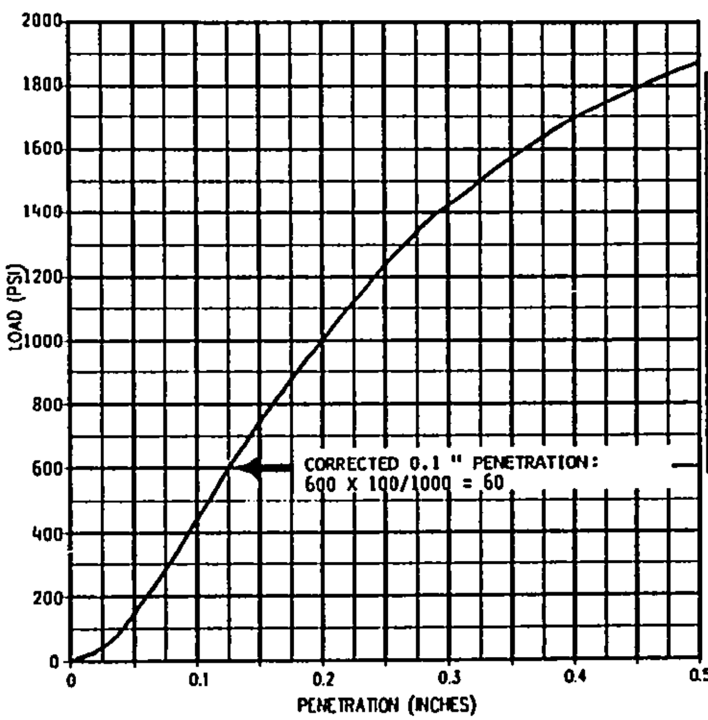
PLATE B-3

CBR TEST

GEOLABS-HAWAII
Foundation & Soil Engineering Geology

DATE W.O.

PROJECT: KAWAIHAE 10-YEAR MASTER PLAN
LOCATION: KAWAIHAE, SOUTH KOHALA, HAWAII
TEST LOCATION: BAG A
DEPTH:
SOIL DESCRIPTION: LIGHT BROWNISH GRAY SILTY GRAVEL WITH SAND



CBR PENETRATION DATA

PENETRATION (INCHES)	LOAD (LBS)	LOAD (PSI)
0.025		
0.050		
0.075		
0.100		
0.125		
0.150		
0.175		
0.200		
0.250		
0.300		
0.350		
0.400		
0.450		
0.500		

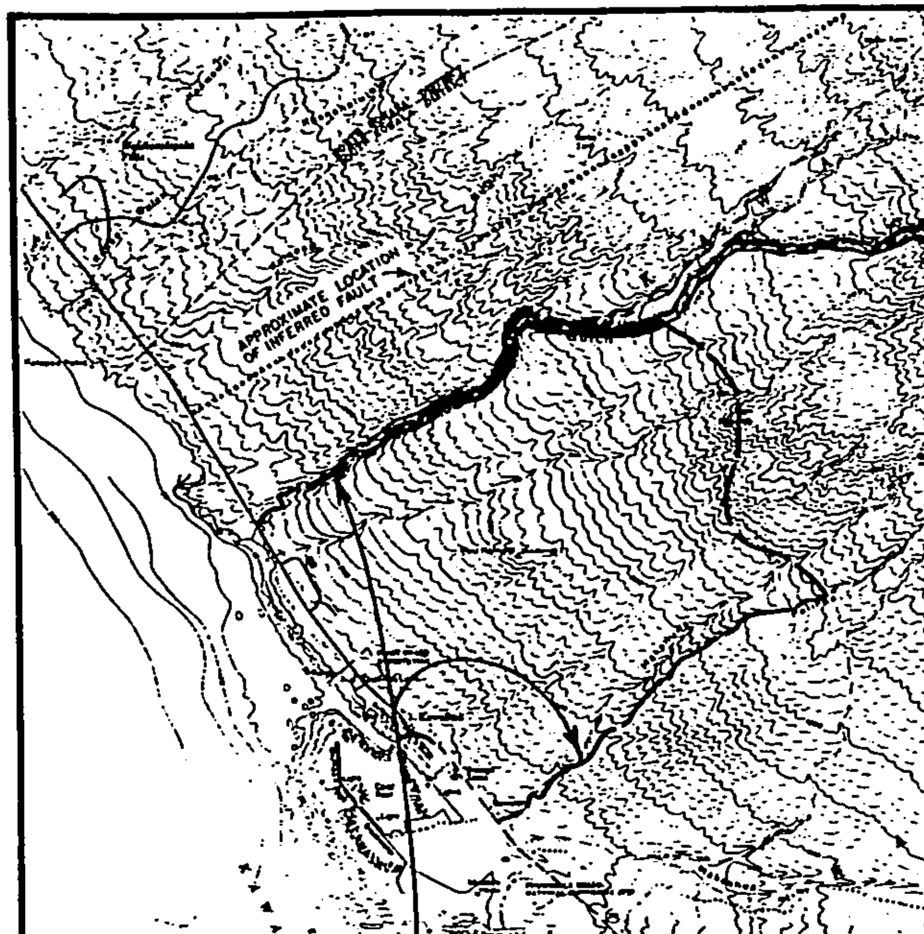
AGGREGATE 3/4 " MINUS
HAMMER WEIGHT 10 LBS.
HAMMER DROP 18 INS.
NO. OF BLOWS 56
NO. OF LAYERS 5

TEST RESULTS

MOLDING MOISTURE (%) 37.1
MOLDING DRY DENSITY (P.C.F.) 79.9
CBR @ 0.1" PENETRATION
DAYS SOAKED 4
SWELL (%) 0.04
DATE 09-06-91 BY J. HO

PLATE B-4

CBR TEST
GEOLABS—HAWAII
Foundation & Soil Engineering Geology
DATE SEPTEMBER 1991 | W.O. 2730-00



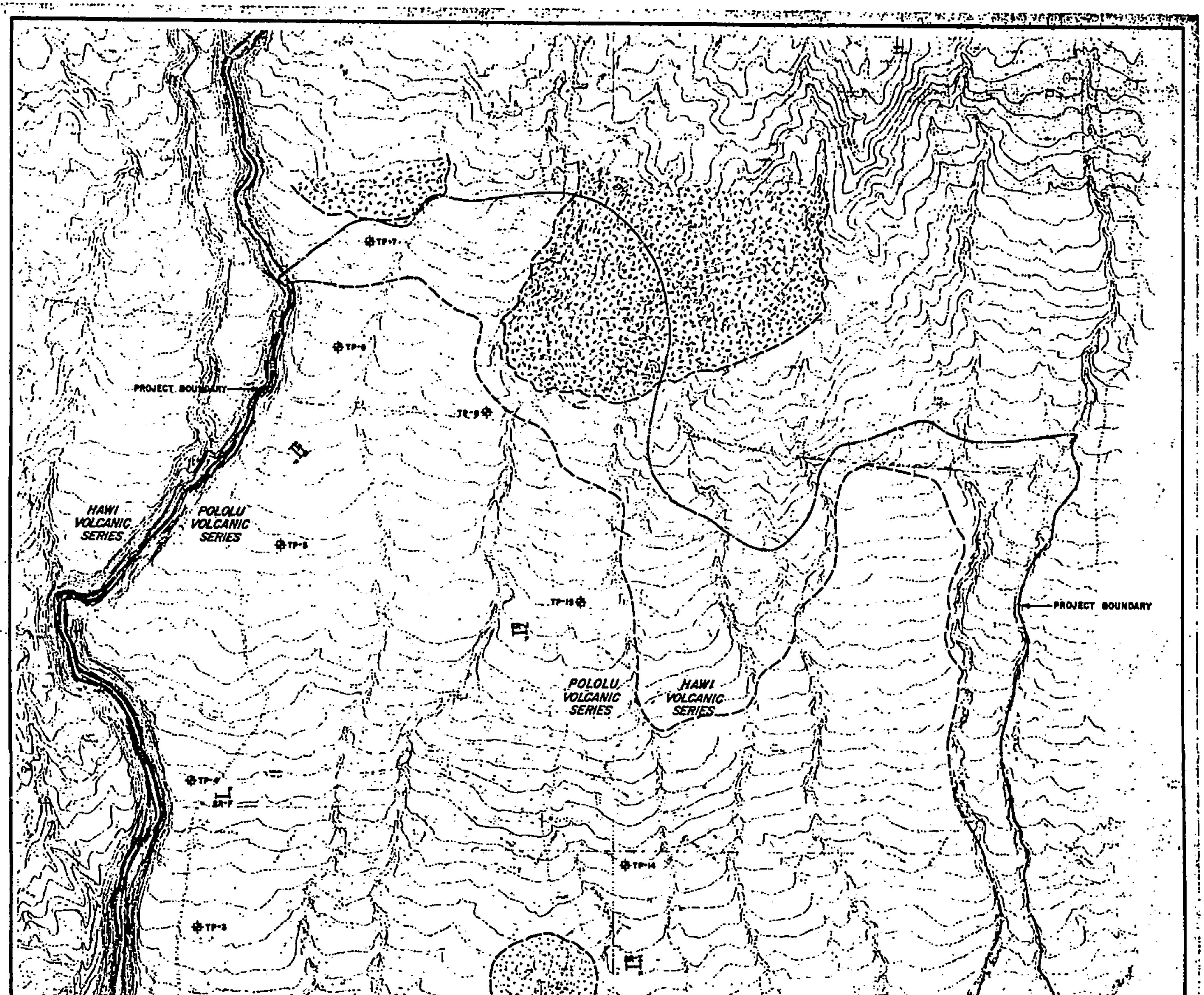
PROJECT LOCATION MAP
KAWAIHAE 10-YEAR MASTER PLAN
KAWAIHAE, SOUTH KOHALA, HAWAII

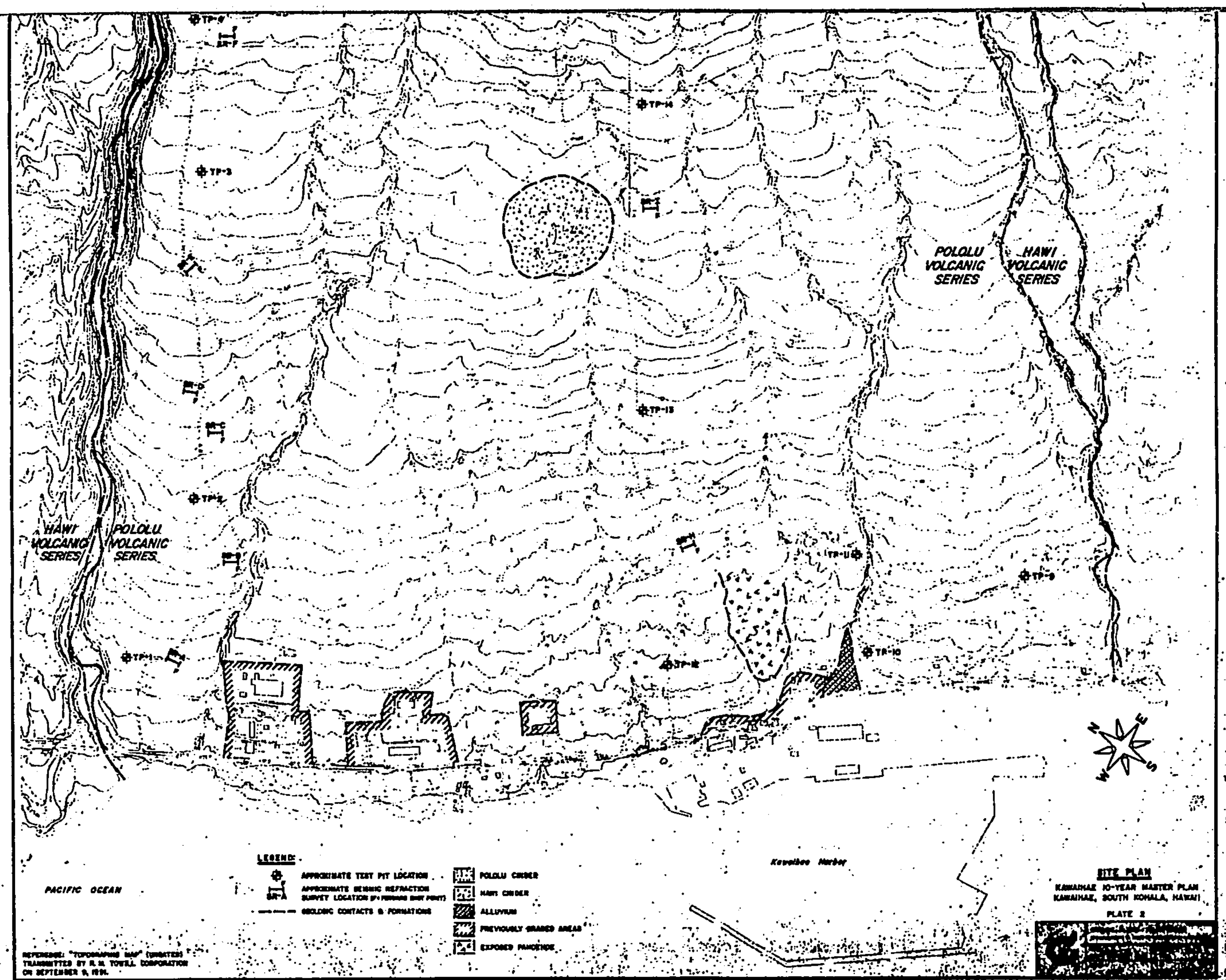
REFERENCE: U.S.G.S. QUADRANGLE MAP;
KAWAIHAE, HAWAII (1982)

PLATE 1

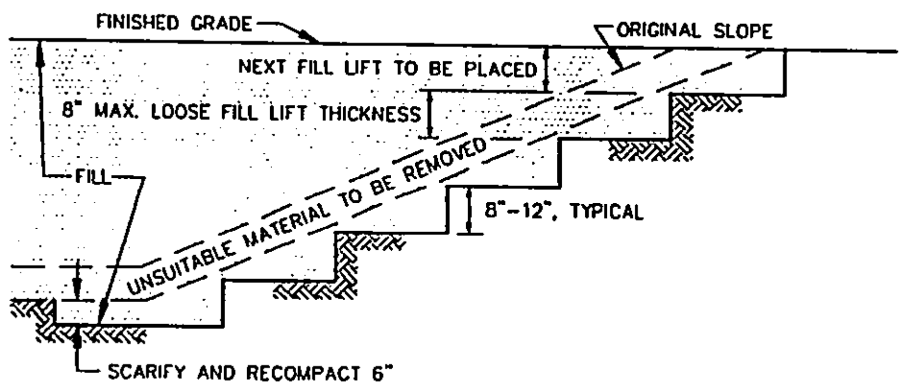
GEOLABS-HAWAII
Foundation & Soil Engineering • Geology

DATE	DRAWN BY
SEPTEMBER 1991	K H N
SCALE 1" = 3,000'	W.O. 2730-00

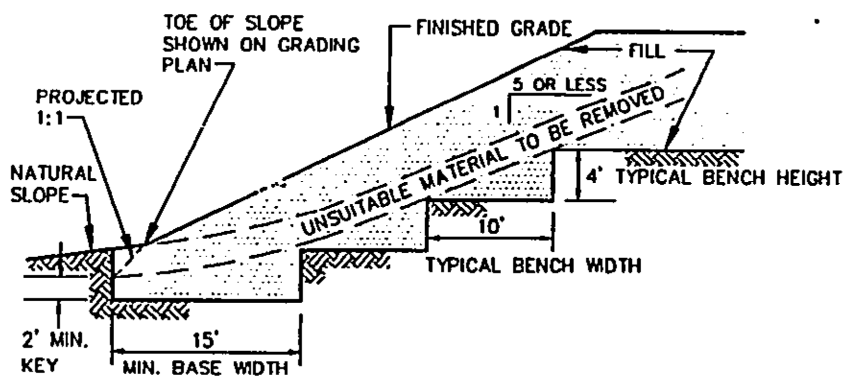

PROJECT BOUNDARY
TP-7
TP-6
TP-9
HAWI VOLCANIC SERIES
POLOLU VOLCANIC SERIES
TP-8
TP-15
PROJECT BOUNDARY
POLOLU VOLCANIC SERIES
HAWI VOLCANIC SERIES
TP-4
TP-14
TP-3


POLOLU VOLCANIC SERIES
HAWI VOLCANIC SERIES
TP-14
TP-3
TP-15
TP-2
TP-1
TP-12
TP-11
TP-10
TP-9
Kawaihae Harbor
PACIFIC OCEAN
LEGEND:
APPROXIMATE TEST PIT LOCATION
APPROXIMATE SEISMIC REFRACTION SURVEY LOCATION
GEOLOGIC CONTACTS & FORMATIONS
POLOLU CINDER
HAWI CINDER
ALLUVIUM
PREVIOUSLY GRADED AREAS
EXPOSED PAHOEHOE
REFERENCE: "TOPOGRAPHIC MAP" (UNDATED) TRANSMITTED BY R. M. TOWILL CORPORATION ON SEPTEMBER 9, 1991.
SITE PLAN
KAWAIHAE 10-YEAR MASTER PLAN
KAWAIHAE, SOUTH KOHALA, HAWAII
PLATE 2

LEVEL FILL ON SLOPING GROUND



FILL SLOPE ON SLOPING GROUND



NOTE:
WHERE NATURAL SLOPE IS FLATTER THAN 5:1 (H:V), BENCHING IS NOT NECESSARY. FILL SHOULD NOT BE PLACED ON COMPRESSIBLE OR UNSUITABLE MATERIAL.

NOT TO SCALE

PLATE 3

SKETCH OF KEYING & BENCHING

GEOLABS–HAWAII
Foundation & Soil Engineering Geology

DATE | W.O.

APPENDIX C

BIOLOGICAL DATABASE & RECONNAISSANCE SURVEY
By Hawaii Heritage Program

BIOLOGICAL DATABASE & RECONNAISSANCE SURVEY

OF THE

DEPARTMENT OF HAWAIIAN HOME LANDS

KAWAIHAE PARCEL

Prepared for:

State of Hawaii
Department of Hawaiian Home Lands
Honolulu, Hawaii

Prepared by:

Hawaii Heritage Program
The Nature Conservancy of Hawaii
Honolulu, Hawaii

April 1990

EXECUTIVE SUMMARY

In June 1989, the Department of Hawaiian Home Lands (DHHL) contracted with The Nature Conservancy's Hawaii Heritage Program (HHP) to prepare a biological inventory of their parcel in Kawaihae (DHHL parcel). This report briefly describes the methods used and summarizes the available information on these biological resources known or reported to occur in the DHHL parcel. The purpose of this report is to provide information useful in planning and general management of the biological resources in the DHHL parcel.

The vast majority of the DHHL parcel consisted of pasture or kiawe (Prosopis pallida) forest. And although most of the original vegetation of Kawaihae has been destroyed by hoofed animals and introduced plants, a few remnant native forest pockets do persist on the DHHL parcel. The three native natural communities observed in the DHHL parcel were the rare Koai'a Lowland Dry Forest, the 'Akia/'A'ali'i/'Ulei Lowland Dry Shrubland, and the 'Ohi'a/'Olapa Montane Wet Forest. All native vegetation patches were small and were located on the upper slopes of cinder cones and in gulches; these patches were surrounded by alien (non-native) vegetation, usually made up of introduced range grasses. Only the Koai'a Lowland Dry Forest is considered rare and two populations of the rare plant Acacia koaia were observed during the survey. The largest population consisted of several hundred trees which compose the dominant cover of the Koai'a Lowland Dry Forest in Keawewai Gulch.

Two other rare plant species are known from the DHHL parcel and are restricted largely to gulches and cinder cones above 2400 feet elevations. These are Lobelia hypoleuca found at the base of Puu Lapalapa and Cyanea tritomantha seen on the slope of Puu Mala. Both taxa had not been previously reported from the DHHL parcel. Populations of these rare plants appear to be located mainly in steep areas, which are least accessible to grazing animals and human disturbance.

No rare native animal species were observed during the 1989 survey nor have they been reported within the DHHL parcel. Two common endemic forest birds, the 'apapane (Himatione sanguinea sanguinea) and the Hawaii 'amakihi (Hemignathus virens virens), were seen during the survey, along with numerous alien birds and invertebrates. Four rare animal species have been reported from lands adjacent to the DHHL parcel: Hawaiian hoary bat (Lasiurus cinereus semotus), Hawaiian duck (Anas wyvilliana), Hawaiian hawk (Buteo solitarius), and a rare land snail (Partulina physa). These species may also be found within the DHHL parcel with further surveys.

Threats that may decrease the long term survival of native plants, animals, and natural communities in the DHHL parcel include: human disturbance, grazing and disturbance by pigs, cattle, and goats; predation by mongeese and rats, and displacement by alien plants. Limited suitable nesting habitat may also contribute to reduced nesting success and decline in rare birds.

CONTENTS

FIGURES

TABLES

APPENDICES

ATTACHMENTS

INTRODUCTION

In June 1989, the Department of Hawaiian Home Lands (DHHL) contracted with The Nature Conservancy's Hawaii Heritage Program (HHP) to provide information on the unique biological resources known from or reported to occur on DHHL's Kawaihae parcel (DHHL parcel). This parcel is located in the South Kohala district of the island of Hawaii (Figure 1). The DHHL parcel consists of the northern section of the Kawaihae region, which extends southward to Highway 19. Results of both a literature review and a field survey of the DHHL parcel were included in this contract. From these data, HHP developed a database on the location and condition of rare elements (natural communities, plants and animals) in the area. This information can be used by DHHL in planning and general management activities.

This report summarizes the methods used and the results of the literature review and field survey. Its purpose is to provide an overview of the unique biological resources known to occur in the DHHL parcel and the adjacent area. Basic information relating to threats is also included.

The results presented in this report are based upon an extensive body of available information derived from publications, documents, museum collections and reports from knowledgeable individuals. Most of the observations discussed in this report were made within the last 15 years. Observations older than 15 years are also valid indications of the potential presence of rare plants or animals, unless an area has been radically altered. In areas not recently visited, field surveys are needed to determine, if possible, the current status of older sightings. HHP staff supplemented information from older observations with recent surveys of the DHHL parcel, conducted on five days between July 17-19 and August 3-4, 1989.

SPECIAL NOTICE

When using the information provided in this report, it is important to know that data collected by the HHP are dependent on the research and observations of many individuals and organizations. In most cases, this information is not the result of comprehensive or site-specific field surveys and has not been confirmed in the field by HHP staff. Many natural areas in Hawaii have never been thoroughly surveyed, and new species of plants and animals are still being discovered. For these reasons, the HHP cannot provide a definitive statement on the presence, absence or condition of biological elements in any part of Hawaii. HHP reports summarize the existing information known to HHP at the time of the request. They should never be regarded as final statements on the biological elements or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments. Furthermore, HHP reports do not represent or imply a position or policy taken by The Nature Conservancy of Hawaii on any related matter. If information from this report is distributed in any way, the above statements must accompany that information.

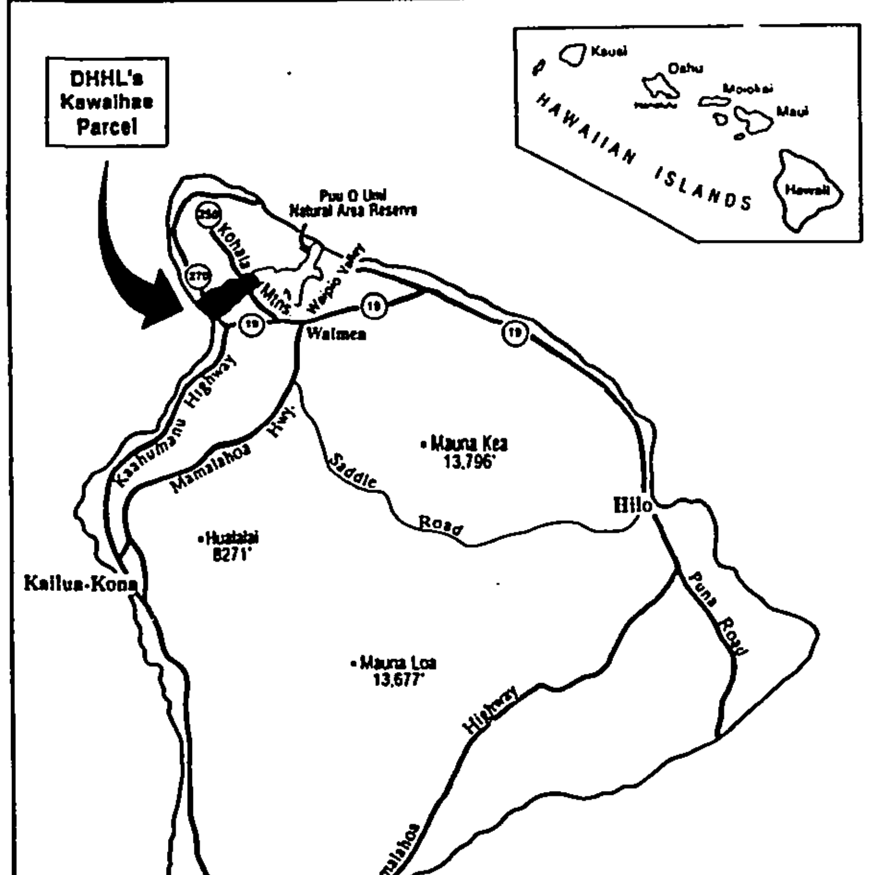


Figure 1
DHHL's Kawaihae Parcel
Island of Hawaii

REPORT ORGANIZATION

In the first section of this report, the natural history of the Kawaihae region is reviewed. The methods section then addresses the Heritage Program's definition of rarity for particular elements (plants, animals, and natural communities) and the methods used to collect this information, including major information sources consulted. Thereafter, Kawaihae's rare biological resources are highlighted in sections describing each of the major types of rare elements. Each section contains a discussion of:

- Rare elements known or believed to occur on DHHL's Kawaihae parcel
- Distribution of these rare elements
- Factors currently threatening the continued survival of these rare elements.

The final section identifies the areas of greatest biological significance and summarizes the report.

FOR MORE INFORMATION

A great deal of additional information is contained in the attachments provided with this report:

> <u>Attachment 1</u> is <u>How to Read Heritage Database Reports</u> (HHP 1989). This book explains the methods used by HHP staff to document plant, animal, and natural community locations and other pertinent information in the database.
>
> <u>Attachment 2</u> contains a map overlay and summaries (Element Occurrence Records) of the available information for each location where a rare natural community, rare plant or rare animal has been reported from Kawaihae or adjacent lands. A list of all information sources in the reference section of this attachment is included for cross referencing. Illustrations of plants known from the Kawaihae region are included (where available) to assist in plant identification.
>
> <u>Attachment 3</u> is the <u>Natural Area Reserves System Inventory Field Manual</u> (NARS 1988). This describes in detail the methods used by HHP staff on field surveys. General Kawaihae field survey methods are covered in the methods section of this report.

This report and its attachments contain the most recent information as of March 1990. If additional or updated information is needed at any time, the Hawaii Heritage staff and database are available for consultation.

NOTE ON TERMINOLOGY AND HAWAIIAN DIACRITICAL MARKS

Throughout this report, we have made a sincere effort to minimize the use of technical terms and HHP "jargon." However, the use of a small number of unfamiliar biological terms is unavoidable. For example, most people are familiar with "rare species." However this term is often inappropriate, as rare plants and animals are sometimes rare species, but they may also be rare subspecies or rare varieties of more common species. The term "rare taxa" is used to refer to subspecies and varieties in this report. To clarify terminology, a glossary of technical terms is included at the end of the report. If definitions are lacking for any unfamiliar terms or concepts contained in this report, please feel free to call the HHP staff for clarification.

This report uses the 'u'ina (glottal stop) in Hawaiian names of plants and animals. The kaha ko (macron) has not been used due to word processing limitations. While HHP recognizes the importance of Hawaiian diacritical marks in place names as well, it has adopted a policy of excluding all marks from place names because U.S. Geological Survey (USGS) topographic maps do not include diacritical marks.

NATURAL HISTORY OF KAWAIHAE

The Hawaiian Islands are the most isolated archipelago of high islands on Earth. An ocean barrier of 2500 miles separates the islands from the nearest continent, and life arrived slowly via wind, waves and birds. The early colonizers diversified over millions of years into thousands of uniquely Hawaiian plants and animals. Scientists the world over have described the biota of Hawaii as one of the most outstanding examples of evolution.

Within this remarkable island chain, the island of Hawaii (Big Island) is the youngest of the main Hawaiian Islands. By latest accounting, the Big Island is less than 500,000 years old. In contrast, Mount Haleakala on Maui is nearly a million years old, and the mountains of Kauai about six million years old (Macdonald et al. 1983).

Kawaihae is a region that lies on the northwest end of the Big Island, which extends southward to Highway 19 (Figure 1). Highways 270 and 250 provide primary access to the region, with smaller ranch roads and various trails providing additional access. The region includes the DHHL parcel. The topography slopes gradually from sea level to approximately 4800 feet elevation (Figure 2). There are several gulches dissecting the middle to low elevations and scattered small volcanic cones at higher elevations. The major gulch draining this area is Honokoa. Several smaller gulches also cross the parcel. After heavy rains, some of these gulches have running streams. From north to south these gulches include: Kalopae, Waipahoehoe, Kilohana, Keawewai, and Makahuna. Gulches at the north and south boundary of the parcel are Keahahalululu and Palihae respectively.

Situated on the leeward side of the Kohala Mountains, the Kawaihae region has a large rainfall gradient. The Kawaihae coast has virtually the lowest annual rainfall on the island (approximately 10 inches per year), equivalent to desert conditions. This is in sharp contrast to well over 75 inches of rainfall per year at 4800 feet elevation, where montane rainforest conditions prevail.

Prior to human settlement, the native vegetation of Kawaihae extended from the coast to the summit and was probably more diverse and abundant than today. Coastal dry shrublands and grasslands probably bordered the shoreline of Kawaihae, with scattered stands of wiliwili (Erythrina sandwicensis) forest. Further inland at lower elevations, lowland dry shrublands dominated by such species as 'akia (Wikstroemia pulcherrima), 'a'ali'i (Dodonaea viscosa), and 'ulei (Osteomeles anthyllidifolia) were likely present. Those shrublands probably gave way to lowland dry and mesic forests dominated by koai'a (Acacia koaia) and perhaps other trees such as naio (Myoporum sandwicense), lama (Diospyros sandwicensis), mamane (Sophora chrysophylla), olopua (Nestegis sandwicensis), and 'ala'a (Pouteria sandwicensis) at somewhat higher elevations. Upper Kawaihae was covered with a montane wet forest, dominated by 'ohi'a (Metrosideros polymorpha) and 'olapa (Cheirodendron trigynum).

When the Hawaiians settled in Kawaihae, they converted drier slopes into pili (Heteropogon contortus) grasslands for thatching. The moister land upslope was farmed for such crops as taro (Colocasia esculenta), yam (Dioscorea alata) and sweet potato (Ipomoea batatas). Other

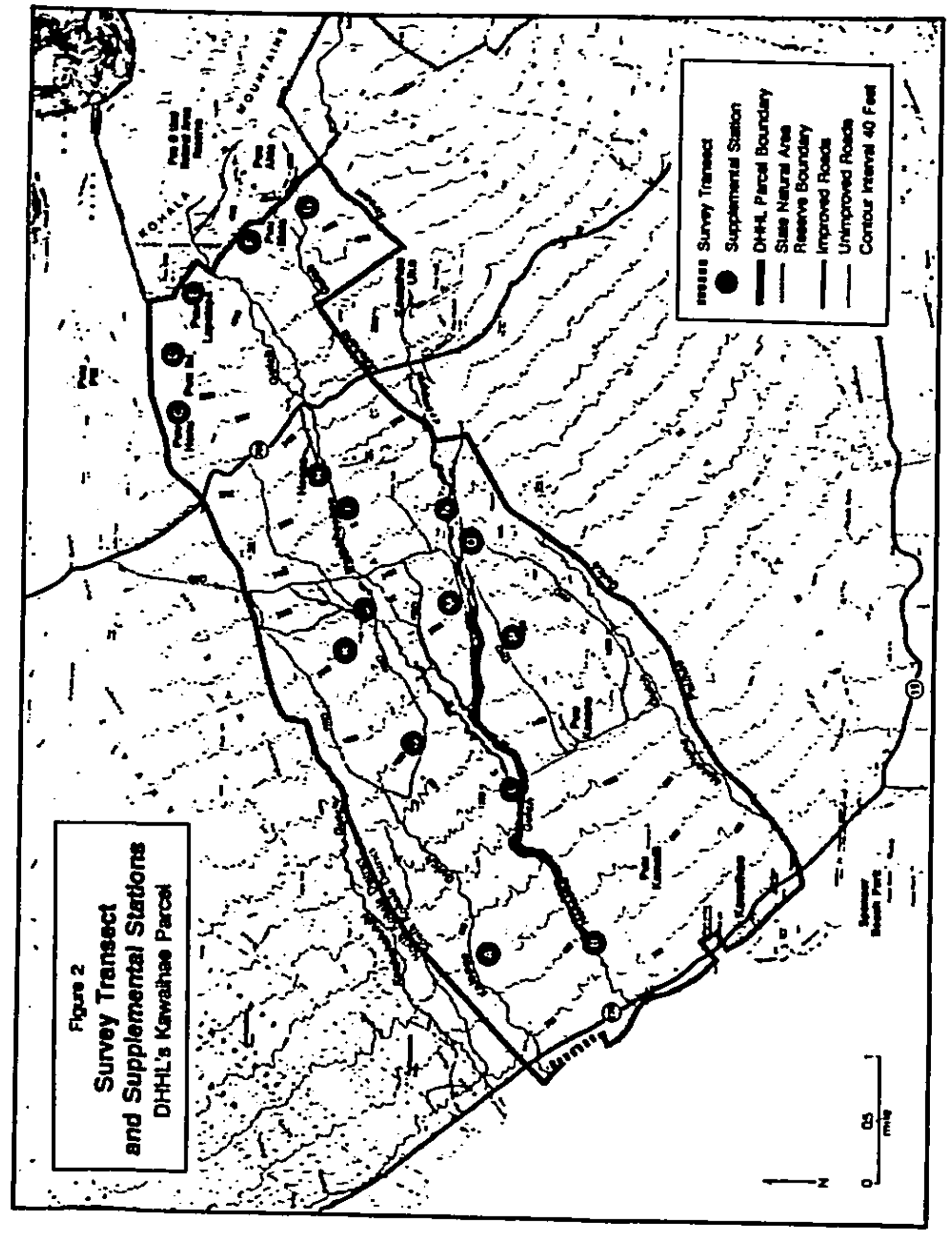


Figure 2
Survey Transect and Supplemental Stations
DHHL's Kawaihae Parcel

plants introduced by the Hawaiians, such as kukui (Aleurites moluccana) and ti (Cordyline fruticosa), were encouraged in gulches where they displaced many native plants.

Post-Cook changes in the landscape reflected changing land use and continued introductions of alien species. The very large cattle populations of the 1800s severely damaged much of Kawaihae's native vegetation, which had never before been exposed to grazing and trampling by large, herbivorous, hoofed animals. As the native vegetation declined, a growing number of introduced plants, such as kiawe (Prosopis pallida), partridge pea (Chamaecrista nictitans), lantana (Lantana camara), koa haole (Leucaena leucocephala) and pasture grasses became established and displaced native plants.

Cattle ranching continues in Kawaihae, both within and outside of the DHHL parcel. Other land uses are horse pasture, housing, fishing along the beach areas, and light industrial and commercial enterprises around the harbor. The remainder of this report documents the biological diversity of the DHHL's Kawaihae parcel.

METHODS

To describe and summarize the biological richness of the DHHL parcel, all pertinent sources of biological information for the area were consulted. From these data, HHP developed a database which contains information on the location and population status of rare plants and animals. This database allows for a better understanding of existing biological resources.

Regardless of the element type, the following four steps were used to gather and process existing information:

1) Search and review all pertinent biological literature and specimen collections on rare elements reported from the DHHL parcel and adjacent lands.

2) Interview scientists and natural resource experts with knowledge of the area.

3) Survey the project area, using representative transects or supplemental stations, to characterize major vegetation types and ecosystems and update the status of rare elements through incidental observations.

4) Summarize this information in a database, including a map of the sites where rare elements have been reported to occur and detailed computerized records of location and status.

HHP compiles and maintains statewide information on all rare and imperilled Hawaiian natural communities, plants and animals. A natural community is considered rare and imperilled if it is known from 20 or fewer localities OR if it covers less than 2000 acres worldwide. More widespread natural communities that are threatened with destruction throughout their range are also considered imperilled. The definition of a rare plant or animal varies depending on professional opinion. HHP defines a plant or animal taxon as rare when available records indicate that its current distribution or abundance is limited. A species is considered rare if within the last 15 years it is known from 20 or fewer locations OR fewer than 3000 individuals. Other widespread taxa that are threatened with destruction throughout their range are also considered imperilled.

After rare elements have been identified and mapped, a "global rank" is assigned by HHP to represent an element's worldwide rarity and threat of extinction. The global rank is based upon the following six criteria and is described in detail in How To Read Heritage Database Reports (Attachment 1):

- Estimated number of sites (or occurrences)
- Estimated abundance
- Number of protected sites
- Range
- Threats
- Ecological fragility

This element ranking system is used by Heritage Programs throughout the United States, Canada and Latin America to identify communities and taxa in need of immediate protection.

The definition of an occurrence varies depending on the element type (natural community, plant or animal). Each of the following three sections first describes the element, lists the major information sources, and defines an occurrence depending on element type.

NATURAL COMMUNITIES

A natural community is an assemblage of plants and animals occurring together at a site. Because of their environmental requirements, particular taxa tend to occur at specific altitudes, or on certain soil types, or under limited ranges of moisture. Additionally, some taxa require the presence of other taxa in order to persist. For example, many native birds require the nectar of 'ohi'a trees, and many native plants require either native birds or native insects to pollinate them. These kinds of direct and indirect interactions between plants, animals and environment form the basis for a healthy natural community.

Classification of natural communities in Hawaii is relatively new. Useful information on the location and condition of natural communities is difficult to obtain because many field botanists focus on rare plants rather than natural communities. Since 1985, ecologists at the Hawaii Heritage Program and the Bernice P. Bishop Museum have been working together to identify and describe the many types of native and non-native communities in the Hawaiian Islands. More than 24 biologists from around the state have assisted in this effort. Known as the Hawaiian Natural Community Classification, it is the best available system for distinguishing native natural communities in the islands. A summary of the Hawaiian Natural Community Classification will formally appear in the Museum's Manual of the Flowering Plants of Hawaii (Wagner et al. In press), scheduled for publication in 1990. However, the classification will continue to change over the coming years, as it is tested and refined through direct field observations.

Review of 1977 aerial photographs, interviews with Linda Cuddihy, Winona Char and P. Quentin Tomich, and data collected from a 1988 survey of Puu O Umi Natural Area Reserve (DLNR 1990) were used to evaluate known and potential native natural communities in the DHHL's Kawaihae parcel. A map of 'ohi'a (*Metrosideros polymorpha*)-dominated vegetation compiled by the United States Fish and Wildlife Service (USFWS) provided significant information on the distribution of this native forest community in the DHHL parcel and adjacent area (Jacobi pers. comm.). These sources also helped to refine the locations and general distribution of natural communities. Although not exhaustive, the HHP survey sponsored by DHHL helped to confirm and augment the sparse available information.

For native natural communities, an "occurrence" is mapped when the vegetation of an area consists of at least 60% native plants. Stands are considered alien communities when alien plants occupy more than 40% of the area. These areas are mapped as alien vegetation and are not included in the natural community database.

For each native natural community reported in Kawaihae, approximate boundaries were plotted on topographic quad maps and on aerial photographs whenever available. Community descriptions and plant species lists were compiled when such information was available. Communities considered rare by HHP were located precisely and detailed computerized records (Element Occurrence Records) were completed (Attachment 2).

RARE PLANTS

Our understanding of Hawaii's native plants is continually being revised. Recently the Bernice P. Bishop Museum sponsored the preparation of the Manual of the Flowering Plants of Hawai'i (Wagner et al. In press), a reevaluation of taxonomic treatments by recognized botanists. Many significant changes in taxonomy were made as the result of these revisions. Upon the advice of Hawaiian botanists, HHP has adopted the taxonomy outlined in the Manual, subject to review by an advisor committee of knowledgeable botanists. Information on ferns comes from an unpublished pc r by Wagner and Wagner (1987).

Information on rare plant locations comes from numerous sources. These include herbarium collections (Bernice P. Bishop Museum, the University of Hawaii's Botany Department and Harold H. Lyon Arboretum), published scientific materials, unpublished reports (environmental impact studies and government reports) and observations by field botanists.

Only native Hawaiian plants are included in HHP's rare plant database. Criteria in compiling this database are:

1) All plant taxa listed as endangered by the USFWS are included (USFWS 1987).

2) All plant taxa identified as candidates for listing by the USFWS are considered for inclusion (USFWS 1990). The fi decision depends on the currently accepted taxonomy and the plant's orted abundance.

3) Additional native plant taxa recommended as rare by experienced botanists are considered for inclusion. Again, the final decision depends on the currently accepted taxonomy and the plant's reported abundance.

For rare plants, an "occurrence" is mapped wherever one or more individuals of a rare plant taxon are reported. Plants of a single taxon scattered along a cliff face, ridge top, or valley floor are considered a single occurrence. Each reported occurrence is classified as either "current" or "historic". Current populations are those observed in the last 15 years (1975-1990); historic populations are those observed prior to 1975. It is important to note that a historical sighting may simply mean that no one has looked recently for the plant at this location, or that the taxon is difficult to find due to habitat, seasonality or small size.

Scientific names are used throughout this report, because many native plants lack Hawaiian or other common names. Where available, common names for plants in the DHHL parcel are provided in Table 2 and Appendix A.

RARE ANIMALS

Animal species considered rare by federal or state wildlife agencies or by the scientific community are included in the HHP database. These include terrestrial animals (birds, snails, and one mammal) and marine animals (sea turtles and one mammal). Also included are fish and aquatic invertebrates, which are used as indicators of relatively pristine stream and anchialine pool habitats.

Only native Hawaiian animal species, subspecies or island populations are included in the HHP rare animal database. The following criteria are used:

1) All species, subspecies, or island populations listed as endangered or threatened by the USFWS (USFWS 1989) or by the State of Hawaii (DLNR 1986) are included in the list.

2) All species, subspecies, or island populations identified as candidates for listing by the USFWS are considered for inclusion.

3) Additional species, subspecies, or island populations regarded as rare by the scientific community are considered for inclusion. Final decision for inclusion is based on known abundance and rarity.

Major sources and the definition of an occurrence for each rare animal taxon from the Kawaihae region are included in the following sections. The definition of a rare animal occurrence varies, due to behavioral differences in animals. Recent records (since 1975) are considered to be "current"; those which are older than 1975 are historic. It is important to note that a historical sighting may simply mean that no one has looked recently for the sighting in this locale. It may also mean that the animal is difficult to find due to habitat, seasonality or behavior. Appendix B includes a list of the scientific, common and Hawaiian names for each species reported from the DHHL parcel and adjacent areas.

Hawaiian Hoary Bat

Information for the Hawaiian hoary bat (Lasiurus cinereus semotus) was obtained from both published literature and unpublished sightings collected by P. Quentin Tomich. An element occurrence for the bat consists of any reliable sighting.

Hawaiian Duck

The main sources of information on the distribution of the koloa or Hawaiian duck (Anas wyvilliana) used for this report are unpublished semi-annual survey data from the Division of Forestry and Wildlife (1986, 1988), USFWS 1976-83 forest bird survey data (USFWS n.d.) and miscellaneous published articles (Paton 1981, USFWS 1985). Any reliable sighting of Hawaiian duck is documented and considered an occurrence in the database. On the recommendation of the State Division of Forestry and Wildlife, only rare waterbird sightings

since 1954 are included in the database. Pre-1954 occurrences are omitted because the distribution of waterbird habitat has changed markedly since the first half of this century.

Hawaiian Hawk

The main sources of information for the 'Io or Hawaiian hawk (Buteo solitarius) in the Kawaihae region are sightings from Banko (1980), USFWS 1976-83 forest bird survey (USFWS n.d.), USFWS Recovery Plan (1984) and a dissertation on the 'Io (Griffin 1985). Only reliable sightings of 'Io nest sites are mapped as an occurrences. Sightings of 'Io in flight or perched along the roadside are not included in the database.

Native Land Snails

Since little malacological research has been done on the island of Hawaii during this century, no comprehensive inventory of the land snails in Kawaihae and surrounding areas exists. The only information available was obtained from the unpublished field notes and collection catalog of R.M. Severns' private collection (1988).

An occurrence of a rare land snail is any post-1945 observation or specimen of one or more snails, alive or recently dead. A recently dead specimen is one that has either a complete or partial periostracum.

FIELD SURVEY

After compiling existing information on rare, endangered or threatened natural communities and taxa in and around the DHHL parcel, specific areas were selected for surveys. The primary objectives of the field survey were to map, describe, and prepare species lists for all the native natural communities occurring within the DHHL parcel and to field check known populations of rare plants and animals.

The field survey was conducted by HHP biologists between July 17-19 and August 3-4, 1989, totalling five days (12 person-days). The first part of the HHP survey was conducted by Steve Perlman and Lyman Abbott; the latter by Steve Perlman, Sam Gon III, and Lyman Perry. To sample the vegetation, one coastal transect and 17 inland supplemental stations (A-Q) were surveyed (Figure 2). These areas were chosen to give good geographic representation of the parcel, as well as to look for rare species previously reported for this site.

During the survey, all plant taxa found within native natural communities were identified and recorded. All birds seen and identifiable calls heard were noted, and the vegetation and ground litter were searched for evidence of land snails or other notable invertebrates. During the field survey, general management needs were also identified. Feral ungulate activity and invasion by alien plants were recorded at each supplemental station. Other threats were noted where recognized. The data collection methods used during this survey are described in detail in the Natural Area Reserves System Inventory Field Manual (Attachment 3).

Limitations

The parcel covers a large area which includes rough and difficult terrain. Only a sample of the gulches could be examined in the available time. It is possible that small pockets of native vegetation were overlooked. And as in most field surveys, the plant and bird taxa recorded reflect the seasonal and environmental conditions existing at the time of the survey. Also, native land snails are small and easily overlooked. It was beyond the scope of this study to thoroughly inspect all native vegetation for native land snails.

NATURAL COMMUNITIES OF KAWAIHAE

Current conservation efforts recognize the need to identify and maintain intact natural communities as stable habitat for rare and common native plants and animals. In Hawaii, nearly all of our natural communities are endemic to the islands, meaning they occur nowhere else in the world.

HAWAIIAN NATURAL COMMUNITY CLASSIFICATION

The Hawaiian Natural Community Classification is hierarchical. There are aquatic, subterranean and terrestrial categories of natural communities. Aquatic communities include springs, streams, lakes and pools. The terrestrial community types are grouped and named according to elevation, moisture conditions and vegetation structure. For example, among the native communities of the DHHL's Kawaihae parcel are lowland dry shrubland, lowland dry forest, and montane wet forest. Individual community types are named more specifically for the most common or dominant plants present. For example, one lowland dry forest in the DHHL parcel is located between 2000 and 3000 feet elevation and is dominated by the koai'a. In the Hawaiian Natural Community Classification, this community is named a Koai'a Lowland Dry Forest.

To date, approximately 150 native Hawaiian natural communities have been recognized and described. Of these, more than half (80-90) are believed to be rare or globally imperilled.

NATIVE NATURAL COMMUNITIES

The vast majority of the DHHL parcel consisted of pasture grasses or kiawe (Prosopis pallida) forest. Although most of the original vegetation of Kawaihae has been destroyed by hoofed animals and alien plants, a few remnant native forest pockets have persisted on the DHHL parcel. All of the native vegetation patches were surrounded by alien vegetation, usually made up of introduced range grasses. All of the native vegetation patches were small and were located on the upper slopes of cinder cones and in the gulches. The three native natural communities observed in the DHHL parcel were the 'Ohi'a/'Olapa (Metrosideros polymorpha/Cheirodendron trigynum) Montane Wet Forest, Koai'a (Acacia koaia) Lowland Dry Forest, and 'Akia/'A'ali'i/'Ulei (Wikstroemia spp./Dodonaea viscosa/Osteomeles anthyllidifolia) Lowland Dry Shrubland (Table 1 & Figure 3). Only the Koai'a Lowland Dry Forest is considered rare.

At the upper elevations (above 4000 feet), adjacent to the Puu O Umi Natural Area Reserve, patches of 'Ohi'a/'Olapa Montane Wet Forest were observed. Below 3000 feet elevation, one gulch contained patches of the rare Koai'a Lowland Dry Forest, while small patches of 'Akia/'A'ali'i/'Ulei Lowland Dry Shrubland occurred on rocky ridges scattered within the pasture lands. At the lower end of the parcel, pasture gave way to alien kiawe forest. Along the coast, only the most common native coastal plants were present. These plants did not

TABLE 1. NATIVE NATURAL COMMUNITIES OF DHHL'S KAWAIHAE PARCEL: HERITAGE RANK AND NUMBER OF OCCURRENCES.

Natural Community Name	Heritage Global Rank (a)	Number of Occurrences (b)
'Akia/'A'ali'i/'Ulei Lowland Dry Shrubland	G3	-
Koai'a Lowland Dry Forest	G2	1
'Ohi'a/'Olapa Montane Wet Forest	G3	-

(a) Key to Global Ranks:
G1 = Natural community critically imperilled globally (typically 1-5 current viable occurrences).
G2 = Natural community imperilled globally (typically 6-20 current viable occurrences).
G3 = Natural community with restricted range (typically 21-100 occurrences).
See Attachment 1 for more information.
(b) = Occurrences are compiled for rare native communities only.

form continuous stands of native coastal shrublands, but were scattered among alien vegetation.

Listed below (from upper to lower elevations) are descriptions of each native natural community. Each community description contains the known elevation and geographic range, the dominant and representative species generally associated with the natural community, and habitat specifics for the DHHL parcel. Appendix A contains plant species listed by natural community type.

'Ohi'a/'Olapa Montane Wet Forest
Metrosideros polymorpha/Cheirodendron trigynum Montane Wet Forest

Wet forests above 3000 feet elevation dominated by 'ohi'a and either 'olapa or lapalapa (Cheirodendron platyphyllum) (rarely both) are known from the islands of Kauai, Oahu, Molokai, Maui, and Hawaii. Associated species of this forest type vary by location, but often include kawa'u (Ilex anomala), as well as, representative species of alani (Pelea spp.), 'ohelo (Vaccinium spp.), 'ohawai (Clermontia spp.), and a variety of ferns and mosses. The community is not considered rare, but some examples are known to contain rare plants. The 'ohi'a/'olapa montane wet forest is important habitat for forest birds and tree snails.

In the DHHL parcel, the demarcation between pasture and the adjacent Puu O Umi Natural Area Reserve was abrupt, with a nearly pure pasture of kikuyu grass (Pennisetum clandestinum) on the parcel side of a cattle fence and a dense 'ohi'a/'olapa forest on the reserve side. There were a few small patches of 'ohi'a/'olapa forest in the DHHL parcel, one of the largest on the east-facing flank of Puu Lapalapa. Other patches were found on Puu Mala and in Kilohana Gulch but were absent from Puu Honu and Puu Iki (Figure 3). The 'ohi'a and 'olapa formed a closed-canopy low stature forest of 2.5-5 meters (ca 8-16 feet).

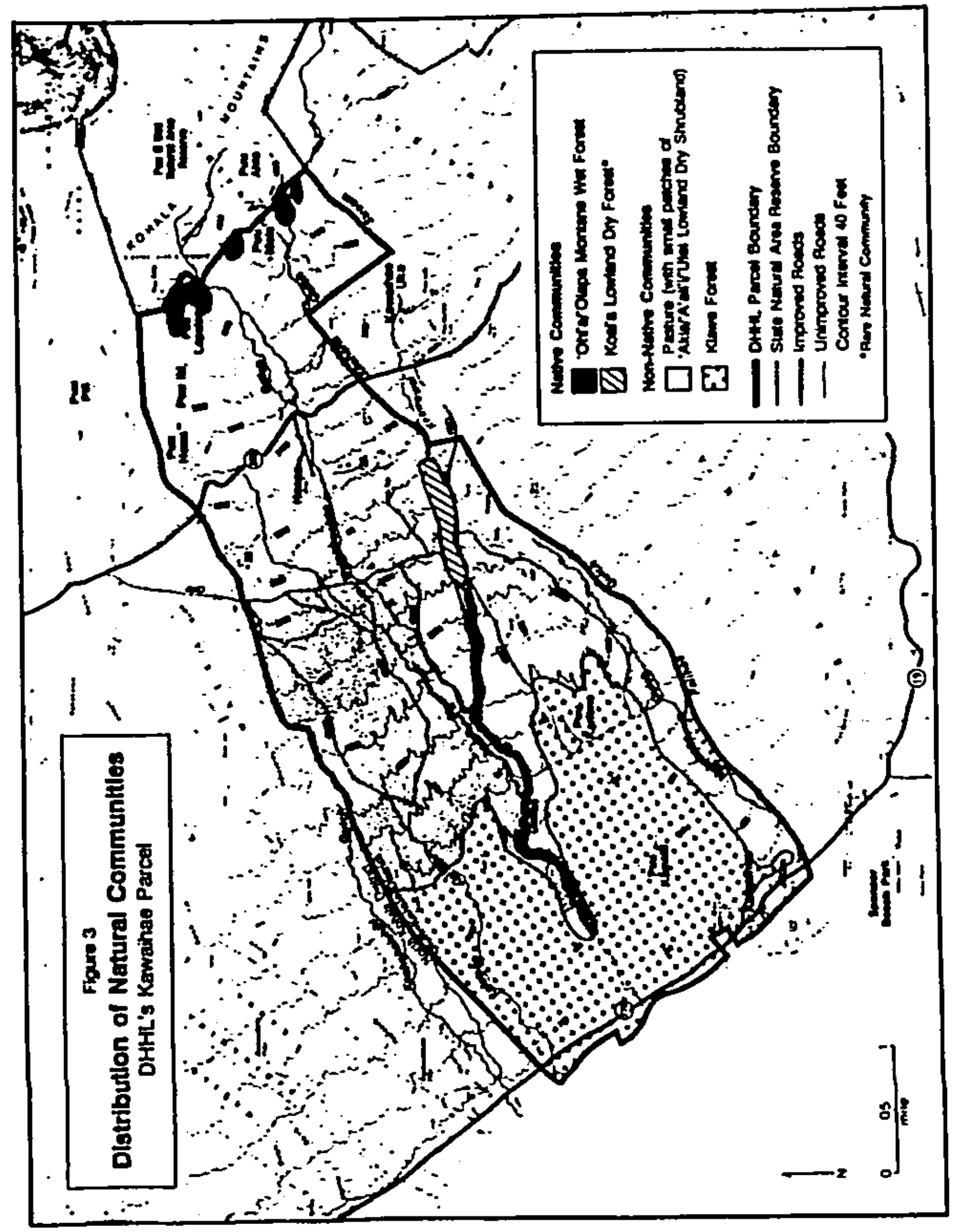


Figure 3
Distribution of Natural Communities
DHHL's Kawaihae Parcel

Other trees included kopiko (Psychotria hawaiiensis), olomea (Perrottetia sandwicensis) and kolea (Myrsine lessertiana and M. sandwicensis). Hapu'u tree ferns (Cibotium glaucum) were common in the understory, as were a variety of shrubs and ground ferns including pu'ahanui (Broussaisia arguta), 'ohelo kau la'au (Vaccinium calycinum), manono (Hedyotis terminalis), kawa'u (Ilex anomala), 'akala (Rubus hawaiensis), mamaki (Pipturus albidus), 'ohawai (Clermontia parviflora), Athyrium spp., Asplenium spp., and Dryopteris spp. Two rare Hawaiian lobeliads were noted during the survey: Lobelia hypoleuca, observed along Waipahoehoe Stream in degraded pastures of these forests, and Cyanea tritomantha in a gulch below Puu Mala (Figure 4).

The major threats to the patches of 'ohi'a/'olapa forest on the DHHL parcel are disturbance by pigs and occasional browsing by cattle. An enclosure fence around the forest patches on Puu Lapalapa and Puu Mala might provide the needed protection from ungulates. Relatively little can be done to protect the remnant patches in gulches. The forest patches contained relatively few weeds, with banana poka (Passiflora mollissima) being the most serious weed observed. An active weed control program, possibly carried out by volunteer organizations, could help maintain the quality of these native forest patches.

Koai'a Lowland Dry Forest
Acacia koaia Lowland Dry Forest

Lowland dry forest dominated by koai'a is an imperilled and rare community that occurs on the islands of Kauai, Molokai, Lanai and Hawaii. Fewer than eight examples of this rare forest type are known. Its elevation range extends from about 2000 feet to just over 3000 feet. Rainfall in koai'a forests is generally less than 50 inches per year. Koai'a forest can occur on slight to steep slopes, with good soil development on gentle slopes and with rocky talus substrates on gulch sides. Associated species vary by location but typically include dryland trees, such as olopua (Nestegis sandwicensis) and lama (Diospyros sandwicensis) in the canopy, and dryland shrubs such as ko'oko'olau (Bidens spp.) in the understory. Lands adjacent to this forest type are often dominated by alien plants, such as pasture grasses.

In the DHHL parcel there were a few stands of remnant koai'a forest, typically on the walls of steep-sided gulches that cattle did not appear to frequent. Only one of these stands was considered large enough and healthy enough to be considered intact, i.e. capable of perpetuating itself. This stand in Keawewai Gulch occupied the north and northwest-facing slopes between 2200 and 2800 feet elevation. The most intact sections within this stand formed a closed-canopy, 5-10 meters (ca 16-33 feet) in height, with koai'a making up more than 60% of the canopy cover. Other trees observed included lama, olopua, mamane (Sophora chrysophylla) and naio (Myoporum sandwicense). The understory contained several native shrub species, including kulu'i (Nototrichium sandwicense), ko'oko'olau (Bidens menziesii), 'aweoweo (Chenopodium oahuense), 'a'ali'i and 'ulei. Koai'a is itself considered a rare plant. None of the other plants observed in the DHHL parcel's koai'a forest example are considered rare.

Cattle damage was observed at the edges of the koai'a forest stand located in Keawewai Gulch, but some portions were surprisingly intact. Goats were flushed from within the stand,

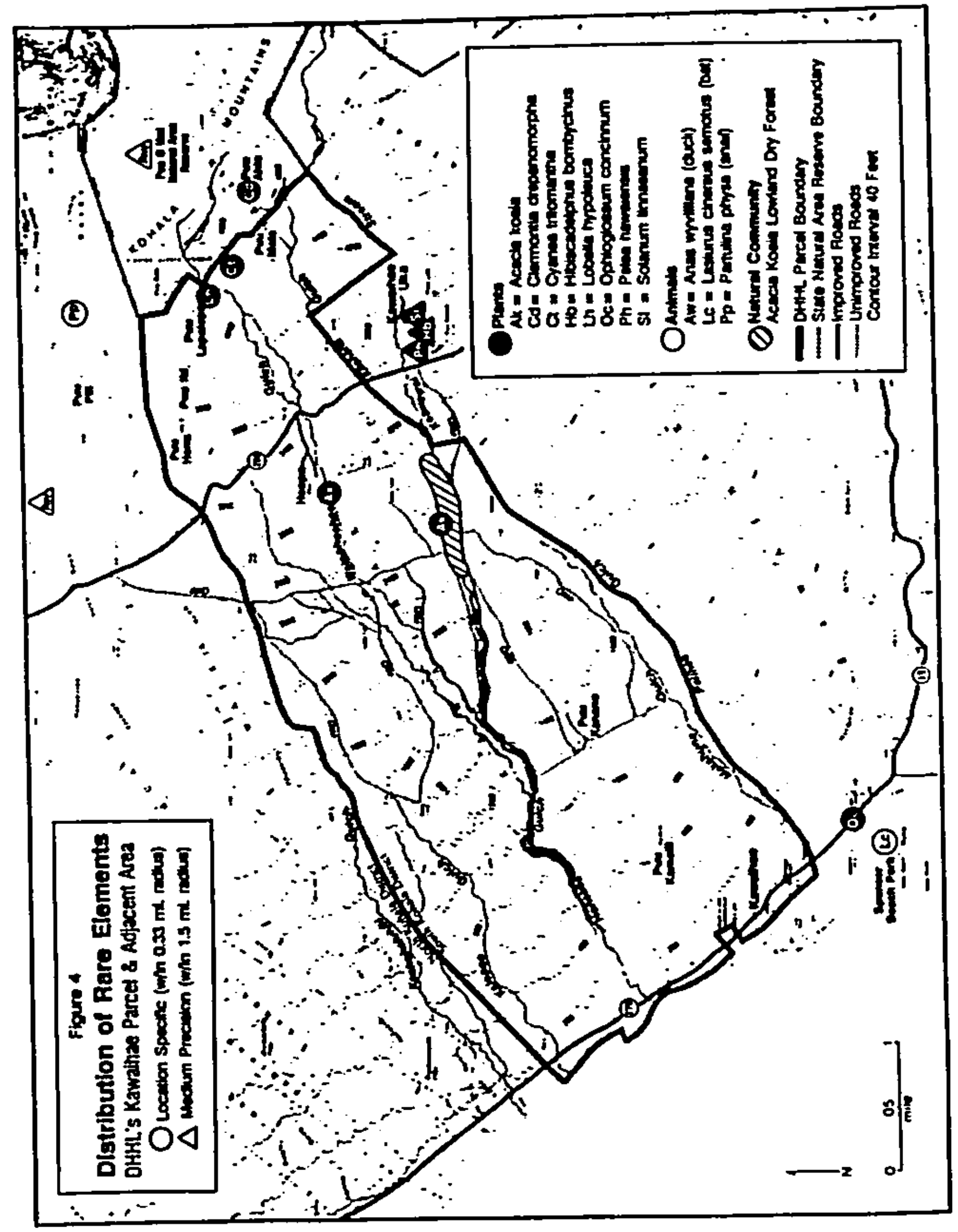


Figure 4
Distribution of Rare Elements
DHHL's Kawaihae Parcel & Adjacent Area

indicating that they are probably an important threat. Alien plants such as lantana, molasses grass (Melinis minutiflora) and fountain grass (Pennisetum setaceum) covered portions of the understory, while kukui (Aleurites moluccana) was present along the gulch bottom.

Three management concerns for this rare natural community are to restrict grazers, prevent fire, and limit weed invasion into the area. An enclosure fence around the forest patches could provide the needed protection from cattle and goats. A fire break should be built and maintained and weeds kept under control in this area. Propagation and replanting of appropriate native species could also limit invasion of weeds. Again volunteer groups could provide labor for the management activities.

'Akia/'A'ali'i/'Ulei Lowland Dry Shrubland
Wikstroemia spp./Dodonaea viscosa/Osteomeles anthyllidifolia Lowland Dry Shrubland

Dry shrublands in the lowland zone, dominated by 'akia (Wikstroemia spp.), 'a'ali'i and 'ulei are known from the islands of Kauai, Oahu, Molokai, Maui, Lanai and Hawaii. Generally this shrubland occurs on ridge tops below about 2500 feet elevation, in areas with annual rainfall below 50 inches. The particular species of 'akia may vary by island and location, and at times localized variants of this shrubland may lack one of the three co-dominant species. This occurs often as a result of chronic disturbance. This community is not considered rare and is not known to contain rare plants.

In the DHHL parcel, many disturbed patches of native shrubland dominated by a locally abundant species of 'akia (Wikstroemia pulcherrima) and the ubiquitous dryland shrub 'a'ali'i were observed on rocky outcrop areas in pastures below 2000 feet elevation. It may be that chronic browsing by cattle and goats has removed many of the more palatable species of native plants that once occurred in this shrubland. For example, although 'ulei was missing from the shrubland, it was present in steep gulches that were partially protected from grazing. Presumably, 'ulei was once a component of the shrubland outside of the gulches, but it was more palatable and eventually removed by grazing. Besides 'akia and 'a'ali'i, the only other native species observed were 'ilima (Sida fallax) and 'uhaloa (Waltheria indica).

The major threats to this shrubland are continued browsing by cattle and goats, and displacement by alien plants, especially lantana, Chamaecrista nictitans, molasses grass, and other grasses. Small enclosure fences could be built around the best examples of this shrubland if its preservation in the parcel is desired. Native plants typical of this shrubland could also be used as landscaping in the DHHL parcel (i.e. preserved Hawaiian cultural sites, not shown on map).

Alien Vegetation

At the time of the HHP survey in 1989, the parcel was covered almost entirely with alien vegetation, mainly introduced range grasses above 1000 feet elevation and kiawe forest below 1000 feet. Pasture lands of Kawaihae were vegetated by a mosaic of grasses and shrubs. At the higher elevations, the dominant grass was kikuyu grass (Pennisetum clandestinum), forming

a dense, nearly pure ground cover. This kikuyu grass zone extended down to about 3200 feet elevation.

At middle elevations, a mix of buffel grass (Cenchrus ciliaris), fountain grass and molasses grass replaced the kikuyu grass. Within this mixed grassland grew shrubs such as partridge pea, lantana, koa haole and apple of Sodom (Solanum linnaeanum). The mosaic of different grass and shrub dominants formed a patchwork appearance across the landscape. One rare plant species, koai'a, was observed in alien vegetation at middle elevations, and on steep gulch walls along Keawewai Stream.

At lower elevations, kiawe cover increased to form an open forest with a grass understory (fountain grass and/or buffel grass were the dominant understory species). The kiawe forest extended from sea level to about 1500 feet.

RARE PLANTS OF KAWAIHAE

The Hawaiian Islands are unique in that approximately 90% of the 1300 native species of vascular plants are endemic to these islands and occur nowhere else in the world. Almost half of the endemic native plants are believed to be rare or imperilled. Of the eight rare plant taxa known from the Kawaihae region, at present none are officially listed as endangered (USFWS 1987). However, five are currently candidates for listing as endangered or threatened (USFWS 1990), and three of these occur within the DHHL parcel boundaries (Table 2). Two other plant species are no longer officially being considered for listing by the USFWS but are included in the Heritage database because the available data indicate that they are rare. The remaining rare plant, a hibiscus relative (Hibiscadelphus bombycinus), is a candidate that is probably extinct, and was last collected in the area in the 1800s.

All three plants known from within the DHHL's Kawaihae parcel boundary were observed within the DHHL parcel during the present survey. One of these three species is endemic to the island of Hawaii.

DISTRIBUTION WITHIN THE DHHL PARCEL

Three rare plant species are known from the parcel and are restricted largely to gulches and cinder cones above 2400 feet elevation. These occurrences appear to be located primarily in steep areas, which are least accessible to grazing animals and least likely to experience human disturbance (Figure 4).

Lobelia hypoleuca was first reported in the parcel during this survey, where it was found at the base of Puu Lapalapa. The species was observed in 'Ohi'a/'Olapa Montane Wet Forest near the upper boundary of the DHHL parcel. Lobelia hypoleuca is ranked G1 (critically imperilled globally) by HHP. Generally a critically imperilled plant is known from five or fewer locations in the world. Lobelia hypoleuca is known from more than five locations throughout Hawaii, but all currently known occurrences are threatened by habitat destruction, predation and invasion by weeds.

Two individuals of Cyanea tritomantha were seen on the slope of Puu Mala. This rare plant was also previously unknown from the Kawaihae region. These plants occurred in 'Ohi'a/'Olapa Montane Wet Forest near the eastern boundary of the DHHL parcel. Cyanea tritomantha is endemic to the island of Hawaii.

Two occurrences of Acacia koaia were observed during the survey. The largest population consisted of several hundred trees which comprise the dominant cover of the Koai'a Lowland Dry Forest in Keawewai Gulch. This tree is closely related to the more common koa tree, and bears small whitish flowers in ball-shaped inflorescences. Several small pockets of Acacia koaia were also discovered scattered along the stream in Waipahoehoe Gulch. This population was not previously known from Waipahoehoe Gulch. Acacia koaia is ranked G2 (imperilled globally).

TABLE 2. RARE PLANTS OF DHHL'S KAWAIHAE PARCEL AND ADJACENT AREA: FEDERAL STATUS, HERITAGE RANK, AND NUMBER OF OCCURRENCES.

SCIENTIFIC NAME (a) (HAWAIIAN NAMES)	FEDERAL STATUS (b)	HERITAGE GLOBAL RANK (c)	# OF OCCURRENCES IN KAWAIHAE DHHL PARCEL Current (Total) (d)
+Acacia koaia (koa'oha koai'a, koai'e)	C2	G2	2 (3)
Clermontia drepanomorpha* ('oha, 'ohawai)	C2	G1	adj.
+Cyanea tritomantha* ('oha, 'haha, 'ohawai)	C2	G2?	1 (1)
Hibiscadelphus bombycinus* (hau kuahiwi)	3A	GH	adj.
+Lobelia hypoleuca ('oha, haha, 'ohawai)	3B	G1	1 (1)
Ophioglossum concinnum (pololei)	C1	G2	adj.
Melicope hawaiensis (alani)	3C	G2?	adj.
Solanum incompletum (-)	C1	G1?	adj.
TOTAL OCCURRENCES			4 (5)
TOTAL TAXA			8

\+ Observed during survey.
* Endemic to the island of Hawaii.
adj. = Rare plants reported from lands adjacent to Kawaihae DHHL parcel.

(a) Scientific names of flowering plants according to the Manual of FLowering Plants of Hawaii (Wagner et al. In press), except Acacia koaia, which is not recognized by the Manual but is considered a separate and rare taxon by other botanists. Ferns follow the taxonomy used in the 1990 Federal Register.
(b) Key to Federal Status (USFWS 1990):
C1 = Candidate for endangered or threatened status.
C2 = Same as C1, more information needed to complete listing package.
3A = Likely extinct, USFWS has persuasive evidence of extinction.
3B = No longer being considered for listing as threatened or endangered on the basis of current taxonomic understanding (plants that do not represent distinct taxa).
3C = No longer being considered for listing as threatened or endangered.
(c) Key to Global Ranks:
G1 = Species critically imperilled globally (typically 1-5 current viable occurrences).
G2 = Species imperilled globally (ty-ally 6-20 current viable occurrences).
GH = Species known only from hist occurrences (not observed since 1973).
G#? = Global rank tentative, insuffic: a available to assign definite rank.
(d) Current occurrences are those obser e last 15 years (1974-1989). Total number of historic and current reported occurren given in parentheses. Rare plants may still be present at the localities identified b. .se older observations.

The major threats to native rare plants are browsing by cattle and goats, disturbance by pigs and displacement by alien plants, especially lantana, partridge pea, molasses grass, and other grasses. Plant populations may be protected by building small enclosure fences around the best preserved examples. Feral animals should be monitored and controlled in the parcel.

DISTRIBUTION ADJACENT TO THE DHHL PARCEL

It was beyond the scope of this study to survey the entire DHHL parcel. Therefore observations from adjacent lands may provide additional information on rare plants that may exist within the DHHL parcel and are discussed below.

Five rare plants have been reported from areas adjacent to the DHHL parcel but have not yet been observed within it. Only one of these has been seen since 1975. The rare fern Ophioglossum concinnum was seen in 1985, near the coast south of the DHHL parcel. Clermontia drepanomorpha was last reported in 1932 from only one location in the Kohala Mountains, Puu Ahia, just east of the DHHL parcel. Melicope hawaiensis and Solanum incompletum are known historically from Kawaihae Uka (have not been seen since 1955 and 1888 respectively). These four species may well be found within the DHHL parcel with further surveys. The remaining rare plant, Hibiscadelphus bombycinus, was last collected in the Kawaihae region in the 1800s and is believed to be extinct.

In addition, 16 rare plants are known from the general south Kohala area, but no specific locations in the Kawaihae region are known at present (Appendix A). These plants may also be found within the DHHL parcel with further surveys.

RARE NATIVE ANIMALS OF KAWAIHAE

Hawaii supports a unique assemblage of native animals including two mammals, 49 land birds, hundreds of land snails, and thousands of insect species. Most of these animals are endemic and exist nowhere else in the world. Because of Hawaii's isolated mid-Pacific location and small size, the native animal population is a result of relatively few colonizations.

Human arrival introduced numerous other species to Hawaii. Competition with these alien species, along with numerous other factors such as habitat loss, introduced disease, and predators have resulted in restriction of many of the endemic populations in both size and range. A number of endemic animals are considered rare and/or in danger of extinction.

Today, over half of Hawaii's 49 surviving endemic bird species are considered threatened or endangered (USFWS 1989). The State of Hawaii has identified island populations of three additional endemic species that they consider at risk of extinction (DLNR 1986). Thirteen of 21 endemic bird species on the Big Island are considered endangered while eight are relatively common (Scott et al. 1986).

No rare native animal species were observed during the 1989 HHP survey nor have they been reported within the DHHL parcel. One common endemic bird, the 'apapane (Himatione sanguinea sanguinea) was observed in flight during the survey, along with numerous alien birds and invertebrates (Appendix B). In areas adjacent to the parcel, however, one rare mammal, two rare bird species (a waterbird and raptor) and a rare land snail have been reported (Table 3 and Figure 4). These animals may also be found within the DHHL parcel with additional surveys.

The following section supplies background information on rare animal species reported from areas adjacent to the DHHL parcel, species distribution and possible threats to these species.

HAWAIIAN HOARY BAT

The ancestral species of the Hawaiian hoary bat or 'ope'ape'a (Lasiurus cinereus semotus) ranges throughout the Americas (van Riper and van Riper 1982). 'Ope'ape'a is found only in Hawaii where its distribution is not well known. The largest population of 'ope'ape'a probably occurs on the Big Island, where it is found in all districts. Large concentrations of this species have been observed in some areas (Tomich 1986a).

The only recorded sighting of 'ope'ape'a in the Kawaihae region occurred in 1960 about 0.5 miles southwest of the parcel in Spencer Beach Park (Figure 4). A single bat was seen hanging on a shrub in the beach area. There also have been sightings along the Kona coast south of the parcel (Tomich pers. comm.).

Threats to the 'ope'ape'a are not well known, but the greatest threat may be the reduction of roosting trees when land is cleared due to agriculture and urbanization (Tomich 1986a, 1986b).

TABLE 3 RARE ANIMALS FROM LANDS ADJACENT TO DHHL'S KAWAIHAE PARCEL: FEDERAL STATUS, HERITAGE RANK AND NUMBER OF OCCURRENCES.

SCIENTIFIC NAME (a) (HAWAIIAN NAME) [COMMON NAME]	FEDERAL STATUS (b)	HERITAGE GLOBAL RANK (c)	# OF OCCURRENCES ADJACENT TO KAWAIHAE PARCEL Current (Total) (d)
MAMMALS			
Lasiurus cinereus semotus ('ope'ape'a) [Hawaiian hoary bat]	LE	G2	0 (1)
BIRDS			
Anas wyvilliana (koloa) [Hawaiian duck]	LE	G1	2 (2)
Buteo solitarius ('io) [Hawaiian hawk]	LE	G2	*
LAND SNAILS			
Partulina physa (-) [Achatinellid land snail]	-	G1	1 (1)

(a) Taxonomic names of birds are according to Pyle 1988; others according to 1989 Federal Register.
(b) Key to Federal Status (USFWS 1989):
LE = Taxa formally listed as endangered.
(c) Key to Global Ranks:
G1 = Species critically imperilled globally (typically 1-5 current viable occurrences).
G2 = Species imperilled globally (typically 6-20 current viable occurrences).
(d) Current populations are those observed in the last 15 years (1974-1989). Total number of historic and current reported populations is given in parentheses. Rare animals may still be present at the localities identified by these older observations.
* Hawaiian hawks seen flying, no nest discovered to date.

Human built structures have been noted as hazardous and insecticides used in orchards may also be a possible threat (Tomich 1986a).

HAWAIIAN DUCK

The koloa (Anas wyvilliana) was once a common species on all major islands except Lanai and Kahoolawe. Koloa are now found only on Kauai, Oahu and Hawaii. On Hawaii they can be found in marshes, reservoirs, ponds, irrigation ditches, taro patches, streams and river valleys, although they prefer streams between 500 and 4000 feet elevation (Paton 1981).

Koloa numbers declined dramatically early in this century and by 1949 they were considered only visitors on the Big Island. Captive propagation and release programs have been successful. Koloa have been released in the Kohala mountains and have been seen regularly in the Kohala Mountains around Waimea and Waipio Valley (Paton 1981). Koloa were observed during the 1979 USFWS survey in Puu O Umi Natural Area Reserve and during the semi-annual DOFAW surveys (1.5 miles northeast of the parcel) since 1980.

Direct threats affecting koloa are predation, human disturbance and land use changes. Waterbirds are particularly prone to the lack of suitable nesting habitat, changes in water levels within suitable areas and toxic chemicals (USFWS 1985, DOFAW 1988).

HAWAIIAN HAWK

The 'io (Buteo solitarius), one of Hawaii's two endemic raptors, breeds only on the Big Island, and is widely distributed in a broad range of both native and alien habitats. It is locally common on the slopes of Mauna Loa, on both the windward and Kona coasts, and to a lesser extent on Mauna Kea. Few sightings have been recorded in the leeward Kohala Mountains. Generally 'io does not occur in dry shrubland zones, but can be seen in open forests, rainforests, and agricultural areas. Nesting occurs in a variety of habitats from lowland agricultural areas and alien forests to pastures and rainforests at higher elevations (USFWS 1984).

'Io nests have not been found within the parcel; therefore observations of this species were not mapped. However, in the late 1960s, an observation of 'io was reported near Puu Pili, about 0.5 miles beyond the northeast boundary of the DHHL parcel (Banko 1980). In 1972 (Banko 1980) and again in 1979 (USFWS n.d.), an 'io was reported within two miles of the upper eastern boundary of the parcel. Although nest sites are not known from within or near the DHHL parcel, 'io defend their territories year round, so frequent observation of this hawk in an area could indicate the presence of nesting sites.

Threats to 'io include land conversion to agriculture and urbanization which has likely decreased available nesting areas. Past harassment and shooting may have had the greatest influence on Hawaiian hawk populations. Environmental contaminants, such as rodenticides, which have severely affected mainland populations of raptors, are not used commonly in

Hawaii and the present level of use is probably not a major factor affecting the population (USFWS 1984).

NATIVE LAND SNAILS

Relatively few native land snails inhabit the geologically young island of Hawaii. However, the relatively old Kohala Mountains contain the greatest diversity of snail species on the island (Chung pers. comm.). There has been little malacological research on the island of Hawaii this century and a comprehensive inventory of the molluscs in the Kawaihae region does not exist. It is worth noting that the greatest concentration of tree snails in the Hawaiian Islands was recorded south of the DHHL parcel on the Waimea Plains in 1903, where approximately 75000 Partulina confusa were seen in an area of 0.5 square mile on 150 olopua (Nestegis sandwicensis) trees (Pilsbry and Cooke 1912-1914). This species is very similar to Partulina physa and may still exist in the Kohala Mountains, even though the colony in the Waimea Plains is now extinct.

Including the July 1989 HHP survey, no rare land snails have been reported from the DHHL parcel since 1945. However, six specimens of the tree snail Partulina physa were collected in 1984 near Puu Pili within 0.5 miles of the northeast boundary (Severns 1988).

In recent years, many land snails have disappeared and are believed to have fallen victim to rats and Euglandina rosea, an introduced predatory snail. Land snails are also threatened by another alien predator, the garlic snail (Oxychilus alliarius), which may have been largely responsible for the reduction of native ground-dwelling snails (Severns, pers. comm.). Rats also seem to be a serious threat to the survival of the beautiful and unique Hawaiian land snails. Loss and destruction of habitat through the spread of alien vegetation, forest clearing and fire also threaten the survival of Hawaii's remaining endemic snail species.

Because many Hawaiian land snails have beautiful shells, they are very attractive to collectors and hikers. In the past, snail populations have been reduced by collectors.. In order to protect these animals from the threat of extinction from over-collecting, detailed locality and habitat information were omitted from the Element Occurrence Records in Attachment 2. If additional information is required, please consult HHP staff.

BIOLOGICALLY ;NIFICANT AREAS

The DHHL's Kawaihae parcel contained few biologically significant areas. However, the cinder cones above 4200 feet elevation and gulches with steep slopes proved to be sanctuaries for rare plants and a rare natural community.

In the DHHL parcel there were two stands of remnant koai'a forest, primarily on the walls of steep-sided gulches that cattle did not appear to frequent. Only one of these stands was considered large enough and healthy enough to be considered viable, i.e. capable of perpetuating itself. This population of koai'a (Acacia koaia) consisted of several hundred trees and was located in Keawewai Gulch on the north and northwest-facing slopes between 2200 and 2800 feet elevation. This population was large enough to form a rare native natural community, the "oai'a Lowland Dry Forest. Anothe· maller population of Acacia koaia was located in Waiָ .oehoe Gulch.

Two additional rare plants, Lobelia hypoleuca and C.yanea tritomantha, were found on the slopes of Puu Lapalapa and Puu Mala respectively. Populations of these rare plants appear to be located primarily in steep areas, which are least accessible to grazing animals and least likely to experience human disturbance. Similarly, other rare plants known from adjacent lands may persist in small inaccessible pockets undetected by this survey.

'Ope'ape'a, koloa, and 'io may also use portions of the DHHL parcel (i.e. foraging). However, the significance of the DHHL parcel to these animal species is unknown.

Within or adjacent to the DHHL parcel, only a few remaining rare native plants are located on steep slopes and rock outcroppings. These occur where threats by grazing animals are minimized. Possible factors that may enhance the biological significance of the DHHL parcel are areas with adequate water suitable for waterbird nesting, as well as, adequate trees for raptor nesting and bat roosting.

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GLOSSARY

Alien: (same as exotic, introduced, or non-native) a species that is not native, i.e., one introduced accidentally or purposefully by man. In Hawaii, these include Polynesian introductions (such as kukui, coconut, pig, rat and jungle fowl) and many post-Cook introductions (such as guava, Christmas berry, mosquitoes, pigs, goats, cattle, deer and sheep). See **Endemic, Indigenous, Native.**

Avian: relating to birds.

Biota: all plants and animals of a given area. A general term for living things.

Biotic: pertaining to plants and animals, and to characteristics related to their presence.

Canopy: the highest vegetation cover of a community. In a forest, the canopy is made up of the tallest and most numerous trees. In a shrubland, the canopy is the tallest shrub layer. Closed canopies are those where the foliage interlocks to form a continuous layer over the underlying vegetation or ground. Open canopies are those where there are gaps in the foliage, and more light may reach the lower vegetation layers or ground.

Coastal: one of five elevation zones used to classify Hawaiian natural communities. The Hawaiian coastal zone extends from sea level to 30 m. (roughly 100 ft.) elevation, but varies with the extent of coastal influence (waves, sea spray, sea cliffs). See **Elevation Zones.**

Current Occurrence: see **Element Occurrence.**

Degraded: physically altered in such a way as to decrease the habitat quality for native species, or invaded by alien species. A community is considered degraded if alien weeds constitute more than 40% of the vegetation cover.

DHHL: Department of Hawaiian Homelands.

DLNR: Department of Land and Natural Resources.

DOFAW: Division of Forestry and Wildlife: a division of the State Department of Land and Natural Resources (DLNR).

Dominant: In a vegetated community, the plant species contributing the most canopy cover in a given area. Dominant species may also be the most numerous in a natural community. By Heritage definition, a dominant species must make up 25% or more of the total vegetation cover. See **Natural Community.**

Dry: a moisture category describing habitat in areas with less than 50 inches annual rainfall, or subject to seasonal drought, or bearing generally dry prevailing soil conditions. See **Mesic, Wet.**

Ecosystem: an assemblage of animals and plants and its interaction with the environment. See **Natural Community.**

Element: a plant, animal or natural community (collectively, the elements of natural diversity).

Element Occurrence (EO): a place where an element is found. It is a location or area which sustains or otherwise contributes to the survival of a population of a particular element. Typically, "current" occurrences are EOs that have been observed within the past 15 years.

Element Occurrence Record (EOR): the basic building block of the Heritage database. The EOR is a summary of all available information for a single element at a singe location or occurrence.

Elevation Zones: broad regions defined by elevation range and used to classify natural communities (ecosystems). There are five elevation zones defined by the Hawaiian natural community classification: coastal, lowland, montane, subalpine and alpine. Each is defined separately.

Endangered: a species officially recognized by federal or state officials to be in immediate danger of extinction due to natural or man-made factors. See **Federal Status.**

Endemic: naturally restricted to a locality. Most of Hawaii's native plants and animal are endemic (restricted) to the Hawaiian Islands. Many are restricted to a single island, mountain range or even gulch. See **Alien, Native, Indigenous.**

Endemism: the extent to which the species of a region are unique to that region. See **Endemic.**

Exotic: not native. See **Alien.**

Fauna: the animals of a specified region.

Federal Status: official U.S. Fish and Wildlife Service categories for endangered and candidate endangered taxa according to the Federal Register 1987, 1990:

LE	=	Taxa formally listed as endangered
C1	=	Candidate Taxa for which the USFWS has substantial information on biological vulnerability and threats to support the proposal to list them as endangered or threatened species.
C1*	=	Same as C1, possibly extinct.
C2	=	Candidate Taxa for which the USFWS has information which indicates that proposing to list them as endangered or threatened species is possibly appropriate. More data on biological vulnerability and threat(s) are needed before they can be proposed for listing as endangered or threatened.
3A	=	Taxa for which the USFWS has persuasive evidence of extinction. If rediscovered, such taxa might acquire high priority for listing.

3B	=	Taxa that are no longer being considered for listing as threatened or endangered species on the basis of current taxonomic understanding (i.e. species do not represent distinct taxa).
3C	=	Taxa that are no longer being considered for listing as threatened or endangered species.
-	=	No federal status. Recommended as rare by Hawaiian biologists and confirmed by Heritage data.

Feral: formerly domesticated animals reverted to wild state, or living in wild habitat.

Feral Ungulate Activity: detectable damage or sign of feral ungulates including: scat, browsing, trails, trampling, wallows, and rooting.

Global Rank: an indicator of rarity or imperilment of an element on a world-wide level. This ranking system is used by Heritage Programs throughout the country to establish The Nature Conservancy's protection priorities.

G1	=	Species critically imperilled globally (typically 1-5 current viable occurrences).
G2	=	Species imperilled globally (typically 6-20 current viable occurrences).
G3	=	Restricted range (typically 21-100 occurrences).
G#?	=	Global rank tentative, insufficient data available to assign definite rank.
GH	=	Species known only from historical occurrences (typically, no observations in past 15 years).
GX	=	Extinct.
G1G2	=	Global rank tentative, 1-20 current viable occurrences, insufficient data available to assign definite rank.
T1	=	Subspecies or variety critically imperilled globally.
T2	=	Subspecies or variety imperilled globally.
TH	=	Subspecies or variety known only from historical occurrences.
T#?	=	Global rank of subspecies or variety tentative, insufficient data available to assign definite rank.

For more details on the definitions and criteria for global ranks, please refer to Attachment 1.

HHP: Hawaii Heritage Program.

Imperilled: rare or threatened by extinction; in Heritage terminology, a plant, animal, or natural community with 20 or fewer viable occurrences, all or most of which are immediately threatened by such factors as alien invasion, direct destruction or loss of habitat.

Indigenous: naturally occurring in a given area as well as elsewhere. Indigenous Hawaiian taxa also occur naturally outside of the Hawaiian Islands (e.g., naupaka kahakai (Scaevola sericea) is indigenous to Hawaii, found in Hawaii and throughout the South Pacific). See Alien, Endemic, Native.

Ined.: abbreviation for "ineditus," referring to a scientific name that has not been published, or a manuscript prepared for publication that has not yet received formal review.

Intact: maintaining at least 60% cover in native species.

Introduced: See Alien.

Invertebrate: animals without backbones, including such groups as insects, spiders, shrimps, and snails. Some Hawaiian invertebrates are rare and endangered.

Lobeliads: members of the Lobelioideae subfamily of plants in the family Campanulaceae, commonly known as lobelias. There are many lobeliad species endemic to the Hawaiian Islands.

Lowland: one of five elevation zones used to classify Hawaiian natural communities. The Hawaiian lowland zone lies above the coastal zone, up to about 1000 m. (roughly 3000 ft.) elevation. There is lowland zone on all of the main islands. See Elevation Zones.

Malacological: having to do with the branch of zoology dealing with mollusks, including snails.

Malacologist: one who studies mollusks, including snails.

Mesic: an area receiving from 50-75 inches of annual rainfall, or otherwise provided with sufficient water to result in moist soil conditions. See Wet, Dry.

Mollusk: invertebrates in the phylum Mollusca. Common representatives are snails, mussels, clams, oysters, squids and octopuses.

Monotypic genus: a genus with only a single species.

Montane: one of five elevation zones used to classify Hawaiian natural communities. The Hawaiian montane zone lies above the lowland zone and runs from 1000 m. (roughly 3000 ft.) to 2000 m. (roughly 6000 ft.) elevation. There is a montane zone on Kauai, Oahu, Molokai, Maui, Lanai and Hawaii. See Elevation Zones.

Multizonal: a community typically occupying more than one broad elevation zone. For example, streams may run from montane sources to sea level. See Elevation Zones.

NARS: Natural Area Reserves System: state lands designated to protect Hawaiian ecosystems, native plants and animals and other natural features in perpetuity.

Native: found naturally in an area, not introduced accidentally or purposefully by man; includes both indigenous and endemic taxa. See Alien, Endemic, Indigenous.

Natural Community: a natural assemblage of plants and animals that occurs within certain elevation, moisture and habitat conditions; sometimes used loosely as another term for "ecosystem," however "ecosystem" includes abiotic environmental factors, so that (natural community + environment) = ecosystem.

Non-native: See **Alien.**

Occurrence: See **Element Occurrence.**

Periostracum: the external layer of most mollusk and brachiopod shells.

Physiognomy: general descriptive term for habitat, including categories such as bog, grassland, shrubland, forest, desert, and cliff.

Priority weed: an alien plant with known ability to disrupt the vegetation of native ecosystems. Control of such weeds is a high priority. For example, Clidemia hirta is a priority weed that has displaced native understory plants in much of Oahu's forests.

Pristine: undisturbed by humans and completely lacking alien taxa; entirely native.

Protected: legally dedicated to the perpetuation of native resources and managed to mitigate or remove threats to those resources, if necessary. Areas lacking either legal protection or management are considered incompletely protected.

Puu: hill or volcanic cone.

Rare: imperilled or threatened by extinction due to low numbers; in Heritage terminology, a plant, animal or natural community with 20 or fewer viable occurrences, all or most of which are immediately threatened by such factors as alien invasion, direct destruction or loss of habitat.

Riparian: pertaining to or associated with streams.

Sexual dimorphism: a condition in which obvious morphological or color differences are seen between sexes.

spp.: abbreviation for more than one species.

ssp.: See **Subspecies.**

Subalpine: one of five elevation zones used to classify Hawaiian natural communities. The Hawaiian subalpine zone lies above the montane zone and runs from 2000 m. (roughly 6000 ft.) to 3000 m. (roughly 9000 ft.) elevation. There is a subalpine zone only on the islands of Maui and Hawaii. See **Elevation Zones.**

Subspecies: (abbreviated ssp.) a taxonomically distinguishable geographic or ecological subdivision of a species. See **Variety.**

Taxon (plural= Taxa): a group of plants or animals making up one of the categories or formal units in taxonomic classification. In this report, a taxon can be a species, subspecies, variety, or form. This distinction is important because certain species have endemic Hawaiian subspecies, and varieties that are considered rare.

Ungulate: a subdivision of hoofed mammals including pigs, goats, cattle, sheep, mouflon and deer.

USFWS: United States Fish and Wildlife Service.

USGS: United States Geological Survey.

Variety: (abbreviated var.) a taxonomically distinguishable subdivision of a species or subspecies. See **Subspecies.**

Vertebrate: an animal with a backbone; n ve terrestrial vertebrate species in Hawaii include fish, birds, a bat, and a seal. See **Invertebrate.**

Viable: Capable of persisting and reproducing under favorable conditions.

Weed: an undesirable plant. In native ecosystems, all alien plants are weeds. See **Priority Weed.**

Wet: an area receiving more than 75 inches of annual rainfall, or situated near groundwater or surface water, such that availability of water is not a major limiting factor to plants or animals there. See **Dry, Mesic.**

APPENDIX A

DHHL's Kawaihae Parcel
Plant Species List

This species list documents the plants observed or previously reported from DHHL's Kawaihae Parcel. It is compiled from available literature sources, personal communication with botanists familiar with the area (backed by specimen verification for rare plants) and field identification during this field survey. Rare plants (typically less than 3,000 individuals, or known from fewer than 20 locations worldwide) are noted by '+' when specific location in the DHHL parcel or adjacent lands is known (see the rare plants table for those confirmed in the parcel). Rare plants whose location information denotes a large general area that may include the parcel are are noted by '#' in the status column.

Due to imprecise location information, some plant species included on this list may not actually be present in the survey area. Plants and their associated vegetation types confirmed during the study are noted by '*'; those plants and their associated vegetation types reported from the literature for the area, but not confirmed during this survey, are noted with an 'x'. Plants recorded for the area without an associated vegetation type are assigned to the natural community in which they would probably occur and are noted with a '?'.

Descriptions of natural communities are in the text. Taxonomy of the native and naturalized non-native flowering plants follows Wagner et al. (in press). Taxonomy of gymnosperms and non-naturalized non-native flowering plants follows St. John (1973). Taxonomy of the Pteridophytes ((ferns and fern allies) follows Wagner and Wagner (1987).

RARE	STATUS	SCIENTIFIC NAME	COMMON NAME	'Akia/'A'ali'i/'Uhi Lowland Dry Shrubland	Koa'a Lowland Dry Forest	'Ohi'a/'Olapa Montane Wet Forest	Alien Vegetation
#	E	Abutilon menziesii	ko'oloa'ula	?	?		?
+	E	Acacia koaia	koaia		•		•
	N	Acacia mearnsii	black wattle	?	?		?
	N	Adiantum hispidulum	rough maidenhair		•		•
	N	Adiantum raddianum	maidenhair fern				•
	N	Agave sisalana	sisal, malina				•
	N	Ageratina riparia	hamakua pamakani				•
	N	Aleurites moluccana	candlenut, kukui		•		•
	E	Alyxia oliviformis	Maile			•	
	N	Amaranthus spinosus	slender amaranth, pakai				•
	N	Ambrosia artemisiifolia	common ragweed				•
	N	Anagallis arvensis	scarlet pimpernel				•

+ = Rare # = Known from Kawaihae Region N = Non-native I = Indigenous E = Endemic

* Confirmed in field survey x = Cited in literature sources
? Cited in literature sources; needs confirmation in natural community

RARE	STATUS	SCIENTIFIC NAME	COMMON NAME	'Akia/'A'ali'i/'Uhi Lowland Dry Shrubland	Koa'a Lowland Dry Forest	'Ohi'a/'Olapa Montane Wet Forest	Alien Vegetation
	E	Argemone glauca	pua kala				•
	E	Artemisia australis	hinahina kuahiwi		•		
	E	Asplenium acuminatum				•	
	E	Asplenium kaulfussii				•	
	I	Asplenium lobulatum				•	
	E	Athyrium microphyllum	'akolea			•	
	E	Athyrium sandwichianum	ho'i'o, pohole			•	
	N	Atriplex semibaccata	Australian saltbush				•
	N	Axonopus fissifolius	narrow-leaved carpet grass				•
	E	Bidens menziesii ssp. filiformis	ko'oko'olau		•		•
	N	Bidens pilosa	Spanish needle		•		
	N	Blechnum occidentale					•
	E	Broussaisia arguta	pu'ahanui			•	
	N	Broussonetia papyrifera		?	?		?
	N	Calopogonium mucunoides			•		
	I	Canthium odoratum	alahe'e		?		?
	E	Carex alligata				•	
	E	Carex wahuensis				•	
	N	Cenchrus ciliaris	buffel grass		•		•
	N	Cenchrus echinatus	common sandbur, 'ume'alu				?
	N	Chamaecrista nictitans	partridge pea, lauki	•			•
	E	Chamaesyce celastroides var. amplectans	'akoko, koko, kokomalei	?	?		?
	N	Chamaesyce hirta	hairy spurge, koko kahiki		•		•
	E	Charpentiera ovata	papala		?	?	
	E	Cheirodendron trigynum ssp. trigynum	'olapa			•	
	N	Chenopodium murale					•
	E	Chenopodium oahuense	'aweoweo, 'aheahea		•		•
	E	Cibotium chamissoi	treefern, hapu'u 'i'i			•	
	E	Cibotium glaucum	treefern, hapu'u pulu			•	
	N	Cirsium vulgare	bull thistle				•
	E	Claoxylon sandwicense	po'ola			?	
+	E	Clermontia drepanomorpha	'oha, 'ohawai			?	
	E	Clermontia parviflora	'oha, 'ohawai			•	
	N	Cocos nucifera	coconut				?
#	E	Colubrina oppositifolia	kauila		?		?
	N	Commelina diffusa	honohono		•		
	N	Conyza bonariensis	hairy horseweed				•
	E	Coprosma pubens	pilo			•	
	N	Cordia subcordata	kou				?

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? Cited in literature sources; needs confirmation in natural community

RARE	STATUS	SCIENTIFIC NAME	COMMON NAME	'Akia/'A'ali'i/Uki Lowland Dry Shrubland	Koai'a Lowland Dry Forest	'Ohi'a/'Olapa Montane Wet Forest	Alien Vegetation
	N	Cordyline fruticosa	ti		?	?	?
	N	Crotalaria sp.					•
	E	Ctenitis rubiginosa				•	
	N	Cuphea carthagenensis	tarweed		•		
#	E	Cyanea pycnocarpa	'oha, haha, 'ohawai			?	
+	E	Cyanea tritomantha	'oha, haha, 'ohawai			•	
	N	Cynodon dactylon	bermuda grass	•			
#	E	Cyrtandra kohalae	ha'iwale			?	
	E	Cyrtandra platyphylla	ha'iwale			•	
#	E	Delissea parviflora	'oha, haha, 'ohawai			?	
	I	Dicranopteris linearis	uluhe			•	
	N	Digitaria pentzii					?
	E	Diospyros sandwicensis	lama, elama		•		•
	E?	Diplopterygium pinnatum	uluhe lau nui			•	
	I	Dodonaea viscosa	'a'ali'i	•	•		•
#	E	Doodia lyonii				?	
	N	Drymaria cordata var. pacifica	pipili, pilipili			?	?
	E	Dryopteris glabra				•	
	E	Dryopteris wallichiana				•	
	E	Dubautia sp.	na'ena'e			?	
	N	Ehrharta stipoides	meadow ricegrass			•	
	E	Elaphoglossum hirtum var. micans				•	
	E	Embelia pacifica	kilioe			?	
	N	Emilia sonchifolia var. javanica	Flora's paintbrush	•			•
	N	Eragrostis tenella	Japenese lovegrass				•
	E	Eragrostis variabilis	kawelu, 'emoloa	?	?		?
	E	Erythrina sandwicensis	wiliwili		?		?
	N	Eucalyptus sp.					?
#	E	Eurya sandwicensis	anini			?	
	N	Festuca sp.					?
	N	Foeniculum vulgare	sweet funnel		•		
	I	Freycinetia arborea	'ie'ie			?	
	N	Grevillea robusta	silk oak				?
	N	Hedychium flavescens	yellow ginger,'awapuhi me		•		
	E	Hedyotis terminalis	manono			•	
	I	Heteropogon contortus	pili				•
+	E	Hibiscadelphus bombycinus	hau kuahiwi		?		
	I?	Hibiscus tiliaceus	hau		?		?
	N	Holcus lanatus	common velvet grass				•

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? Cited in literature sources; needs confirmation in natural community

RARE	STATUS	SCIENTIFIC NAME	COMMON NAME	'Akia/'A'ali'i/Uki Lowland Dry Shrubland	Koai'a Lowland Dry Forest	'Ohi'a/'Olapa Montane Wet Forest	Alien Vegetation
	N	Hypochoeris radicata	gosmore, hairy cat's ear		•	•	•
	E	Ilex anomala	kawa'u			•	
	N	Indigofera suffruticosa	indigo	•			•
	I	Ipomoea indica	koali 'awa, koali 'awahia		•		
	E	Jacquemontia ovalifolia ssp. sandwicensis	pa'u-o-hi'iaka				•
	N	Kyllingia brevifolia	kili'o'opu				•
	E	Labordia hedyosmifolia	kamakahala			•	
	N	Lantana camara	lantana	•	•		•
	N	Lepidium virginicum		•			
	N	Leucaena leucocephala	koa haole		•		•
	E	Lipochaeta lavarum	nehe				•
+	E	Lobelia hypoleuca	'opelu, mo'owahie			•	
	N	Ludwigia octovalvis	primrose willow, kamole				?
	E	Luzula hawaiiensis				•	
	I	Lycopodium cernuum				•	
	E	Melicope clusiifolia	alani			•	
+	E	Melicope hawaiensis	alani			?	
	N	Melinis minutiflora	molasses grass	•	•		•
	N	Merremia aegyptia					•
	E	Metrosideros polymorpha	'ohi'a			•	•
	I	Microlepia strigosa	palapalai			?	
	N	Mirabilis jalapa	four-o'clock, marvel of Per		•		•
	N	Muhlenbergia repens					•
	N	Musa sp.				?	?
	I	Myoporum sandwicense	naio		•		•
	E	Myrsine lanaiensis	kolea		?		
	E	Myrsine lessertiana	kolea			•	
	E	Myrsine sandwicensis	kolea			•	
	I	Nephrolepis exaltata	kupukupu, ni'ani'au				•
#	E	Neraudia ovata	ma'aloa, ma'oloa, 'oloa		?		?
	E	Nestegis sandwicensis	olopua		•		
	E	Nototrichum sandwicense	kulu'i		•		
	I	Odontosoria chinensis	pala'a			•	
+	E	Ophioglossum concinnum	poloei	?			
	N	Opuntia ficus-indica	prickly pear, panini	•	•		•
	I	Osteomeles anthyllidifolia	'ulei		•		•
	I	Pandanus tectorius	screw pine, hala				?
	N	Panicum maximum	guinea grass	•	•		•
	N	Paspalum conjugatum	hilo grass		?	?	?

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RARE	STATUS	SCIENTIFIC NAME	COMMON NAME	'Akia/'A'ali'i/'Ulei Lowland Dry Shrubland	Koai'a Lowland Dry Forest	'Ohi'a/'Olapa Montane Wet Forest	Alien Vegetation
	N	Passiflora mollissima	banana poke			•	
	N	Pennisetum clandestinum	kikuyu grass		•		•
	N	Pennisetum setaceum	fountain grass		•		•
	E	Peperomia sp.	'ala'ala wai nui			•	
	E	Perrottetia sandwicensis	olomea			•	
#	E	Phyllostegia floribunda				?	
#	E	Phyllostegia vestita				?	
	N	Physalis peruviana	poha, cape gooseberry		•		
	E	Pipturus albidus	mamaki			•	
	E	Pittosporum sp.	ho'awa		?	?	
	N	Plantago lanceolata	narrow-leaved plantain	•	•	•	•
#	E	Platydesma remyi	pilo kea			?	
#	E	Pleomele hawaiiensis	halapepe		?		
	I	Pleopeltis thunbergiana	pakahakaha, 'ekaha 'akolea			•	
	N	Pluchea symphitifolia	sourbush				•
	I	Plumbago zeylanica	'ilie'e				•
	N	Polygonum punctatum	water smartweed		•	•	
	E	Polypodium pellucidum	'ae			•	
	N	Portulaca oleracea	pigweed, 'ihi	•	•		•
	N	Portulaca pilosa	pigweed, 'ihi	•	•		•
#	E	Portulaca sclerocarpa	pigweed, 'ihi	?	?		?
	E	Pouteria sandwicensis	'ala'a		?		
#	E	Pritchardia lanigera	loulu			?	
	N	Prosopis pallida	kiawe				•
	N	Psidium guajava	guava, kuawa		•		
	I	Psilotum nudum	moa		•		
	E	Psychotria hawaiiensis	kopiko			•	
	E	Pteridium decompositum	kilau				•
	I	Pteris cretica				•	
	E	Pteris excelsa				•	
	N	Ranunculus repens	creeping buttercup			•	
	N	Rhus sp.		?	?	?	?
	N	Rhynchelytrum repens	natal redtop	•	•		•
	N	Richardia brasiliensis		•			•
	N	Ricinus communis	castor bean, pa'aila, koli				•
	E	Rubus hawaiensis	'akala			•	
	N	Rubus rosifolius	thimbleberry			•	
	N	Rumex crispus	curly dock, yellow dock			•	
	N	Sacciolepis indica	glenwood grass			?	?

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RARE	STATUS	SCIENTIFIC NAME	COMMON NAME	'Akia/'A'ali'i/'Ulei Lowland Dry Shrubland	Koai'a Lowland Dry Forest	'Ohi'a/'Olapa Montane Wet Forest	Alien Vegetation
	E	Sadleria cyatheoides	'ama'u, ma'u			•	
	E	Sadleria pallida	'ama'u, ma'u			•	
	N	Salvia coccinea	scarlet sage, Texas sage, lil		•		
	E	Santalum paniculatum	sandalwood, 'iliahi		•		•
#	E	Schiedea diffusa				?	
	N	Schinus terebinthifolius	christmas berry, wilelaiki		•		•
	N	Senna occidentalis	coffee senna, mikipalaoa, '		•		•
	N	Setaria gracilis	yellow foxtail		•		•
	I	Sida fallax	'ilima	•	•		•
	N	Sida spinosa	prickly sida		•		
	E	Smilax melastomifolia	hoi kuahiwi			•	
+	E	Solanum incompletum	popolo ku mai	?	?		?
	N	Solanum linnaeanum	apple of Sodom				•
	E	Sophora chrysophylla	mamane		•		
	N	Sporobolus africanus	smutgrass, West Indian dro	?	?		?
	N	Stachytarpheta jamaicensis	Jamaica vervain, oi		•		
	E	Sticherus owhyensis				•	
	I	Styphelia tameiameiae	pukiawe			•	
	E	Thelypteris cyatheoides	kikawaio			•	
	I?	Thespesia populnea	milo				?
	E	Touchardia latifolia	olona			?	
	N	Trifolium repens var. repens			•		•
	I	Uncinia uncinata				?	
	E	Urera glabra	opuhe			•	
	E	Vaccinium calycinum	'ohelo kau la'au			•	
	E	Vandenboschia draytoniana				?	
	N	Verbena litoralis	ha'uoi, oi		•		
	N	Vicia sativa	common vetch, spring vetc				•
	I?	Waltheria indica	'uhaloa	•	•		•
	E	Wikstroemia pulcherrima	'akia	•	•		•
#	E	Zanthoxylum hawaiiense	hea'e, a'e		?	?	
	N	Zinnia peruviana	piapihi				•

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? Cited in literature sources; needs confirmation in natural community

APPENDIX B

DHHL's Kawaihae Parcel
Animal Species List

The animals listed are native species (excluding insects) that have been reported from visual and audio identification in or near DHHL's Kawaihae Parcel. The list also includes information on rare animals compiled from the literature. Bird taxonomy follows Pyle (1988).

RARE	STATUS	SCIENTIFIC NAME	HAWAIIAN &/OR COMMON NAME	SOURCE
		MAMMALS		
+	E	Lasiurus cinereus semotus	'ope'ape'a, Hawaiian hoary bat	x
		BIRDS		
+	E	Anas wyvilliana	koloa, Hawaiian duck	x
+	E	Buteo solitarius	'io, Hawaiian hawk	x
	N	Cardinalis cardinalis	northern cardinal	*
	N	Carpodacus mexicanus	house finch	*
	E	Chasiempis sandwichensis sandwichensis	Hawaii 'elepaio	?
	N	Columbia livia	rock dove	*
	N	Geopelia striata	zebra dove	*
	N	Francolinus erckelii	Erckel's francolin	*
	E	Hemignathus virens virens	Hawai'i 'amakihi	*
	E	Himatione sanguinea sanguinea	'apapane	*
	N	Mimus polyglottos	northern mockingbird	*
	N	Phasianus colchicus	ring-necked pheasant	*
	N	Streptopelia chinensis	spotted dove	*
	N	Tyto alba	common barn-owl	*
	E	Vestiaria coccinea	'I'iwi	?
	N	Zosterops japonicus	Japanese white-eye	*
		NATIVE LAND SNAILS		
+	E	Partulina physa	Achatinellid land snail	x

+ = Rare N = Non-native E = Endemic

* Confirmed in field survey x = Cited in literature sources
? Cited in literature sources; needs confirmation in DHHL's Kawaihae Parcel

APPENDIX C

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APPENDIX D

ARCHAEOLOGY
By Cultural Surveys Hawaii

Documents Relating to the Cultural Surveys Hawaii's Inventory of Hawaiian Home Lands at Kawaihae Excluded from the Main Body of the Report

by

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Prepared for

**Department of Hawaiian Home Lands
State of Hawai'i**

by

Cultural Surveys Hawaii
Revised June 1991

Contents

I. Significance Evaluations

EXPLANATION OF CRITERIA FOR SITE SIGNIFICANCE

The 147 new sites identified by Cultural Surveys Hawaii are evaluated in terms of significance in the following table (IB) according to Federal and State criteria for site significance. The rationale for assigning of significance codes is briefly discussed below:

NS *Not Significant.* All Hawaiian sites were regarded as having been significant. In the field a number of trail segments were given temporary site numbers but were later decided to be livestock trails and thus were not given state site numbers and are regarded as not significant. Only one site was given a state site number (Site 13,925) and was later evaluated as not significant. This L-shaped wall was determined to be the result of 20th century ranching activity and may be less than 50 years old.

NLS *No Longer Significant.* A number of sites were evaluated as no longer significant because the sites were significant solely for their information content, and sufficient amounts of this information were recorded in the survey. These NLS sites were typically small cairns, single use shelters or WWII fortifications with no or minimal deposits. Experience with similar sites at Kawaihae tested extensively in the Waimea Kawaihae road Corridor research (cf. Welch, 138ff in Clark and Kirch, 1983) suggests that further research at these sites would be highly unlikely to yield further data important to prehistory or history. It is because of this lack of further potential to yield information that these sites are declared no longer significant. We note, however, that all Hawaiian sites are regarded as significant by some people and recommend that where possible, even these minor sites be left undisturbed.

A *Site reflects major trends or events in the history of the state or nation.* No sites were given this designation.

B *Site is associated with the lives of persons significant in our past.* No sites were given this designation.

C *Site is an excellent example of a site type.* A number of sites were regarded as excellent examples of site types in their regional context of coastal sites in Kohala District. Typically these sites (which included trails, overhang shelters, graves, shelter caves, habitation enclosures, habitation complexes, agricultural areas, and midden/lithic scatters were more formal in construction, better preserved and appeared to have been utilized more extensively than other sites of the same type.

D *Site may be likely to yield information important in prehistory or history.* Any site which was regarded as likely to contain a stratified cultural deposit or to yield a significant quantity or quality of midden or artifacts or charcoal suitable for carbon dating was regarded as significant under code D.

E *Site has cultural significance.* Any site which was regarded as having a probable grave or shrine component was given this significance code assessment.

? *Signifies site is only a possible burial or religious feature.*

Temporary field numbers and site tags are presented in parentheses

❖ IB. Kawaihae Significance Table ❖

Site#	Description	Recommendations	Significance
13,785 (1)	Midden Scatter & Ahu, Activity Area	No further work	NLS
13,786 (2)	Shelter & Agricultural Complex	No further work	NLS
13,787 (3)	Habitation Enclosure	Data Recovery	C,D
13,788 (4)	Shelter	No further work	NLS
13,789 (5)	Habitation & Shelters	Data Recovery	D
13,790 (6)	Shelter Complex	Data Recovery	D
13,791 (7)	Habitation & Shelter Complex	Data Recovery	D

Site #	Description	Recommendations	Significance
13,792 (8)	Historic Wall	No further work	NLS
13,728 (9)	Pu'uhe Trail	Preserve a portion?	C
13,793 (10)	Shelter Complex	No further work	NLS
13,794 (11)	Shelter Complex	No further work	NLS
13,795 (12)	Historic Wall	No further work	NLS
13,796 (13)	Overhang Shelter	Data Recovery	C,D
13,797 (14)	Overhang Shelter	No further work	NLS
13,798 (15)	Overhang Shelter	No further work	NLS
13,799 (16)	Probable Grave	Data Recovery	C,D
13,800 (17)	Hearth	No further work	NLS
13,801 (18)	Shelter Cave	Data Recovery	C,D
13,802 (19)	Overhang Shelters	Data Recovery	C,D
13,803 (20)	Shelter Cave	Preserve	C,D,E
13,804 (21)	Habitation Enclosure	Data Recovery	C,D
13,805 (22)	Shelter Complex	Data Recovery	D
13,806 (23)	Shelter Enclosure	No further work	NLS
13,807 (24)	Habitation Complex	Data Recovery	C,D,E
13,808 (25)	Habitation Enclosure Remnant	No further work	NLS
13,809 (26)	Shelter Enclosure	No further work	NLS
13,810 (27)	Clearance Mound	No further work	NLS
13,700 (28)	Historic Wall	No further work	NLS
13,811 (29)	Habitation Enclosure	Preserve/Stabilize	C,D,E
13,812 (30)	Shelter/Habitation Complex	Data Recovery	C,D
13,813 (31)	Habitation Platform	Data Recovery	D
13,814 (32)	WWII Observation Post	No further work	NLS
13,815 (33)	Agricultural C-shape	No further work	NLS
13,816 (34)	Small Ahu	No further work	NLS
13,817 (35)	Small Ahu	No further work	NLS
(36)	Livestock Trail	No further work	NS
13,818 (37)	Overhang Shelter	No further work	NLS
13,819 (38)	Cave & Overhang Shelter	Data Recovery	C,D
13,820 (39)	Overhang Shelter	No further work	NLS
13,821 (40)	Shelter & Activity Area	No further work	NLS
(41)	Livestock Trail	No further work	NS
(42)	Livestock Trail	No further work	NS
13,822 (43)	Shelter Complex	Data Recovery	D
13,823 (44)	Shelter & Agricultural Area	No further work	NLS
13,824 (45)	Shelter Complex	Data Recovery	D
13,825 (46)	Shelter Complex	No further work	NLS

Site #	Description	Recommendations	Significance
13,826 (47)	Shelter Complex	Data Recovery	D
13,827 (48)	Shelter & Shrine	Data Recovery	D,E
13,828 (49)	Wall	No further work	NLS
13,829 (50)	Shelter	No further work	NLS
13,830 (51)	Shelter Complex	Data Recovery	D
13,831 (52)	Shelter Complex	Data Recovery	C,D
13,832 (53)	U-shape Shelter	No further work	NLS
13,833 (54)	C-shape Shelter	No further work	NLS
13,834 (55)	Enclosure Shelter	Data Recovery	D
13,835 (56)	Terrace & Coral Scatter	Data Recovery	E
13,836 (57)	Enclosure Shelter	Data Recovery	D
13,837 (58)	Agricultural Enclosure	No further work	NLS
13,838 (59)	Enclosure Shelters	No further work	NLS
13,839 (60)	Prehistoric Trail	No further work	NLS
13,840 (61)	Agricultural Enclosure	No further work	NLS
13,841 (62)	Agricultural Enclosure	No further work	NLS
13,842 (63)	Shelter	No further work	NLS
13,843 (64)	Habitation Enclosure, Agricultural Terraces	Data Recovery	D
13,844 (65)	Shelter Complex	Data Recovery	D
13,845 (66)	Shelter Complex	No further work	NLS
13,846 (67)	Shelter Complex	Data Recovery	D
8,824 (68)	Activity Area	Data Recovery	D
13,847 (69)	Shelter Complex	No further work	NLS
13,848 (70)	Shelters	No further work	NLS
13,849 (71)	Midden & Lithic Scatter	Data Recovery	D
13,850 (72)	Habitation & Shelter Complex	Data Recovery	C,D
13,851 (73)	Habitation Enclosure	Data Recovery	C,D
13,852 (74)	Habitation Complex	Data Recovery	C,D
13,853 (75)	Habitation Complex	Data Recovery	C,D
13,854 (76)	Shelter Complex	Data Recovery	D
13,855 (77)	Activity Area	Data Recovery	D
13,856 (78)	Habitation Enclosure	Data Recovery	D
13,857 (79)	Shelters	Data Recovery	D
13,858 (80)	C-shape Shelter	No further work	NLS
13,859 (81)	Shelter Complex	Data Recovery	C,D
13,860 (82)	Shelter Complex	No further work	NLS
13,861 (83)	Shelter Complex	Data Recovery	D
13,862 (84)	WWII Fortifications	No further work	NLS
13,863 (85)	Shelter Complex	No further work	NLS

Site #	Description	Recommendations	Significance
13,864 (86)	Shelter Complex	Data Recovery	C,D
13,865 (87)	Midden Lithic Scatter	Data Recovery	C,D
13,866 (88)	Shelter Complex	Data Recovery	C,D
13,867 (89)	C-shape Shelter	No further work	NLS
13,868 (90)	WWII Fortification	No further work	NLS
13,869 (91)	Shelter Complex	Preserve	D
13,870 (92)	Shelter Complex	No further work	NLS
13,871 (93)	WWII Fortification	No further work	NLS
13,872 (94)	Shelter Complex	Preserve	C,D
13,873 (95)	Shelter & Activity Area	Data Recovery	D
13,874 (96)	Historic Agricultural Mounds	No further work	NLS
13,875 (97)	Shelter & Agricultural Area	Data Recovery	C
13,876 (98)	Habitation Complex	Preserve	D
13,877 (99)	Shelter Complex	Data Recovery	D
13,878 (100)	Shelter Complex	Data Recovery	D
13,879 (101)	WWII Fortification	No further work	NLS
13,880 (102)	Habitation & Shelter Complex	Data Recovery	D
13,881 (103)	Shelter Complex	Data Recovery	D
13,882 (104)	WWII Fortifications	No further work	NLS
(105)	Site # Unused		
13,883 (106)	C-Shape Shelter Remnant	No further work	NLS
13,884 (107)	Shelter Complex Remnant	No further work	NLS
13,885 (108)	Shelter & Agricultural Complex	Data Recovery	D
(109)	Site # Unused		
13,886 (110)	Historic Wall	No further work	NLS
13,887 (111)	Historic Wall	No further work	NLS
13,888 (112)	Cave Shelter	Data Recovery	D
13,889 (113)	Historic Wall	No further work	NLS
13,890 (114)	Terrace	Data Recovery	D,E
13,891 (115)	2 C-Shapes & an Ahu	No further work	NLS
13,892 (116)	Wall Shelter	No further work	NLS
13,893 (117)	C-Shape	Preserve	C
13,894 (118)	Oval Enclosure & C-shape	Preserve	C
13,895 (119)	Habitation Site Complex	Preserve	C,D
13,896 (120)	C-shaped Shelters	No further work	NLS
13,897 (121)	C-shaped Shelters	No further work	NLS
13,898 (122)	Small Ahu	No further work	NLS
13,899 (123)	Shelter Complex	Data Recovery	D
13,900 (124)	Wall Shelter	No further work	NLS

Site #	Description	Recommendations	Significance
13,901 (125)	Shelter Site	No further work	NLS
13,902 (126)	C-shaped Shelter	No further work	NLS
13,903 (127)	C-shaped Shelter	Data Recovery	D
13,904 (128)	Activity Area	Data Recovery	D
13,905 (129)	Wall Shelter	No further work	NLS
13,906 (130)	C-shaped Shelter	No further work	NLS
13,907 (131)	Shrine Remnant	Data Recovery	D,E?
13,908 (132)	WWII Fortification	No further work	NLS
13,909 (133)	Shelter Enclosure	No further work	NLS
13,910 (134)	Burial Mounds	Data Recovery	D,E
13,911 (135)	Shelter Enclosure	No further work	NLS
13,912 (136)	Shelter Enclosures	No further work	NLS
13,913 (137)	Shelter Complex	Data Recovery	D
13,914 (138)	Burial Terrace	Data Recovery	D,E
13,915 (139)	Habitation Remnant	No further work	NLS
13,916 (140)	Burial Mound	Data Recovery	D,E
13,917 (141)	Burial Mound	Data Recovery	D,E
13,918 (142)	Burial Complex	Data Recovery	D,E
13,919 (200)	Habitation U-shape	Data Recovery	C,D
13,920 (201)	Habitation Enclosure	Data Recovery	C,D
13,921 (202)	Burial Platform	Data Recovery	D,E
13,922 (203)	Habitation & Shelter Complex	Data Recovery	C,D
13,923 (204)	WWII Serpentine	No further work	NLS
13,924 (205)	Shelter C-shape	Data Recovery	D
13,925 (206)	Shelter L-shape	No further work	NS
13,926	Forbes Cave	Preserve	C,D,E
13,927	Mummy Cave	Preserve	C,D,E

II. Recommendations

Recommendations presented below include the following: A) recommendations for preservation including proposed preservation areas for excellent examples of site types, burial preservation, and recommendations for the preservation of Forbes and Mummy Caves; B) recommendations for archaeological data recovery; and C) recommendations for erosion control.

IIA. Preservation Recommendations

1. Proposed Preservation Areas for Excellent Examples of Site Types

We have identified only a few areas that we feel should be set apart for archaeological preserves on the basis of containing excellent examples of archaeological site types. These are listed in the following table (IIA2) and are located on the map in the back pocket of this report. Foremost of these is Honokoa Gulch. We agree with Allen (1987:66) that Honokoa Gulch should be preserved, including the Habitation Complex, 13,895; the Canoe Shed 13,746; four shrine features at Sites 13,730, 13,737, and 13,742; and the probable area of the Observatory set up by the scientists of the L'Uranie, Site 13,737. We recommend that at a minimum this preserve area includes Sites 13,730-13,747, and 13,893-13,895 and Sites 13,926 and 13,927. This area is recommended for preservation because of the number of probable religious structures (shrines) and/or burials present and because there are excellent examples of several site types including permanent habitations, a canoe shed, shrines and burial caves. This area appears to be thematically linked with the royal center in the Pu'u Kohala area on the basis of the Forbes cave artifact cache, the historic interment of the *konohiki* of Kawaihae in Honokoa Gulch and by the number of probable religious structures in the proposed Honokoa preserve area.

We also recommend the preservation of Sites 13,872 and 13,876 as particularly good examples of sites at the *mauka* edge of coastal habitation at Kawaihae with particularly dense scatters of features.

We also recommend the preservation of Site 13,811 as a particularly good example of a high status and/or men's house (*Hale mua*) site. Site 13,811 is the most architecturally impressive traditional (pre 1778) site within the project area. We recommend that this site be stabilized.

The State Historic Preservation Office has made it clear that a solid program of preservation of fragile cave sites is desired and thus we recommend that Caves Sites 13,803; 13,926; and 13,927 be sealed.

❖ IIA2. Table of Sites Recommended for Preservation

State Site Number	Description	Location By Lot	Rationale
13,730	Residential Complex	7	Probable religions structure
13,731	Shelter & Ag. Features	7	In Proposed Preservation Area
13,732	Shelter	7	In Proposed Preservation Area
13,733	Shelter	7	In Proposed Preservation Area
13,734	Canoe Shed	4	Excellent Example of Site Type
13,735	Trail	4	In Proposed Preservation Area
13,736	Shelter Complex	4	In Proposed Preservation Area
13,737	Shelter Complex	4	Historical Importance, Probable Religious Structure
13,738	Shelter	4	In Proposed Preservation Area
13,739	Shelter Complex	4	In Proposed Preservation Area
13,740	Shelter or Ag. Complex	4	In Proposed Preservation Area
13,741	Modern Fireplace	4	In Proposed Preservation Area
13,742	Agricultural Complex	4	Probable Religious Structure
13,743	Shelter	4	In Proposed Preservation Area
13,744	Shelter	4	In Proposed Preservation Area
13,745	Shelter Complex	4	In Proposed Preservation Area
13,746	Shelter Complex	4	In Proposed Preservation Area
13,747	Shelter Complex	4	In Proposed Preservation Area
13,803	Shelter Cave	1	Excellent Example of Site type, Burials?
13,811	Massive Rectangular Enclosure	9	In Proposed Preservation Area
13,869	Shelter Complex	22	Excellent Example of Site Type
13,872	Habitation and Ag. Complex	22	Excellent Example of Site Type
13,876	Habitation Complex	22	Excellent Example of Site Type
13,893	Shelter	4	In Proposed Preservation Area
13,894	Shelter	4	In Proposed Preservation Area
13,895	Habitation Complex	26	Excellent Example of Site Type
13,926	Forbes (burial) Cave	26	Burials, Excellent Example of Site Type
13,927	Mummy (burial) Cave	26	Burials, Excellent Example of Site Type

IIA3. Burials Introduction

Burials are commonly encountered features in the uplands of Kawaihae, particularly north of Makahuna Gulch. Clark (1983: 133 and Table 4.15) recorded 88 probable burial monuments within or in close proximity to (within 1-30 meters) Section 1 of the proposed highway right-of-way (ROW). Indeed, 43% of all archaeological features identified by Clark in the ROW were thought to be burials. All but one of these burials (Site 2680) lie north of Makahuna Gulch within Lot 21. The Bishop Museum field crew (Allen, 1987:54ff) identified a total of 37 probable or possible burials in the course of their study which documented 381 archaeological features. We have identified an additional 11 possible or probable burial features amongst the 491 features we have described. In addition, there are burials in Mummy and Forbes caves. All suggested burials are listed below with general comments, location and source of information and are located on the map in the back pocket of this report.

❖ IIA 4. Table of Burials at Kawaihae ❖

Site No.	Number of Burial Features ▼	Description	Comments	Location	Source
5998	4	high platforms		NW end Lot 21	Clark
6516	1	high platform		NW end Lot 21	Clark
6522	39	many different types, 8 identified as burials	possibly 91B (CSH 142)	Lot 21	Clark
6521	12	mostly low platforms, 12 identified as burials		Lot 21	Clark
8824	10	mostly mounds	(CSH68)	Lot 21	Clark
8823	2	mounded platforms		Lot 21	Clark
5980	9	different types, 2 identified as burials		Lot 21	Clark
2732	4	different types, 2 identified as burials		Lot 21	Clark
2733	3	different types		Lot 21	Clark
2722	1	low platform		Lot 21	Clark
2727	1	low platform		Lot 21	Clark
8822	1	low platform	burial found by CSH	Lot 21	Clark
13700	5	mounds	A-25	Lot 8	Allen
13749	4	platform	B-20, examined by CSH	Betw. Lots 19, 20	Allen
13750	1	platform	B-21	Lot 19	Allen

Site No.	Number of Burial Features ▼	Description	Comments	Location	Source
13751	5	mostly terraces	B-22	Lot 19	Allen
13755	2	platform & terrace	no longer exists	Lot 18	Allen
2730	1	platform	burial found by CSH	Lot 19	Allen
13756	1	terrace	B28, burial found by CSH	Lot 19	Allen
13782	9	historic cemetery	W of Lot 20		Allen
13703	1	platform	burial found by CSH	NW Lot 10	Allen
13736	2	platform & mound	B-7	Lot 4	Allen
13737	2	mounds	B-8, Feature C	Lot 4	Allen
13742	1	mound	B-13	Lot 4	Allen
13745	1	mound	B-16	Lot 4	Allen
13763	1	mound/platform	No burial found by CSH	Lot 16	Allen
13769	1	terrace	examined by CSH, B-40	Lot 16	Allen
13775	1	platform	burial found by CSH, B-46	Lot 16	Allen
13799	1	terrace	possibly a shrine, CSH16	Lot 6	Hammatt
13803	1	shelter cave	CSH20	Lot 1	Hammatt
13807	1	filled crevice	CSH24	E of Lot 4	Hammatt
13835	1	terrace	CSH56	SW Lot 27	Hammatt
13890	1	terrace	CSH114	SE corner Lot 19	Hammatt
13910	2	mounds	CSH134	mauka bound. Lot 12	Hammatt
13914	1	terrace	CSH138	mid makai Lot 16	Hammatt
13916	1	crypt	CSH140	Lot 18	Hammatt
13917	1	mound	CSH141	Lot 16	Hammatt
13918	8	mounds	CSH142	bound. Lots 21, 16	Hammatt
13921	1	platform	CSH202	S.central Lot 25	Hammatt
13926		Forbes Cave			
13927		Mummy Cave			

Thus, some 132 extant archaeological features within the project area are presently identified as burials (not including Forbes' & Mummy Caves). Of these, all but 19 lie within 152 m. (500') of the proposed Kawaihae-Waimea Realignment Corridor. Obviously, these suggested burials require special consideration in planning. Where possible, we recommend that burials be left *in situ*. We tested seven supposed burial features and found burials in 5 (71%) of these. When areas are to be developed it may well be desirable to test identified burials in the light of the suggested probability that 30% of these features are in fact not burials.

The major importance of the distribution of burials at Kawaihae is that it seem highly probable that the proposed realignment route will never be developed. We must recommend a different route as there are simply too many identified burial features (approximately 80) within the 4,000' strip between Makahuna Gulch and where the proposed realignment corridor meets the existing Highway 270. In addition to these burials, there are a great number of other archaeological sites within the corridor which would be costly in time and money to salvage.

Two alternative routes are suggested. If the realignment could follow the corridor just *makai* of Lots 23 and 24 (just *mauka* of Lots 13, 17, and 22) at about 240' elevation it would impact virtually no archaeology and would still run within 0.8 km (1/2 mile) of the coast. Another possibility — which would be less preferable archaeologically but probably more preferable from a traffic engineering perspective — would be a route crossing Makahuna Gulch at, or near the "Old Waimea—Kawaihae Road" bridge and then following the old road corridor, or just NE of it, until reaching the vicinity of Site 8824 (CSH68), at which point the route would jog just *mauka* of Sites 775 and 773 (B46 & B44), and then just *makai* of Sites 769 and 763 (B40 & B34) to rejoin Highway 270 at the previously suggested location. Such a route would require some archaeological salvage but might be accomplished without requiring the destruction of any designated burial features.

The resolution of a burial treatment plan for DHHL at Kawaihae is perhaps best worked out between DHHL, SHPO, and the Big Island Burial Council. We note only that there is a precedent for the movement of burials at Kawaihae and a precedent for the collective reinterment of Hawaiian burials in burial caves. Honokoa Gulch has previously been recommended as a reinterment site (Allen, 1987:67).

IIA5. Recommendations for Forbes' and Mummy Caves

We recommend that these two caves be sealed soon. We recommend that barriers with lockable doors be constructed out of steel and cement at the entrances to Forbes' and Mummy Caves with signs asking for respect for the Hawaiian dead. We recommend limited archaeological research prior to sealing which would have as its primary objective the acquisition of samples for carbon isotope dating. It would be desirable that the cave systems be mapped and described in greater detail.

IIB. Recommendations for Archaeological Data Recovery

1. Limited Program

We recommend that a limited program of archaeological data recovery targeted at cave sites and overhang shelters be coordinated with data recovery of specific areas planned for immediate development. The rapid development of lands at Kawaihae will have an ancillary effect of adversely impacting cultural resources as the population in the area increases. It would seem quite feasible to preserve three caves sites (13,801; 13,926; 13,927), however, there are several shallow overhang shelters that would, because of the configuration, be very difficult to seal effectively. Because of the natural isolation of these sites form range fires and sheet wash which have adversely affected so many sites at Kawaihae, we recommend testing at five of these sites (13,796; 13,801; 13,802; 13,819; 13,888). These sites are not expected to prove rich in cultural material but they may offer uncontaminated and perhaps even stratified carbon samples. The primary purpose of this testing would be to determine the chronological sequence for occupation at Kawaihae. To our knowledge there are still only three carbon isotope dates for coastal Kawaihae which predate the historic (post 1778) period. It would seem highly desirable to acquire carbon samples from the few sites which are free of range fire and sheet wash contamination to improve our understanding of the history of settlement at Kawaihae. We recommend that testing of these sites be coordinated with data recovery of specific lots slated for development.

2. Table of Recommended Data Recovery Sites

All CSH designated sites recommended for data recovery are listed in the following table (IIB2) and are located on the map in the back pocket of this report. A determination of which sites designated by Bishop Museum researches (Clark in Clark & Kirch, 1983 and Allen, 1987) should be data recovered or preserved is to be accomplished by the State Historic Preservation Office (SHPO). Of the 71 sites designated by CSH for data recovery, some 44 (62%) lie within the area considered in density studies for the town center and industrial areas (Lots 10-22 inclusive). It seems very probable that a number of Bishop Museum designated sites in this area will also be recommended for data recovery by the SHPO. because of the large number of sites in this area which will require data recovery it is recommended that archaeological data recovery be planned at least one year in advance of any proposed development of this area. It may well be highly desirable to develop this area in phases to minimize the delay of archaeological mitigation on development plans. As previously discussed under "Burials" a number of sites in this area may be problematic.

❖ IIB2. Table of Kawaihae Sites ❖
❖ Recommended for Data Recovery ❖

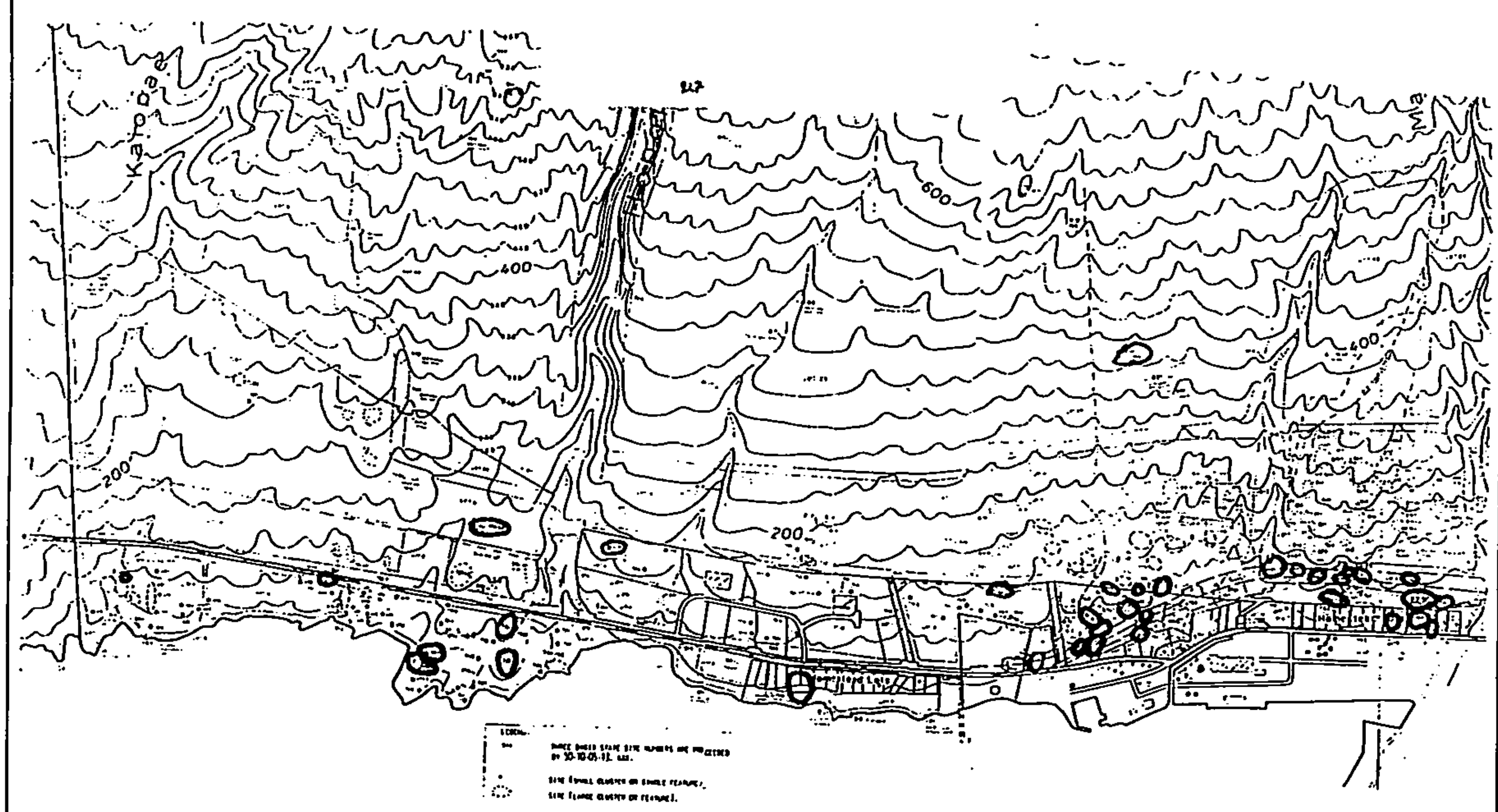
Site#	Description	Recommendations	Significance	Lot#
13,787 (3)	Habitation Enclosure	Data Recovery	C,D	SW6
13,789 (5)	Habitation & Shelters	Data Recovery	D	S of 5
13,790 (6)	Shelter Complex	Data Recovery	D	S of 5
13,791 (7)	Habitation & Shelter Complex	Data Recovery	D	6S
13,796 (13)	Overhang Shelter	Data Recovery	C,D	6/25
13,799 (16)	Probable Grave	Data Recovery	C,D	6S
13,801 (18)	Shelter Cave	Data Recovery	C,D	1
13,802 (19)	Overhang Shelters	Data Recovery	C,D	1/2
13,803 (20)	Shelter Cave	Data Rec./Pres.	C,D,E	1
13,804 (21)	Habitation Enclosure	Data Recovery	C,D	3
13,805 (22)	Shelter Complex	Data Recovery	D	3 makai
13,807 (24)	Habitation Complex	Data Recovery	C,D,E	4
13,811 (29)	Habitation Enclosure	Data Rec./Pres./Stabilize	C,D,E	9
13,812 (30)	Shelter/Habitation Complex	Data Recovery	C,D	9
13,813 (31)	Habitation Platform	Data Recovery	D	9
13,819 (38)	Cave & Overhang Shelter	Data Recovery	C,D	27
13,822 (43)	Shelter Complex	Data Recovery	D	13
13,824 (45)	Shelter Complex	Data Recovery	D	13SW
13,826 (47)	Shelter Complex	Data Recovery	D	13
13,827 (48)	Shelter & Shrine	Data Recovery	D,E	13SW
13,830 (51)	Shelter Complex	Data Recovery	D	17SW
13,831 (52)	Shelter Complex	Data Recovery	C,D	17 cent.
13,834 (55)	Enclosure Shelter	Data Recovery	D	27SW
13,835 (56)	Terrace & Coral Scatter	Data Recovery	E	27SW
13,836 (57)	Enclosure Shelter	Data Recovery	D	16/17

Site#	Description	Recommendations	Significance	Lot#
13,843 (64)	Habitation Enclosure, Agricultural Terraces	Data Recovery	D	17/22
13,844 (65)	Shelter Complex	Data Recovery	D	16
13,846 (67)	Shelter Complex	Data Recovery	D	22
8824 (68)	Activity Area	Data Recovery	D	23
13,849 (71)	Midden & Lithic Scatter	Data Recovery	D	21
13,850 (72)	Habitation & Shelter Complex	Data Recovery	C,D	22NW
13,851 (73)	Habitation Enclosure	Data Recovery	C,D	22NW
13,852 (74)	Habitation Complex	Data Recovery	C,D	22NW
13,853 (75)	Habitation Complex	Data Recovery	C,D	22NW
13,854 (76)	Shelter Complex	Data Recovery	D	22NW
13,855 (77)	Activity Area	Data Recovery	D	22NW
13,856 (78)	Habitation Enclosure	Data Recovery	D	22NW
13,857 (79)	Shelters	Data Recovery	D	22NW
13,859 (81)	Shelter Complex	Data Recovery	C,D	22W
13,861 (83)	Shelter Complex	Data Recovery	D	22W
13,864 (86)	Shelter Complex	Data Recovery	C,D	22 cent.
13,865 (87)	Midden Lithic Scatter	Data Recovery	C,D	22W
13,866 (88)	Shelter Complex	Data Recovery	C,D	22 cent.
13,873 (95)	Shelter & Activity Area	Data Recovery	D	22W
13,875 (97)	Shelter & Agricultural Area	Data Recovery	C	22
13,877 (99)	Shelter Complex	Data Recovery	D	22SE
13,878 (100)	Shelter Complex	Data Recovery	D	22SE
13,880 (102)	Habitation & Shelter Complex	Data Recovery	D	22SE
13,881 (103)	Shelter Complex	Data Recovery	D	22SE
13,885 (108)	Shelter & Agricultural Complex	Data Recovery	D	22SE
13,888 (112)	Cave Shelter	Data Recovery	D	24W
13,890 (114)	Terrace	Data Recovery	D,E	19SE
13,899 (123)	Shelter Complex	Data Recovery	D	10NW
13,903 (127)	C-shaped Shelter	Data Recovery	D	10W
13,904 (128)	Activity Area	Data Recovery	D	10W
13,907 (131)	Shrine Remnant	Data Recovery	D,E?	10
13,910 (134)	Burial Mounds	Data Recovery	D,E	12E
13,913 (137)	Shelter Complex	Data Recovery	D	12/15
13,914 (138)	Burial Terrace	Data Recovery	D,E	16W
13,916 (140)	Burial Mound	Data Recovery	D,E	18
13,917 (141)	Burial Mound	Data Recovery	D,E	16
13,918 (142)	Burial Complex	Data Recovery	D,E	21/16
13,919 (200)	Habitation U-shape	Data Recovery	C,D	25 cent.

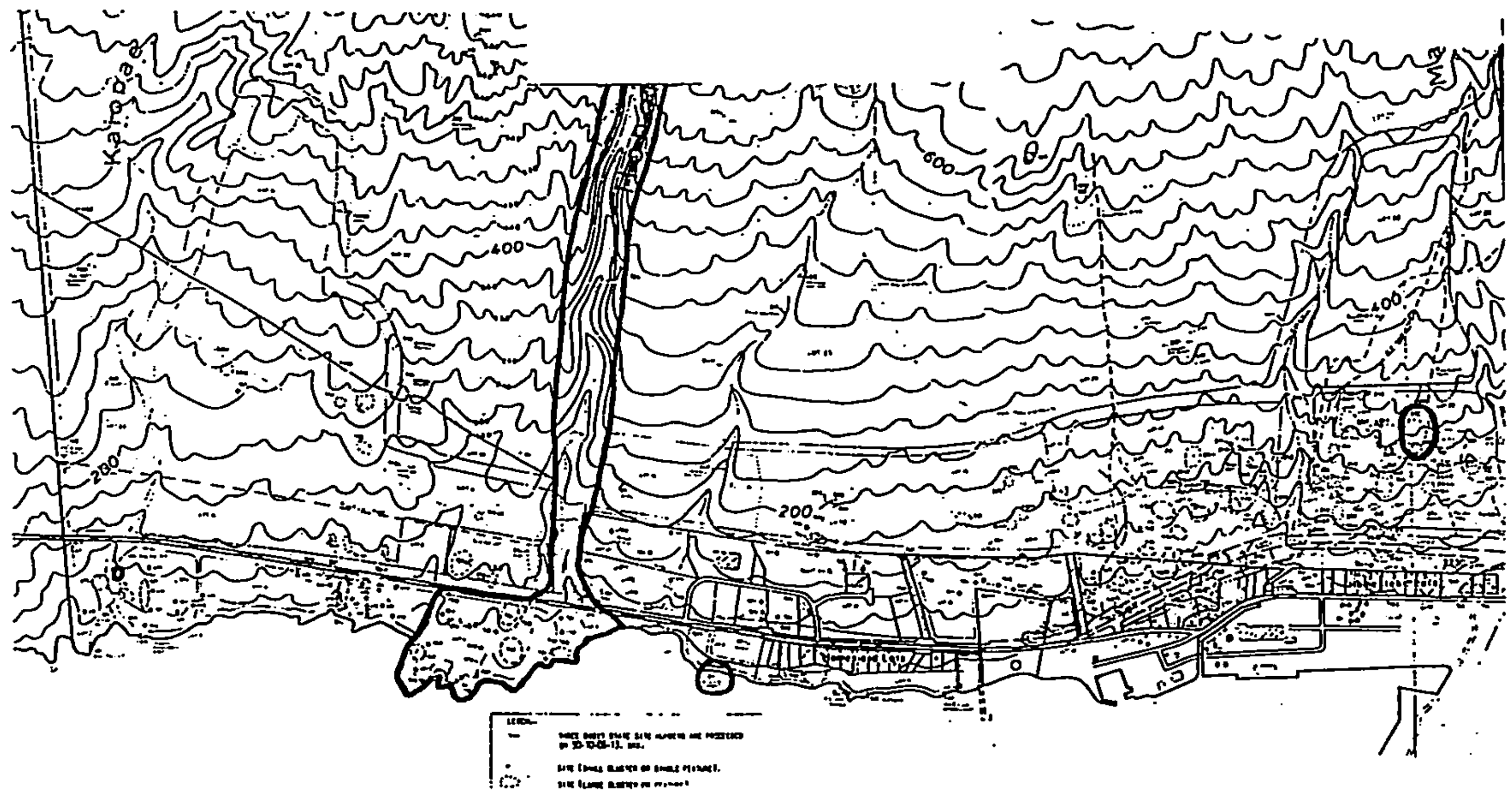
Site#	Description	Recommendations	Significance	Lot#
13,920 (201)	Habitation Enclosure	Data Recovery	C,D	25 cent.
13,921 (202)	Burial Platform	Data Recovery	D,E	25S
13,922 (203)	Habitation & Shelter Complex	Data Recovery	C,D	27
13,924 (205)	Shelter C-shape	Data Recovery	D	27
13,926	Forbes Cave	Data Rec./Pres.	C,D,E	26
13,927	Mummy Cave	Data Rec./Pres.	C,D,E	26

IIC. Recommendations for Erosion Control

A major concern is the ongoing damage to archaeological sites by unchecked erosion. During the brief period of our fieldwork we saw sites being destroyed before our eyes as erosion gullies washed away boulder alignments. Sheetwash continues to adversely impact sites downslope. The absence of sound land management practices with regards to erosion may well do more damage to archaeological sites than presently proposed development. We recommend that any proposed development of DHHL at Kawaihae have a strong component of land management and erosion control.



Locations of Indicated Possible, Probable, and Known Burials at Kawaihae



Suggested Preserve Areas for Hawaiian Home Lands at Kawaihae

APPENDIX E

AIR QUALITY
B. D. Neal & Associates

AIR QUALITY STUDY

FOR THE PROPOSED

KAWAIHAE MASTER PLAN

KAWAIHAE, SOUTH KOHALA, HAWAII

Prepared for:

R.M. Towill Corporation

October 1991

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CONTENTS

TABLES (cont.)

1.0 SUMMARY

The Department of Hawaiian Homelands of the State of Hawaii is proposing to develop 2100 acres of land at Kawaihae in the South Kohala District on the island of Hawaii. Major elements of the project will include approximately 3700 low- and medium-density residential units on about 1200 acres, 265 acres of commercial and industrial lots, 58 acres for a town center and the remainder for community/support facilities, infrastructure and open space. Construction of the project is expected to begin during 1993 and be completed in phases over a 10-year period. This study examines the potential short- and long-term air quality impacts that could occur as a result of construction and use of the proposed facilities. Mitigative measures to lessen project impacts are suggested were possible and appropriate.

Both federal and state standards have been established to maintain 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 set at the same level.

Regional and local climate together with the amount and type of human activity generally dictate the air quality of a given location. The climate of the Kawaihae area is very much affected by its leeward and coastal situation. During periods of strong trade winds, winds approach the project area from the east through the gap between the Kohala Mountains and Mauna Kea. Kona storms generate occasional strong winds from the south during winter. When the larger scale trade winds or Kona winds are weak or absent, small scale landbreeze-seabreeze and/or mountain-induced circulations may develop. These smaller scale phenomena tend to dominate the wind pattern for the area causing winds to be predominantly bimodal with an east-west orientation. During the daytime, winds move onshore from the west while at night a 180-degree shift typically occurs reversing the flow. Wind speeds generally vary between about 5 and 20 miles per hour, although there can be prolonged periods of higher or lower velocities. Based on temperature data for the area, temperatures on the lower elevations of the project site likely range between about 55°F and 95°F while the higher areas are about 3 to 5 degrees F cooler. Average annual rainfall is scant amounting to somewhere in the 10-to 20-inch range with summer months being the driest.

Air quality in the vicinity of the project presently is mostly affected by emissions from natural, industrial, agricultural and/or vehicular sources. The dominant factor for the past several years has been the volcanic haze (vog) from Kilauea Volcano which eventually drifts into the Kona and Kohala areas from more than 60 miles away. Other natural sources of air pollution that may affect the air quality of the site include the ocean, plants and wind-blown dust. Some particulate and hydrocarbon emissions presently occur from industries located at Kawaihae Port while agriculture in the area may also contribute relatively minor amounts of fugitive dust to the atmosphere. Automotive emissions, primarily nitrogen oxides and carbon monoxide, from traffic attracted by the port or from motor vehicles passing through the area on Kawaihae Road/Akoni Pule Highway may reduce air quality slightly. Virtually no air quality monitoring data from the State Department of Health are available for the South Kohala area, but based on what little data are available, it appears likely that both state and national ambient air quality standards are currently being met despite the persistent vog. On the whole, air quality for the area is

presently considered good except for the vog and for occasional fugitive dust problems or problems related to occasional congested traffic locations.

If the proposed project is given the necessary approvals to proceed, it is inevitable that some short- and long-term impacts on air quality will occur either directly or indirectly as a consequence of project construction and use. Short-term impacts from fugitive dust will likely occur during the project construction phase. To a lesser extent, exhaust emissions from stationary and mobile construction equipment, from the disruption of traffic, and from workers' vehicles may also affect air quality during the period of construction. State air pollution control regulations require that there be no visible fugitive dust emissions at the property line. Hence, an effective dust control plan must be implemented to ensure compliance with state regulations, especially in dust-prone South Kohala. Fugitive dust emissions can be controlled to a large extent by watering of active work areas, use of wind screens, keeping adjacent paved roads clean, and by covering of open-bodied trucks. Other dust control measures could include limiting the area that can be disturbed at any given time and/or mulching or chemically stabilizing inactive areas that have been worked. Paving and landscaping of project areas early in the construction schedule will also reduce dust emissions. Exhaust emissions can be mitigated by moving construction equipment and workers to and from the project site during off-peak traffic hours.

After construction, long-term impacts on air quality could potentially occur indirectly as a result of emissions emanating from vehicular traffic coming to and from the development. Access to the project will likely be accomplished via at-grade intersections constructed along the Kawaihae bypass road, which is assumed to exist within the next ten years either with or without the project. To assess the impact of emissions from these vehicles, an air quality modeling study was undertaken to estimate current maximum ambient concentrations of carbon monoxide along roadways leading to and from the project area and to predict future levels of air pollution both with and without the proposed project. Based on the modeling results, present worst-case carbon monoxide concentrations were estimated to be within the national ambient air quality standards but may occasionally exceed the state standards near the intersection of Queen Kaahumanu Highway and Kawaihae Road due to over capacity conditions during the afternoon. Because the state standards are set at such stringent levels, however, it is likely that they are currently exceeded at many locations in the state that have even moderate traffic volumes. In the year 2003 without the project, the highest concentrations at this location were predicted to decrease to about 60 percent of the 1991 values 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 roadway improvements. Worst-case concentrations would comply with both state and national ambient air quality standards. In the 2003 with-project scenario, maximum concentrations will be higher compared to the without-project case at several locations within the project vicinity due to increased traffic and to the creation of several intersections along the Kawaihae bypass road. Concentrations should remain within national standards but may occasionally exceed the more stringent state standards. Other than the roadway improvements recommended by the traffic consultant, air quality impacts due to project traffic could potentially be reduced further by reducing traffic through the promotion of bus service, carpooling and alternate business and school hours. Due to the extended completion date of the project, it is also possible that emissions may be lower than projected either because emission reductions mandated by the 1990 Clean Air Act Amendments could take effect or possibly state regulations

could be enacted that would reduce emissions. It is also possible that technological breakthroughs in fuels or emission control devices may be achieved before the project is completed.

Depending on the demand levels, long-term impacts on air quality are also possible due to indirect emissions associated with a development's electrical power and solid waste disposal requirements. The proposed project will increase current electrical demand for the county as a whole by about 40 percent; solid waste disposal demand will likely increase by about 10 to 15 percent. Quantitative estimates of these potential impacts were not made, but based on the estimated emission rates involved and the relative changes in demands, some impacts are probable. Requiring homes and businesses to incorporate energy conservation design features and promoting conservation and recycling programs within the proposed development could serve to reduce any impacts.

Impacts on air quality could also occur as a direct result of emissions from industries locating within the industrial zone associated with the project. At this time, sufficient detail is not available to quantitatively assess any such impacts, but before any industries that emit air pollution can begin construction they must apply to the state Department of Health for a permit to construct. At this time, detailed analyses of the potential impacts may be required. Due to the high terrain in the project area and to the bimodal nature of the winds, it is recommended that any air polluting industries applying to locate within the proposed development be examined for potential plume impact on the mountain side and for recirculation of air pollution emissions.

2.0 INTRODUCTION AND PROJECT DESCRIPTION

The Department of Hawaiian Homelands of the State of Hawaii (DHHL) is proposing to develop a large portion of its property located at Kawaihae on the island of Hawaii (see project location map given as Figure 1). The Long-Range Master Plan for the Kawaihae site calls for the eventual development of 10,000 acres of land at this location over a period of 30 to 40 years. Initially, a smaller portion of the property encompassing an area of approximately 2,100 acres will be master planned and developed over a period of 10 years. As indicated in Figure 2, major elements of the Ten-Year Master Plan include: approximately 3,700 residential units, 265 acres of business and industrial lots, 84 acres of community support facilities including schools and parks, a 58-acre town center and other infrastructure and community/support facilities. Currently, the area involved within the Ten-Year Master Plan is largely vacant containing only 22 residential/commercial units on 12 acres. Project construction is expected to begin during 1993 and be completed in phases by 2003.

The purpose of this study was to evaluate the potential air quality impacts of the initial major phase of the proposed project (i.e., the Ten-Year Master Plan only) and recommend mitigative measures, if possible and appropriate, to reduce or eliminate any degradation of air quality in the area. Before examining the potential impacts of the proposed project, a discussion of ambient air quality standards is presented and background information concerning the regional and local climatology and the present air quality of the project area is provided.

3.0 AMBIENT AIR QUALITY STANDARDS

Ambient concentrations of air pollution are regulated by both national and state ambient air quality standards (AAQS). National AAQS are specified in Section 40, Part 50 of the Code of Federal Regulations (CFR), while State of Hawaii AAQS are defined in Chapter 11-59 of the Hawaii Administrative Rules. Table 1 summarizes both the national and the state AAQS that are specified in the cited documents. As indicated in the table, 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.

4.0 REGIONAL AND LOCAL CLIMATOLOGY

Regional and local climatology significantly affect the air quality of a given location. Wind, temperature, atmospheric turbulence, mixing height and rainfall all influence air quality. Although the climate of Hawaii is relatively moderate throughout most of the state 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.

Kawaihae, the site of the proposed project, is located within the South Kohala District on the northwestern side of the island of Hawaii. The topography of Hawaii Island is dominated by the great volcanic masses of Mauna Loa (13,653 feet), Mauna Kea (13,796 feet), and of Hualalai, the Kohala Mountains and Kilauea. The island consists entirely of the slopes of these mountains and of the broad saddles between them. Mauna Loa and Kilauea, located on the southern half of the island, are still active volcanoes. The site of the proposed project occupies a portion of the lower southwestern slope of the Kohala Mountains, extending from an elevation of about 10 feet up to an elevation of about 1450 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. Much of the western coast of the island of Hawaii, however, is sheltered from the trade winds by high mountains. In the Kohala area, winds can vary substantially over short distances and short periods of time due to topographic effects. During periods of strong trade winds, high winds from the east or northeast can sweep through the saddle between the Kohala Mountains and Mauna Kea and reach the areas to the lee. In winter, the passage of storms can bring very strong "Kona" winds for brief periods from the south or southwest. When trade winds or Kona winds are absent or weak, local winds such as land/sea breezes and/or upslope/downslope winds tend to dominate the wind pattern for the area. During such times, winds typically move onshore from the west during the daytime because of seabreeze and/or upslope effects. At night and during the early morning hours, winds generally are land breezes and/or drainage winds which move downslope from the east and out to sea; oftentimes, early morning drainage winds from the east are quite strong for a few hours just near sunrise and then subside. Actual wind data collected at Kawaihae Harbor [3] show that, on the long-term, wind directions in this area are strongly bimodal and from opposite compass points (east or west). Wind speeds predominantly vary between about 5 and 20 mph with calms occurring about 9 percent of the time.

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 wind tend to have the least temperature variation, while inland and leeward areas often have the most. The lower elevations of the South Kohala District are well known for their warm climate. Unfortunately, there are no published long-term temperature data for this area of Hawaii Island that are representative of the project site. However, during the past few years, measurements have been reported at nearby Pu'ukohala Heiau. During 1990, the

temperature ranged from 58 to 92°F at this location with an average of 76°F [4]. These temperatures should be reasonably representative of the lower elevations of the project site; higher elevations within the development area are likely about 3 to 5 degrees F cooler. It should be noted that the above temperature range is based on one year of data only and that over a period of several years, the range is undoubtedly larger.

Small scale, random motions in the atmosphere (turbulence) cause air pollutants to be dispersed as a function of distance or time from the point of emission. Turbulence is caused by both mechanical and thermal forces in the atmosphere. It is oftentimes measured and described in terms of Pasquill-Gifford stability class. Stability class 1 is the most turbulent and class 6 the least. Thus, air pollution dissipates the best during stability class 1 conditions and the worst when stability class 6 prevails. In the South Kohala area, stability class 5 or 6 is generally the highest stability class that occurs, developing during clear, calm nighttime or early morning hours when temperature inversions form either due to radiational cooling or to downslope winds that push warmer air aloft. 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 are no mixing height data for the South Kohala area, mixing heights elsewhere in the state typically are above 3000 feet (1000 meters). Mixing heights in the South Kohala area probably tend to be somewhat lower during periods of light winds and also during periods when sea breeze conditions 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 lower elevations of South Kohala are some of the driest areas in the state. Much 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. Average annual rainfall reported for Puako, located near sea level a few miles to the south, is only about 9 inches [5], but this may vary substantially from one year to the next. During 1990, Pu'ukohala Heiau reported nearly 18 inches [4]. These data are likely representative of the lower portions of the project site; upper areas are probably somewhat wetter.

5.0 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, plants, wind-blown dust and volcanoes. Of these natural sources of air pollution, volcanoes are the most significant. Volcanic emissions have chronically plagued large portions of the Kona and Kohala Coast areas since the latest eruption phase of Kilauea Volcano began in 1983. Air pollution emissions from Kilauea 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 more than 60 miles southeast of the project site, the prevailing wind patterns eventually carry the emissions into the Kona and South Kohala areas. 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 at several locations around the island. Preliminary results indicate that sulfate levels are up to five times higher in the West Hawaii area compared to locations near Hilo. Potential impacts on human health from the vog are still inconclusive and remain under study. Federally-funded programs to better research its effects are expected to be implemented within the next year.

The only industrial sources of air pollution which currently exist in the project area are located at Kawaihae Port adjacent to the project site. Industries at this location include a cement plant, a fuel storage depot, raw sugar storage and conveying facilities, a barge terminal, a feed company and a coral crushing and storage plant. Air pollution emissions consist mostly of particulate from cement, sugar and coral operations and hydrocarbons from fuel storage facilities.

Agriculture in the area is confined mainly to cattle grazing. Any air pollution associated with this activity is limited mostly to minor emissions of dust.

Although there is relatively little development in the area at present, the port attracts moderately heavy motor vehicle traffic at times. In addition, Kawaihae Road/Akoni Pule Highway which border the site on the west provide the major coastal route to the north toward Hawi. Exhaust gases and fugitive dust from motor vehicles traversing these roadways tend to be carried over the site during Kona or seabreeze wind conditions. Any high levels of air pollution presently occurring in the area due to motor vehicle emissions 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 the island of Hawaii, and none are available for the South Kohala area specifically. As indicated in Table 2, the only existing monitoring data anywhere near the project site consist of sulfur dioxide and particulate measurements that were made about 35 miles to the south at Kealakekua during 1985 and 1986. During this 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 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.

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 by mathematically modeling the atmospheric dispersion of motor vehicle emissions.

6.0 SHORT-TERM IMPACTS OF PROJECT

Short-term direct and indirect impacts on air quality could potentially occur due to project construction. For a project of this nature, there are two potential types of air pollution emissions which could directly result in short-term air quality impacts during the construction phase: (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. The emission rate for fugitive dust emissions from construction activities is difficult to estimate accurately because of its elusive nature of emission and because the potential for its generation varies greatly depending upon the type of soil at the construction site, the amount and type of earth-disturbing activity taking place, the moisture content of exposed soil in work areas, and the wind speed. The EPA [6] 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 higher due to the dry climate and fine nature of the soil in the area. In any case, State of Hawaii Air Pollution Control Regulations [7] stipulate that emissions of fugitive dust from construction activities cannot be visible beyond the property line. Due to the dust-prone nature of the Kawaihae area, an effective dust control plan for the project construction phase is particularly essential.

Adequate fugitive dust control can usually be accomplished by the establishment of a frequent watering program to keep bare-dirt surfaces in construction areas from becoming significant sources of dust. In dust-prone or dust-sensitive areas such as South Kohala, other control measures such as limiting the area that can be disturbed at any given time, applying chemical soil stabilizers, mulching and/or using wind screens may be necessary. Control regulations further stipulate that open-bodied trucks be covered at all times when in motion if they are transporting materials that could be blown away. Haul trucks tracking dirt onto paved streets from unpaved areas is oftentimes a significant source of dust in construction areas. Some means to alleviate this problem, such as road cleaning or tire washing, may be appropriate. Paving of parking areas and/or establishment of landscaping as early in the construction schedule as possible can also lower the potential for fugitive dust emissions.

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.

7.0 LONG-TERM IMPACTS OF PROJECT

7.1 Roadway Traffic

After construction is completed, use of the proposed facilities will result in increased motor vehicle traffic on nearby roadways, potentially causing long-term impacts on ambient air quality in the project vicinity. 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 require that new motor vehicles be equipped with emission control devices that reduce emissions significantly compared to a few years ago. Just recently, the President signed into law the Clean Air Act Amendments of 1990. This new legislation requires further emission reductions be phased in beginning in 1994. Even without the new restrictions on motor vehicle emissions, current emission standards for new vehicles will lower average emissions each year as more and more older vehicles leave the state's roadways. Carbon monoxide emissions, for example, will go down by about 25 percent on the average by the year 1995 compared to the amounts now emitted due to the replacement of older vehicles with newer models.

To evaluate the potential long-term indirect ambient air quality impact of increased roadway traffic associated with a project such as this, computerized emission and atmospheric dispersion models can be used to estimate ambient carbon monoxide concentrations along roadways leading to and from the project. Carbon monoxide is selected for modeling because it is both the most stable and the most abundant of the pollutants generated by motor vehicles. Furthermore, carbon monoxide air pollution is generally considered

to be a microscale problem, whereas nitrogen oxides air pollution most often is a regional issue that cannot be addressed by a single new development.

For this project, three scenarios were selected for the carbon monoxide modeling study: year 1991 with present conditions, year 2003 without the project, and year 2003 assuming the project is complete and fully built-out. To begin the modeling study, critical receptor areas in the vicinity of the project were identified for analysis. Generally speaking, roadway intersections are the primary concern because of traffic congestion and because of the increase in vehicular emissions associated with traffic queuing.

Currently, the busiest intersection in the project area is the T-intersection of Queen Kaahumanu Highway and Kawaihae Road. The project traffic study [8] indicates that by the year 2003, with or without the project, it is expected that a bypass road will be constructed which will intersect both with Mamalahoa Highway and Akoni Pule Highway. The new bypass road would create a four-way, at-grade intersection at Queen Kaahumanu Highway which would be controlled by traffic signals. Entries into the proposed project for the 10-year master plan would be provided at three locations along the bypass road. These would include a road into the residential area, an entry into the shopping center and a main entrance road. These areas of potential traffic congestion along the bypass road which were studied by the traffic consultant were also selected for air quality analysis. Modeling of the present scenario was performed assuming the existing roadway configuration. For the future air quality modeling scenarios, it was assumed that with or without the proposed project an at-grade, four-way intersection will exist at the intersection of Queen Kaahumanu

Highway and Kawaihae Road. Queen Kaahumanu Highway and Kawaihae Road would make up two of the legs and the bypass road the other two. Project access roads were assumed to connect with the bypass road at the three locations mentioned previously. All intersections were assumed to be at grade and signalized. Present and future conditions and configurations of these roadways are described in more detail in the project traffic impact study referenced above.

The main objectives of the modeling study were to estimate both current and projected levels of maximum 1-hour average carbon monoxide concentrations which could then be directly compared to the national and state AAQS. The traffic impact study indicates that traffic volumes generally are or will be higher during the afternoon peak hour than during the morning peak period at most locations within the project area. Worst-case emission and meteorological dispersion conditions typically occur during the morning hours at many locations. Thus, both morning and afternoon peak traffic hours were examined to ensure that worst-case concentrations were identified.

The EPA computer model MOBILE4 [9] 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 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. Farther away at the intersection of Queen Kaahumanu Highway and Kawaihae Road where engines will likely be mostly stabilized due to the relatively isolated location, cold/hot-start fractions of 5/1 percent were assumed. These operational mode values were estimated based on a report from the California Department of Transportation [10] 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 [11].

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 [12]. CALINE4 was developed by the California Transportation Department to simulate vehicular movement and atmospheric dispersion of vehicular emissions. The model 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 with project scenario include project traffic as well as traffic from other growth that is expected to occur in the area by the year 2003. Traffic queuing estimates were made based on the project traffic study, Transportation Research Board procedures [13], U.S. EPA guidelines [14], and traffic observations at the subject intersections. Vehicles using Queen Kaahumanu Highway were assumed to accelerate to 55 mph, while traffic on Kawaihae Road and on the bypass road was assumed to move at 45 mph until reaching the project area. Through the project area, traffic on the bypass road was assumed to slow to 35 mph while traffic on connecting roads was modeled at 25 mph. Deceleration and acceleration times of 25 and 30 seconds, respectively, were assumed for vehicles traveling at 55 mph, whereas values of 20 and 25 seconds were assumed for those traveling at 45 mph. Deceleration/acceleration times of 16/18 and 10/12 seconds were assumed for traffic moving at 35 and 25 mph.

Model roadways were set up to reflect roadway geometry, physical dimensions and operating characteristics. Presently, there are no pedestrian walkways along the roadways within the project area. In the 2003 with project case, sidewalks will likely exist in the vicinity of the bypass road and project access roads. Concentrations predicted by air quality models generally are not considered valid within the roadway mixing zone. The roadway mixing zone is taken to include 3 meters on either side of the traveled portion of the roadway and the turbulent area within 10 meters of a cross street. Model receptor sites were thus located at the edges of the mixing zones where a sidewalk or other public area would likely exist. In areas where sidewalks likely would not exist, model

receptor sites were located near the edge of the road right-of-ways at distances of about 10 meters from the traveled portions of the roadways near the intersections studied. All receptor heights were placed at 1.8 meters above ground to simulate levels within the normal human breathing zone. Roadway geometry and capacity assumed for the future with-project case are based on the "full bypass with industrial access road alternative geometry" described in the project traffic study.

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 10 cm was assumed for the area near the Queen Kaahumanu Highway/Kawaihae Road intersection while a value of 100 cm was used for the with-project intersections along the bypass road. (Project development will result in an increase in surface roughness due to the construction of buildings and other structures.) A mixing height of 300 meters was assumed in all cases. Worst-case wind conditions were defined as a wind speed of 1 meter per second with a wind direction resulting in the highest predicted concentration.

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 1991 scenario. Due to the expected significant development that is predicted to occur in the project area within the next several years, a background value of 0.5 ppm was used for all 2003 scenarios.

Table 3 summarizes the final results of the modeling study in the form of the estimated worst-case 1-hour 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 1991 with existing traffic, year 2003 without project traffic and year 2003 with project traffic. The locations of these estimated worst-case 1-hour concentrations all occurred at or very near the indicated intersections.

As indicated in the table, the estimated present worst-case 1-hour carbon monoxide concentration in the project area is 16.0 mg/m^3. This is predicted to occur during the afternoon peak traffic hour near the intersection of Queen Kaahumanu Highway and Kawaihae Road and is mainly due to long delays experienced by traffic on Queen Kaahumanu Highway waiting to turn onto Kawaihae Road.

As noted in the table and mentioned previously, it is assumed that a bypass road will exist in the year 2003 with or without the project forming an at-grade intersection with Queen Kaahumanu Highway at the existing Kawaihae Road intersection. Without the proposed project in 2003, the highest worst-case 1-hour concentration in the project area (9.1 mg/m^3) would occur near this intersection. Concentrations at other locations could be expected to remain near background levels. Based on these estimates, worst-case 1-hour concentrations occurring in the study area in the year 2003 without the project should decrease to about 60 percent of the

maximum 1991 level. This is partly due to roadway improvements and partly attributable to reduced emissions from motor vehicles as one moves forward in time.

Predicted 1-hour worst-case concentrations for the 2003 with project scenario ranged from 3.7 mg/m^3 during the morning near the project shopping center entrance to 14.8 mg/m^3 during the morning near the intersection of Queen Kaahumanu Highway and the Kawaihae Road/bypass road. Compared to the without project case, predicted concentrations are substantially higher due to the increase in traffic that would be generated by the project and to the creation of several new intersections. Compared to the present case, worst-case concentrations in 2003 with the proposed project would be lower near the Queen Kaahumanu Highway/Kawaihae Road intersection but higher at several other locations.

In addition to comparing model results of the three scenarios to each other, predicted concentrations should also be compared to the state and the national AAQS. All estimated worst-case 1-hour carbon monoxide levels for all three scenarios are within the national AAQS of 40 mg/m^3. It appears likely, however, that worst-case concentrations of carbon monoxide in the project vicinity both for the existing case and for the future with-project alternative could potentially exceed the more stringent State of Hawaii 1-hour AAQS of 10 mg/m^3 on occasion within small "hot-spot" areas while the future without-project scenario would be in compliance with the state limit.

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 [15] concluded that 1-hour to 8-hour persistence factors could typically be expected to range from 0.4 to 0.5. EPA guidelines [14] 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 [16] 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 1991 scenario, the estimated worst-case 8-hour carbon monoxide concentration was 8.0 mg/m^3 at the intersection of Queen Kaahumanu Highway and Kawaihae Road. The predicted maximum value for the year 2003 without project scenario also occurred at this location but decreased significantly to 4.6 mg/m^3. In 2003 with the project, the estimated maximum worst-case 8-hour concentration would continue to occur near the Queen Kaahumanu Highway/Kawaihae Road intersection but would decrease only slightly compared to the existing case to 7.4 mg/m^3; concentrations at several other locations along the bypass road would increase substantially.

Comparing the predicted 8-hour concentrations to the AAQS, it appears likely that the more stringent state standard could be

exceeded in the project vicinity during the current year (near the intersection of Queen Kaahumanu Highway and Kawaihae Road) while the federal standard will be achieved. Without the project, both state and federal standards would likely be met in 2003, while with the project the state standard would likely 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. It should also be noted that predictions for future years do not account for any reductions in emissions that may result from the new Clean Air Act Amendments of 1990 and thus concentrations could be lower than projected.

7.2 Electrical Demand

The proposed project will 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 about 45 megawatts. This includes power demands from residential, commercial and industrial components of the project. Present generating capacity on the Big Island is 161 megawatts with most of this power provided by oil-burning generating units. Island wide, peak power demand is currently about 120 megawatts. Average annual electrical demand of the project when fully developed is not expected to exceed about 240 million kilowatt-hours. This power demand will most probably be provided mainly by oil-fired generating facilities located on the island. In order to meet the electrical power needs of the proposed project, power generating facilities will have to be expanded and/or burn more fuel, and hence more air pollution will be emitted at these facilities. Given in Table 5 are estimates of the indirect air pollution emissions that 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 peak power demand on Hawaii, the project power demand will result in about a 40 percent increase in emissions from the electric utility if all project power is derived from fuel oil.

7.3 Solid Waste Disposal

Solid waste generated by the project when fully completed is expected to amount to less than 45 tons of refuse (about seven to eight 6-ton truckloads) per day. Presently, the refuse district handles about 360 tons per day. Most if not all project 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 6 gives emission factors for municipal refuse incinerators in terms of pounds of air pollution per ton of refuse material

charged. Thus, 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.

7.4 Industrial Operations

As mentioned in the project description given in Section 2, a total of about 265 acres will be designated for business and industrial use (38 acres for business and 227 acres for industry). The industrial portion will include both light and heavy industries which will largely be directly related to the planned growth of Kawaihae Harbor. As indicated in the site plan given in Figure 2, these facilities will be located on the makai side of the planned bypass road. In addition to the 227-acre makai industrial area, approximately 95 acres of land mauka of the bypass road will be designated for potential light industrial use if expansion becomes necessary.

To date, DHHL has received several requests for land located within the proposed industrial area, but no specific commitments have been made. Requests that have been received include:

- Akana Petroleum - 2.5 acres for petroleum storage
- Hawaii Electric Light Company - 30 acres for electrical power plant
- Pacific Resources - 5 acres for petroleum storage
- Sungshin Cement Industrial Company - 50 acres for concrete panel manufacturing

Other requests have been received for industrial lots for: a manufactured home factory, a mobile home factory, an aluminum recycling plant, lumber storage, a food processing plant and a canvas manufacturing plant.

Air pollution emissions from industries locating at the proposed project could potentially result in direct impacts on air quality. While the specific industrial residents of the proposed project have not yet been identified, of the potential industries currently being considered, it appears possible at this time that air pollution sources could include petroleum storage facilities, a power plant and a concrete panel manufacturing plant. Information describing these facilities is not yet available in sufficient detail to quantitatively assess the potential impacts on air quality, however, some qualitative discussion can be provided.

Petroleum storage facilities would potentially emit volatile organic compounds (hydrocarbons). Presently, there are no state or federal ambient air quality standards pertaining to hydrocarbons as hydrocarbons normally are not considered injurious to health. However, hydrocarbons do play a role in the formation of ozone which is detrimental to health and for which state and federal ambient air quality standards are provided. Thus, while there are no ambient air quality standards for hydrocarbon emissions, hydrocarbon emissions from such facilities must be controlled in accordance with both state and federal hydrocarbon emission standards. These standards normally require that petroleum storage facilities use of floating roof storage tanks and/or vapor recovery systems to limit hydrocarbon emissions.

Hawaii Electric Light Company (HELCO) is currently searching the west Hawaii area for a site that will accommodate at least 200 megawatts of new generation capacity. One of the sites being

considered is located within the industrial area of the proposed project. The types of fuel sources being considered include diesel fuel oil, residual fuel oil and coal. The types of generation being considered include any combination of medium- or low-speed diesels, simple and/or combined cycle combustion turbines, and oil- or coal-fired steam generators. Emissions from such a facility will vary substantially depending on the type of fuel and the type of generation selected. At 200 megawatts capacity, however, it may be concluded that emissions will be relatively significant. Whichever type of fuel or generation is selected, significant amounts of sulfur dioxide and nitrogen oxides would likely be emitted. If coal serves as the fuel source, then significant quantities of particulate would also likely be emitted. All of these pollutants are regulated by both state and federal emission and ambient air quality standards. Nitrogen oxide emissions can be limited by controlling the combustion environment. Sulfur dioxide emissions are controlled by limiting the sulfur in the fuel or by the use of flue gas desulfurization systems. Particulate emissions from such facilities typically are controlled to a substantial degree by using bag filtration equipment.

The concrete panel manufacturing plant proposed for the site would involve importing and unloading cement, sand, gravel and steel reinforcing bars and exporting the finished pre-stressed concrete panels. Any air pollution from this activity would likely be limited to particulate emissions associated with the unloading, storage and handling of bulk materials. Such emissions are regulated by state rules pertaining to fugitive dust and process particulate emissions. Emissions from cement unloading can be substantially controlled by unloading the material pneumatically and by installing filtration systems on the storage silo vents. Based on the current description of this proposed industry, other activities associated with the plant would take place inside a large warehouse which should effectively control fugitive particulate emissions.

Any air pollution emissions emanating from industries located within the proposed project's industrial area will be transported and dispersed by the prevailing winds. As discussed in Section 4, winds in the Kawaihae area are strongly bimodal, typically moving onshore (toward the east) during the day and offshore (toward the west) at night. Thus, during the nighttime, when dispersion conditions are least favorable, any industrial emissions will tend to be transported out to sea. During the daytime when dispersion conditions normally are most favorable, emissions from the industrial area will move toward the east and tend to impact on the slopes of the Kohala Mountains, although quite probably mostly to the south of the project's residential areas. Due to the strongly bimodal nature of the winds in the area, emissions transported out to sea during the nighttime could potentially be recirculated back onto land during the daytime.

Given specific information concerning stack heights, stack gas temperatures, exhaust gas exit velocities and emission rates, air quality impacts from the potential industrial facilities can be quantitatively estimated using computerized atmospheric dispersion models. At the present time, such detailed information is not available. However, Hawaii air pollution control rules [7] require that any activity that causes air pollution must first obtain written approval from the director of the Hawaii Department of Health. This written approval generally involves applying for both a permit to construct and a permit to operate. At the time of application, detailed information must be provided by the applicant concerning the type and nature of any air pollution emissions and the emission control technology that would be utilized. Depending

on the magnitudes of the project emissions and other factors, air quality impact analyses and/or air quality monitoring may be required before the application to construct/operate is approved. Thus, even though an assessment of potential direct impacts from project air pollution emissions cannot be done at this time, state rules may require that such analyses be performed at a later date when specific industries apply to locate at the proposed project site.

8.0 CONCLUSIONS AND RECOMMENDATIONS

The major short-term air quality impact will be the potential emission of significant quantities of fugitive dust during project construction phases. The Kawaihae area is particularly dust-prone due to the dry climate and fine nature of the soil in the area. Uncontrolled fugitive dust emissions from construction activities are estimated to amount to about 1.2 tons per acre per month. To control dust, active work areas and any temporary unpaved work roads should be watered at least twice a day on days when rainfall does not occur. Use of wind screens and/or limiting the area that is disturbed at any given time will also help to contain fugitive dust emissions. Wind erosion of inactive areas of the site that have been disturbed could be controlled by mulching or by the use of chemical soil stabilizers. Dirt-hauling trucks should be covered when traveling on roadways to prevent windage. A routine road cleaning and/or tire washing program will also help to reduce fugitive dust emissions that may occur as a result of trucks tracking dirt onto paved roadways. Paving of parking areas and establishment of landscaping early in the construction schedule will also help to control dust.

During construction phases, emissions from engine exhausts (primarily consisting of carbon monoxide and nitrogen oxides) will also occur both from on-site construction equipment and from vehicles used by construction workers and from trucks traveling to and from the project. Increased vehicular emissions due to disruption of traffic by construction equipment and/or commuting construction workers can be alleviated by moving equipment and personnel to the site during off-peak traffic hours.

Long-term air pollution impacts from the project will potentially arise indirectly from 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. The highest concentrations in the project area currently occur near the intersection of Queen Kaahumanu Highway and Kawaihae Road which is oftentimes congested with traffic during the afternoon peak traffic hour. With the project in the year 2003, this will continue to be the location of maximum concentrations. Although concentrations at this location will be lower than existing levels, they may continue to exceed the state AAQS while meeting the federal standards. At other locations near where major new project intersections are created, carbon monoxide concentrations will unavoidably increase substantially and air pollution levels could approach the state standards within small areas near the roadways. Without the project, concentrations in 2003 will likely decrease to levels within the state standards near the Queen Kaahumanu/ Kawaihae Road intersection and increase only slightly at other locations, mostly due to an expected increase in background concentrations. With or without the project, concentrations will likely be lower than projected for 2003 due to provisions included in the 1990 Clean Air Act Amendments which are not accounted for in the present study. It should be mentioned also that, although it is estimated that the

state standards may be exceeded on occasion both for the existing case and for the future with-project case, the allowable state carbon monoxide levels are set so low they are probably currently 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.

Options available to mitigate long-term, traffic-related air pollution from increased project motor vehicle traffic are to improve roadways, reduce traffic or reduce individual vehicular emissions. Estimates of carbon monoxide concentrations from emissions emanating from vehicular traffic associated with the completed development include the "full bypass with alternative geometry" roadway improvements recommended in the traffic impact study for the project. Aside from improving roadways, air pollution impacts from vehicular emissions could be further mitigated by reducing traffic through the promotion of bus service 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 also 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. With regard to cleaner burning fuels, vehicles burning reformulated gasoline, 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.

Long-term impacts also could potentially occur due to indirect emissions from power generating facilities supplying the project with electricity and from the disposal of waste materials generated by the project. Quantitative estimates of these impacts were not made, but it appears that some impacts are possible due to the magnitude of the project electrical and solid waste demands compared to the present county demands. Indirect emissions from project electrical demand could be reduced somewhat by incorporating energy-saving features into project design requirements. This might include the use of solar water heaters; designing building space so that window positions maximize indoor light without unduly increasing indoor heat; using landscaping where feasible to provide afternoon shade to cut down on the use of air conditioning; installation of insulation and double-glazed doors to reduce the effects of the sun and heat; movable, controlled openings for ventilation at opportune times; and possibly automated room occupancy sensors. 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. Operation of the landfill would be a county function and beyond the control of the developer. However, the promotion of conservation and recycling programs within the proposed development could reduce solid waste volumes which would in turn reduce any related air pollution emissions proportionately.

At this time, sufficient detail is not available describing the facilities that may be located within the industrial zone of the project to perform any quantitative impact assessments. However,

before any air pollution sources can be built anywhere in the state, an application must be submitted to the Department of Health for a permit to construct. Detailed information concerning any air pollution emissions must be provided in the application. Of the industries currently being considered for inclusion in the proposed development, the electrical power plant has the greatest potential to impact air quality. Before approving the construction of any such facility, air pollution emissions should be carefully examined to assess the potential impacts that could occur as a result of plume impact on the adjacent mountain sides and/or recirculation of emissions caused by the bimodal wind pattern at the site.

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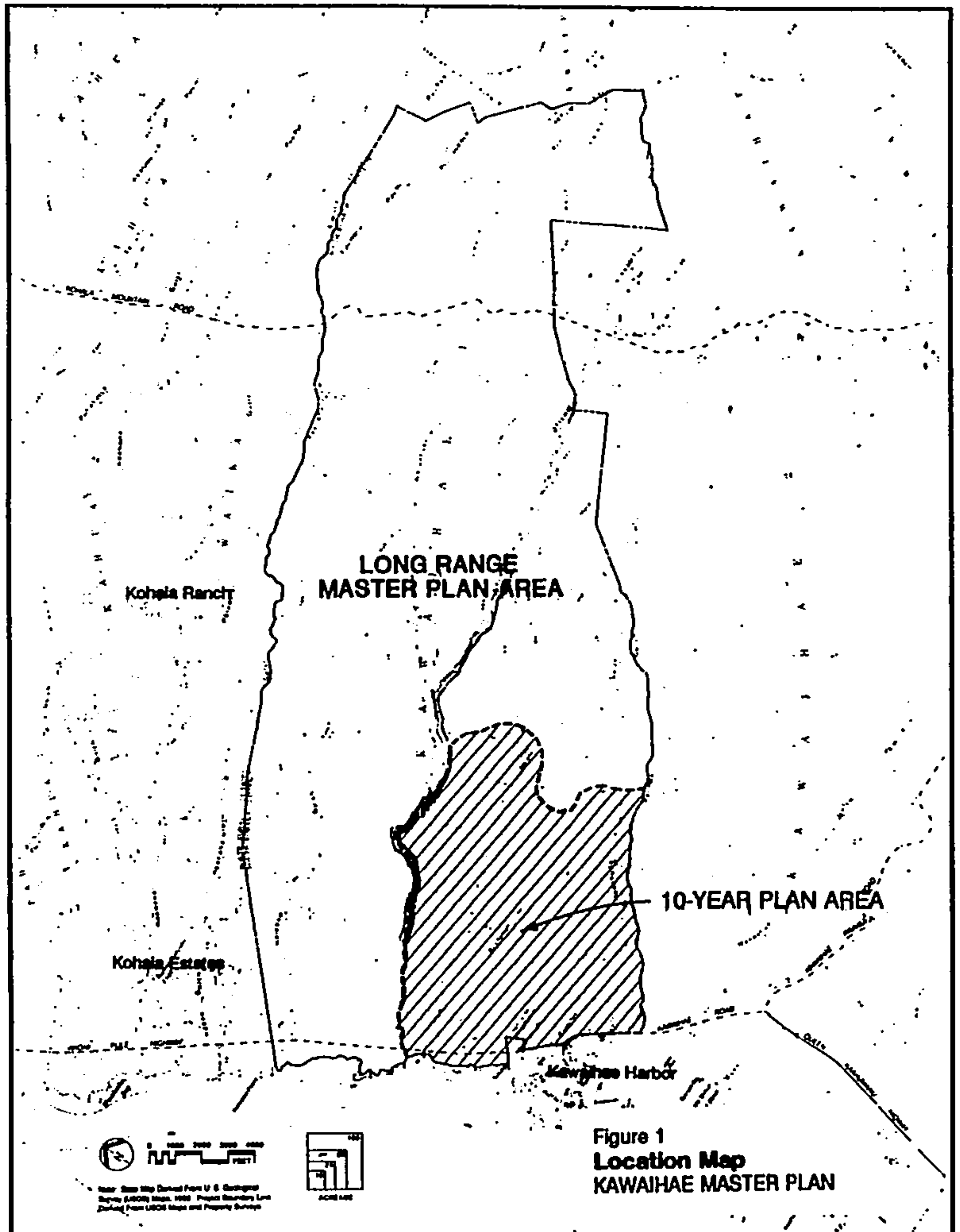

Figure 1
Location Map
KAWAIHAE MASTER PLAN

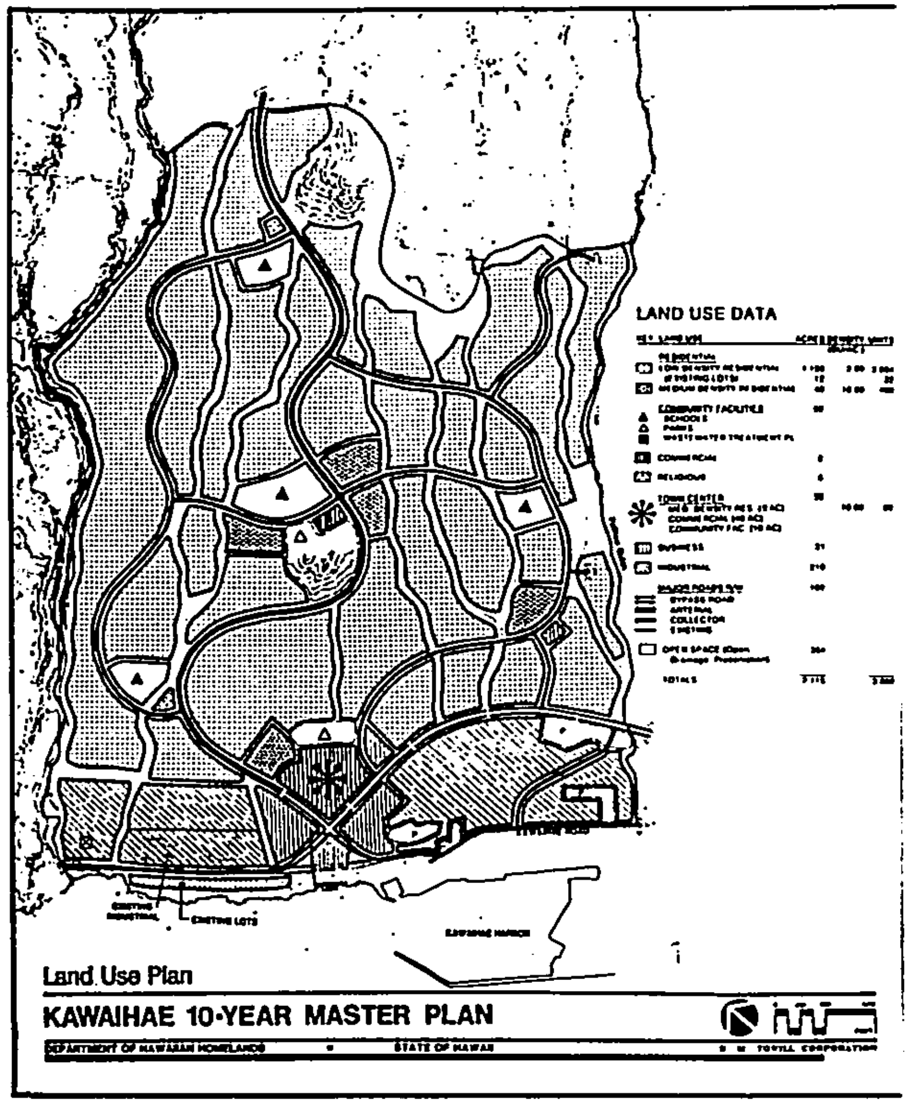

Figure 2

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 SUMMARIES OF AIR QUALITY MEASUREMENTS FOR MONITORING STATIONS NEAREST KAWAIHAE 10-YEAR MASTER PLAN PROJECT

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 KAWAIHAE 10-YEAR MASTER PLAN PROJECT (milligrams per cubic meter)

Roadway Intersection	Year/Scenario[a]					
	1991/ Present		2003/ Without Project		2003/ With Project[b]	
	AM	PM	AM	PM	AM	PM
Kawaihae Road at Queen Kaahumanu Hwy	5.8	16.0	9.0	9.1	14.8	13.9
Bypass Road at Residential Entrance	0.1	0.1	0.5	0.5	10.4	8.6
Bypass Road at Shopping Center Entr.	0.1	0.1	0.5	0.5	3.7	8.4
Bypass Road at Main Entrance	0.1	0.1	0.5	0.5	8.9	7.5

Hawaii State AAQS: 10
National AAQS: 40

[a]2003 without project scenario assumes bypass road intersects with Queen Kaahumanu Highway forming a signal-controlled, at-grade intersection at existing Kawaihae Road intersection; other intersections would not exist (background concentration assumed). With project in 2003, bypass road assumed to exist and all intersections along bypass road were assumed to be signal controlled and at grade.

[b]Assumes full bypass with industrial access road alternative geometry.

Table 4

ESTIMATED WORST-CASE 8-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR KAWAIHAE 10-YEAR MASTER PLAN PROJECT (milligrams per cubic meter)

Roadway Intersection	Year/Scenario[a]		
	1991/ Present	2003/ Without Project	2003/ With Project[b]
Kawaihae Road at Queen Kaahumanu Hwy	8.0	4.6	7.4
Bypass Road at Residential Entrance	0.1	0.2	5.2
Bypass Road at Shopping Center Entr.	0.1	0.2	4.2
Bypass Road at Main Entrance	0.1	0.2	4.4

Hawaii State AAQS: 5
National AAQS: 10

[a]2003 without project scenario assumes bypass road intersects with Queen Kaahumanu Highway forming a signal-controlled, at-grade intersection at existing Kawaihae Road intersection; other intersections would not exist (background concentration assumed). With project in 2003, bypass road assumed to exist and all intersections along bypass road were assumed to be signal controlled and at grade.

[b]Assumes full bypass with industrial access road alternative geometry.

Table 5

ESTIMATED INDIRECT AIR POLLUTION EMISSIONS FROM KAWAIHAE 10-YEAR MASTER PLAN ELECTRICAL DEMAND[a]

Air Pollutant	Emission Rate (tons/year)
Particulate	50
Sulfur Dioxide	600
Carbon Monoxide	130
Volatile Organics	50
Nitrogen Oxides	600

[a]Based on U.S. EPA emission factors for utility gas turbines [6]. Assumes electrical demand of 240 million kw-hrs per year and low-sulfur oil used to generate power.

Table 6

AIR POLLUTION EMISSION FACTORS FOR MUNICIPAL REFUSE INCINERATORS (lb/ton)[a]

Air Pollutant	Emission Factor
Particulate	0.38
Lead	0.022
Sulfur Dioxide	1.1
Carbon Monoxide	2.2
Volatile Organic Compounds	0.11
Nitrogen Oxides	3.6

[a]Assumes mass burn unit with 99 percent control of particulate emissions. Emission factors are given in terms of weight of material emitted per unit weight of refuse material charged.

Source: U.S. Environmental Protection Agency [6]

APPENDIX F

NOISE STUDY
Y. Ebisu & Associates

NOISE STUDY FOR THE KAWAIHAE TEN-YEAR MASTER PLAN SOUTH KOHALA, HAWAII

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CHAPTER I. SUMMARY

The existing and future traffic noise levels in the vicinity of the Kawaihae 10-Year Master Plan Project in Kawaihae, Hawaii were evaluated for their potential impact on present and future noise sensitive areas. The future traffic noise levels along the primary access roadways to the project site were calculated for the Year 2003 with and without the proposed development. The noise analysis assumed that the necessary roadway improvements, including the planned Kawaihae Bypass Highway, would be implemented in order to accommodate the increases in future project and non-project traffic.

Along Akoni Pule Highway, traffic noise levels are expected to increase significantly by 6.7 to 8.3 Ldn between CY 1991 and CY 2003, with worsening traffic conditions requiring major improvements to the existing highway and other roadways in the project area. Project traffic are predicted to cause a 1.6 to 4.4 Ldn increase in traffic noise levels along the existing Kawaihae-Mahukona Road from the present to CY 2003. Along Queen Ka'humanu Highway, project traffic are predicted to cause a 2.5 Ldn increase in traffic noise levels. These increases in traffic noise levels are considered to be significant, and reflect the current plans for urbanization of North Kohala and Kawaihae.

The large traffic noise increases are expected to occur as a result of non-project traffic growth in North Kohala and Kawaihae by CY 2003. The projected increases are in the order of 0.9 to 6.7 Ldn, and are the result of a four-fold increase in traffic volumes due to other planned developments in North Kohala and Kawaihae. Noise sensitive receptors along Akoni Pule Highway, Kawaihae-Mahukona Road, Queen Ka'ahumanu Highway, and Kawaihae-Waimea Road may be impacted by future increases in traffic noise if adequate setback distances are not provided from these roadways, or if other noise mitigation measures are not incorporated into the roadway improvement projects which will be necessary to

accommodate the increased traffic volumes.

The project's 10-Year Master Plan locates non-noise sensitive, commercial and industrial land uses at the makai (harbor) side of the project site and along Akoni Pule Highway. For this reason, adverse traffic noise impacts from the existing sections of Akoni Pule Highway are considered to be minimal. Traffic noise impacts from the planned bypass highway are possible at the four residential parcels which are located mauka of the bypass highway. For these residential parcels, minimum setback distances of 157 to 190 FT from the centerline of the bypass highway are recommended to meet FHA/HUD noise standards. Alternately, other noise mitigation measures, such as the use of berms or sound attenuation walls, may be employed in order to minimize traffic noise impacts on these future residences.

Noise impacts from industrial uses on the makai lands of the project are possible if adequate setbacks are not provided between these industrial uses and the residential lands on the inland portions of the project site. Adherence to the property line noise level limits of the State Department of Health noise regulations is recommended within the project, even though these regulations have not been adopted by Hawaii County. Where adequate setbacks are not available, enclosure of the noise source, the construction of sound attenuating walls, or the installation of silencers or mufflers are standard noise mitigation measures which can be employed to reduce noise levels to required property line limits.

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

The objectives of this study were to describe the existing and future noise environment in the environs of the Ten-Year Kawaihae Master Plan for Hawaiian Home Lands in Kawaihae on the island of Hawaii. Traffic noise level increases and impacts associated with the proposed development were to be determined within the project site as well as along the public roadways expected to service the project traffic. A specific objective was to determine 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 the planned industrial land uses on the makai portions of the project area, as well as 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) prior to 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**. As a general rule, 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 project area, noise levels at lots which front Queen Ka'ahumanu Highway and Akoni Pule Highway are typically above 60 Ldn. Due to noise shielding effects from intervening structures or natural terrain features, 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 the purposes of 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.

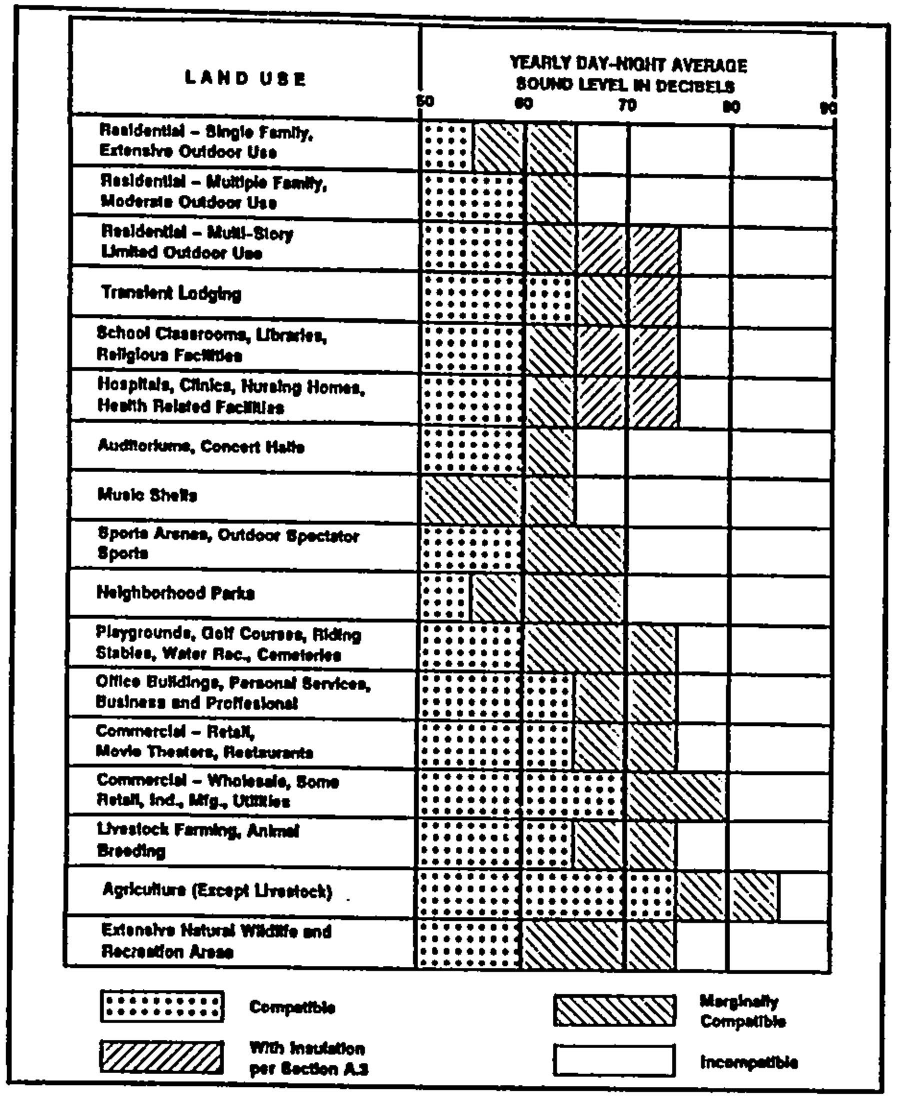
TABLE 1

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

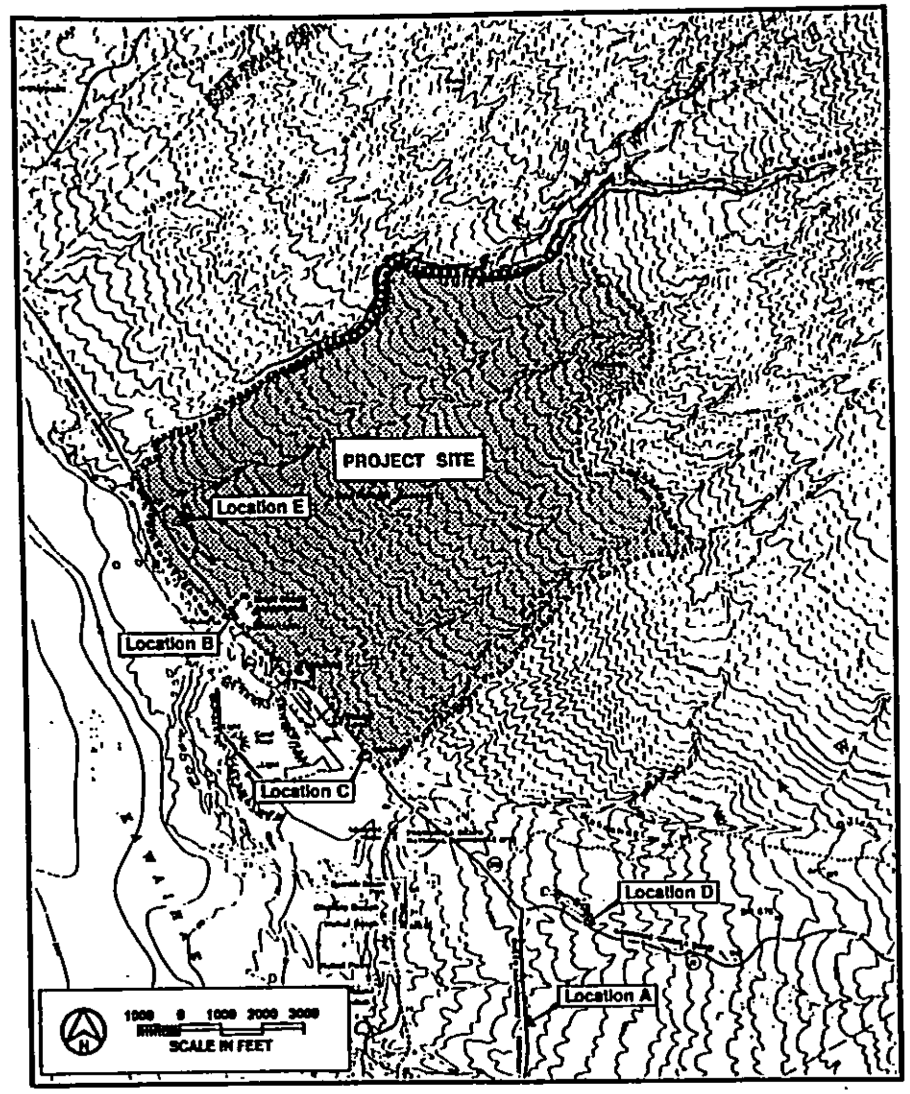
Because of our open-living conditions, the predominant use of naturally ventilated dwellings, and the relatively low exterior-to-interior sound attenuation afforded by these naturally ventilated structures, an exterior noise level of 65 Ldn does not eliminate all risks of noise impacts. Because of these 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**, relatively high exterior noise levels of 65 to 80 Ldn are considered to be "Compatible" or "Marginally Compatible" for commercial land uses such as those planned within the proposed development. Industrial land uses are considered to be compatible in areas with exterior noise levels as high as 80 Ldn, as long as sound attenuation measures (such as total closure and air conditioning) are provided to reduce interior noise to acceptable levels in office or other noise sensitive facilities.

CHAPTER IV. GENERAL STUDY METHODOLOGY

Existing background ambient and traffic noise levels were measured at five locations in the project environs to provide a basis for describing the existing background ambient noise levels and for developing the project's traffic noise contributions along the roadways which will service the project: Akoni Pule Highway, Queen Ka'ahumanu Highway, Kawaihae-Mahukona Road, and Kawaihae-Waimea Road. The locations of the measurement sites are shown in **FIGURE 2**. The noise measurements were performed during the latter part of August 1991. 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. Additional measurements of existing background ambient noise levels in the Kawaihae Industrial Center were obtained at Site "E" (see **FIGURES 3 & 4**). The resulting background ambient noise levels were relatively low at an average (or Leq) level of 53.7 dB. The maximum noise level measured was 75 dB within the industrial area.

Traffic noise calculations for the existing conditions as well as noise predictions for the Year 2003 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 results of the traffic study for the project (**Reference 5**) and Hawaii State Department of Transportation counts at Queen Ka'ahumanu Highway and Kawaihae Road (**References 6 and 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 0.8 dB less than the 24-hour Ldn along each roadway segment. This assumption was based on com-



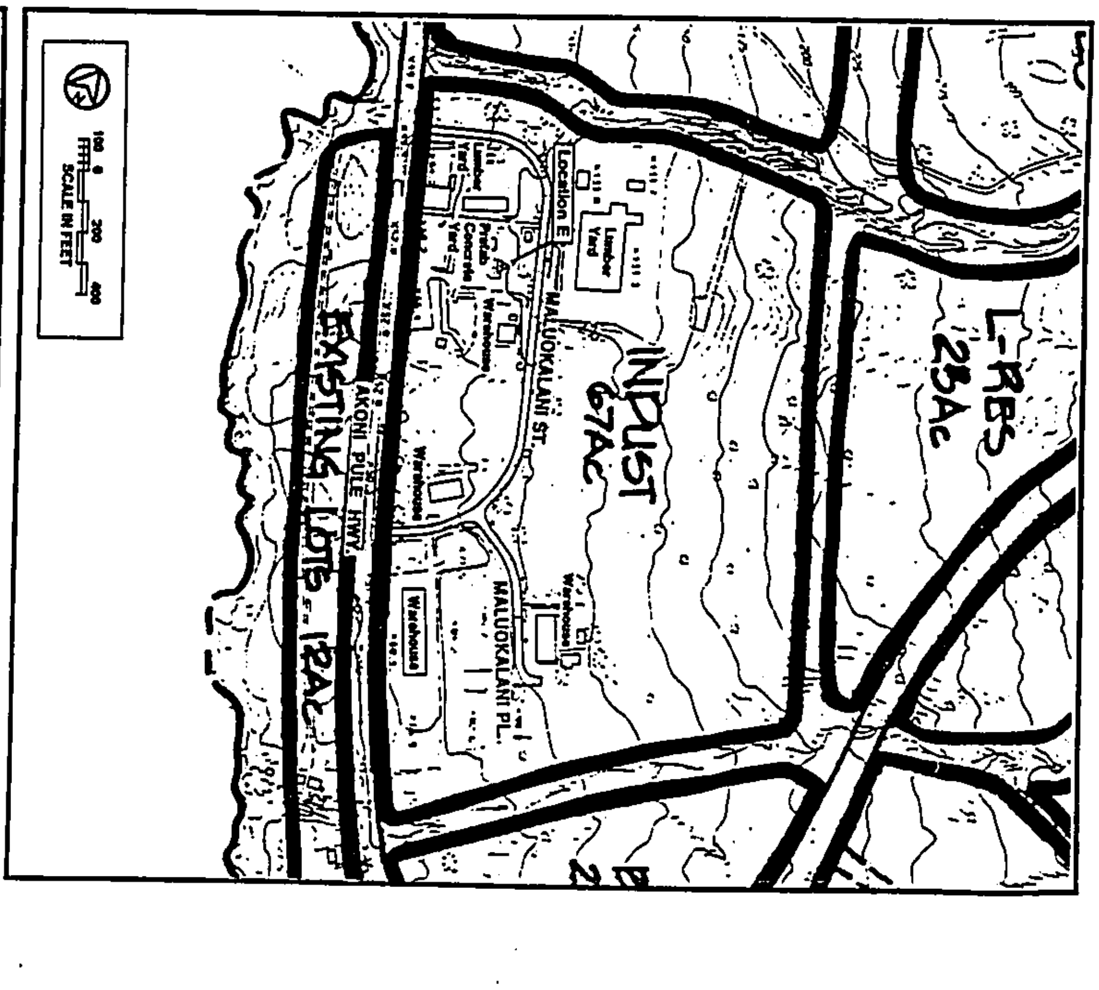
LOCATIONS OF NOISE MEASUREMENT SITES

FIGURE 2

TABLE 2

NOISE MEASUREMENT RESULTS
(August 28, 1991)

	Location	Time of Day (HRS)	Ave.Speed (MPH)	---Hourly Traffic Volume--- Auto	Med.Truck	Heavy Truck	Measured Leq (dB)	Predicted Leq(dB)
A.	100 FT from the center-line of Queen Kaahumanu Hwy. at Telephone Bldg.	1245 TO 1345	54	442	23	23	59.2	58.7
B.	50 FT from the center-line of Akoni Pule Hwy. at Lighthouse.	1630 TO 1730	52	219	14	6	58.6	58.8
C.	95 FT from the center-line of Kawaihae-Mahu-kona Road at Cemetary.	1515 TO 1615	50	446	22	19	60.3	60.7
D.	120 FT from the center-line of Kawaihae-Waimea Rd. at Hulukupuna St.	1400 TO 1500	57	436	51	15	58.6	58.6
E.	120 FT from the center-line of Maluokalani St., Kawaihae Industrial Center.	1000 TO 1100	N/A	N/A	N/A	N/A	53.7	N/A



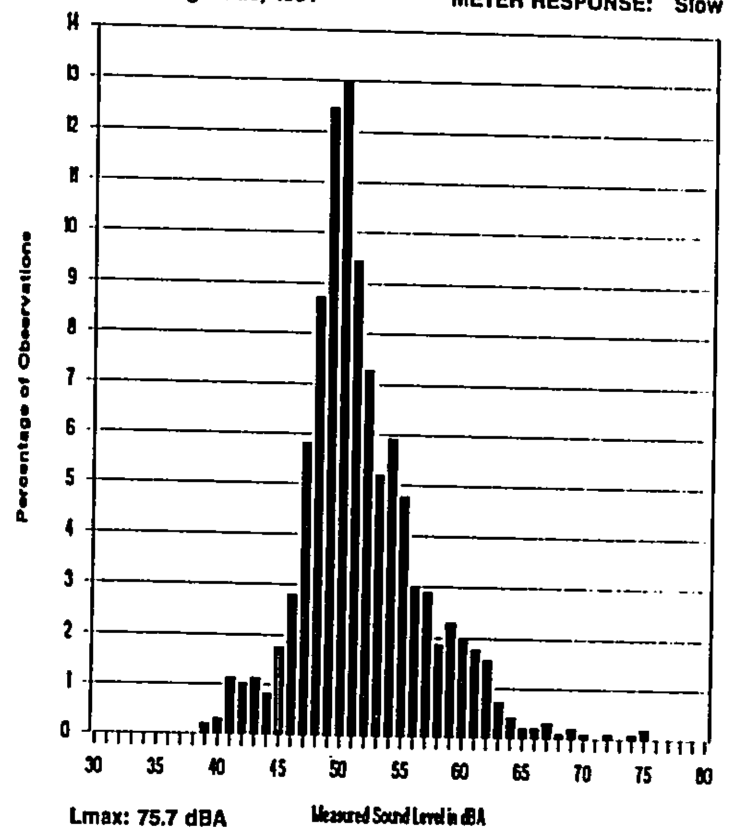
LOCATION OF NOISE MEASUREMENT SITE 'E'

FIGURE 3

FIGURE 4

BACKGROUND NOISE LEVELS
AT MONITORING LOCATION 'E'
(1000 HRS TO 1100 HRS)

DATE: August 28, 1991 METER RESPONSE: Slow



Lmax: 75.7 dBA
L10: 59.0 dBA
Leq: 53.7 dBA
Lmin: 39.1 dBA

putations of both the hourly Leq and the 24-hour Ldn of traffic noise on Queen Ka'ahumanu Highway and Kawaihae Roads (see FIGURES 5 thru 7).

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. 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, and an evaluation of possible traffic noise impacts was made.

FIGURE 5

HOURLY VARIATIONS OF TRAFFIC NOISE AT 50 FT SETBACK DISTANCE FROM THE CENTERLINE OF QUEEN KA'AHUMANU HIGHWAY AT KAWAIHAE ROAD (10/23-24/90)

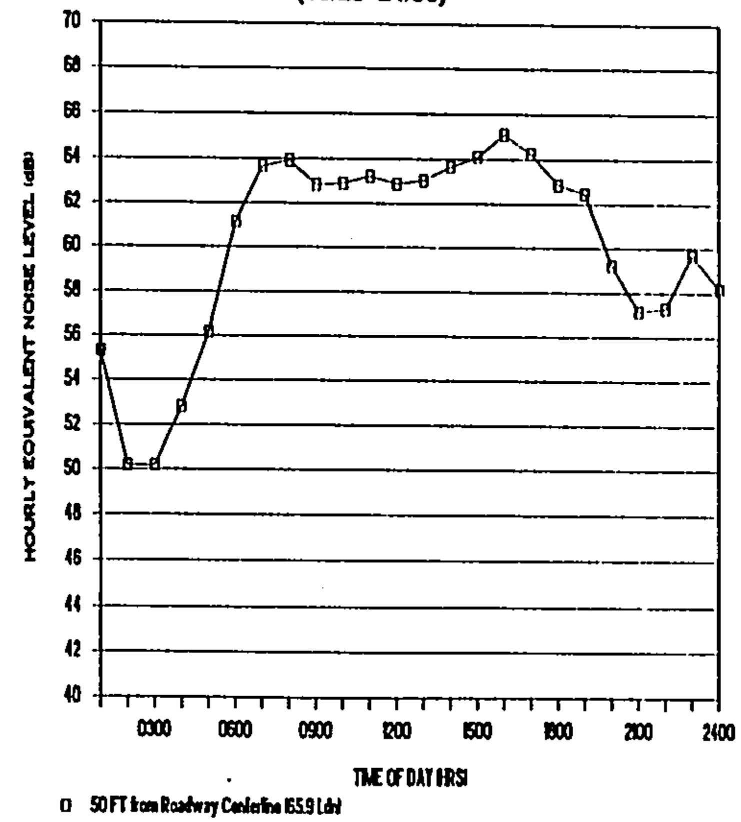


FIGURE 6

HOURLY VARIATIONS OF TRAFFIC NOISE AT 50 FT SETBACK DISTANCE FROM THE CENTERLINE OF KAWAIHAE-MAHUKONA ROAD AT QUEEN KA'AHUMANU HIGHWAY (10/23-24/90)

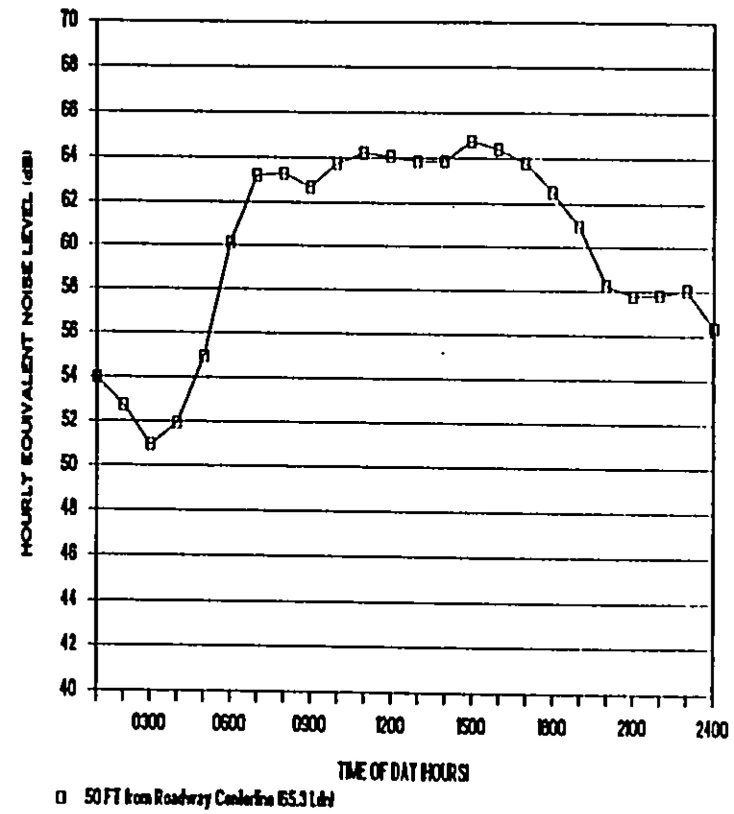
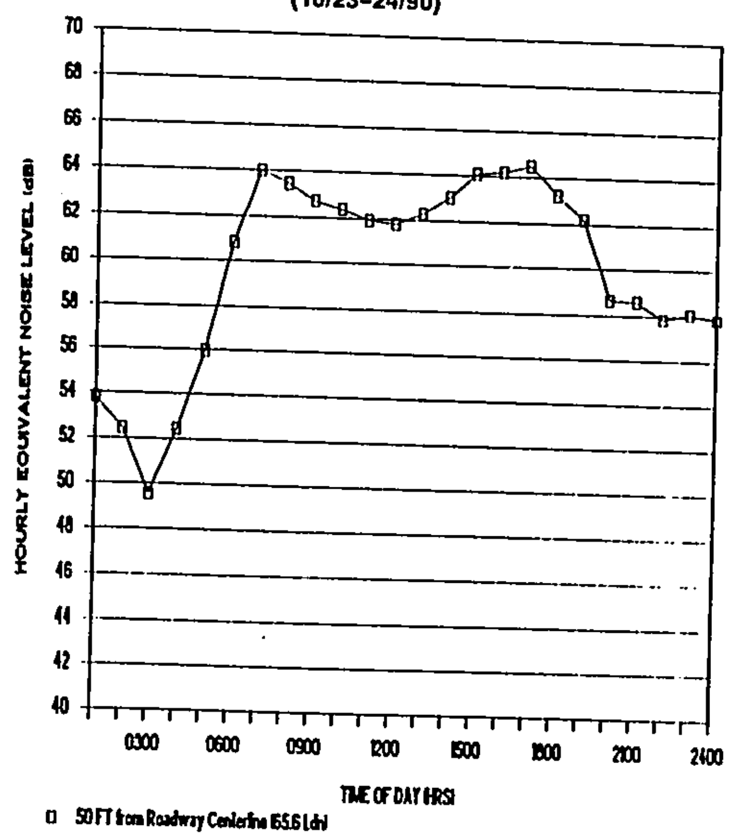


FIGURE 7

HOURLY VARIATIONS OF TRAFFIC NOISE AT 50 FT SETBACK DISTANCE FROM THE CENTERLINE OF KAWAIHAE-WAIMEA ROAD AT QUEEN KA'AHUMANU HIGHWAY (10/23-24/90)



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 Kawaihae-Mahukona and Kawaihae-Waimea Roads. 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 61 to 70 FT, traffic noise along Queen Ka'ahumanu Highway and Kawaihae Roads decrease to the "Moderate Exposure, Acceptable" category. Setback distances of approximately 70 to 37 FT are required from the centerlines of Kawaihae-Mahukona Road and Akoni Pule Highway, respectively, 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 TABLE 3. The hourly Leq (or Equivalent Sound Level) contribution from each roadway section in the project environs was calculated for comparison with forecasted traffic noise levels with and without the project. The existing setback distances from the roadways' centerlines to their associated 60, 65, and 70 Ldn contours were also calculated as shown in TABLE 4. The contour line setback distances do not take into account 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 short along Queen Ka'ahumanu Highway, Kawaihae Roads, and Akoni Pule Highway.

Existing traffic noise levels at the mauka (inland) portions of the project site are very low (less than 60 Ldn) due to their large setback distances from Akoni Pule Highway and Kawaihae-Mahukona Road. The proposed residential areas of the project are located beyond a half mile from the highway. At 70 FT or greater setback distance from the centerlines of Kawaihae-Mahukona Road or

TABLE 3

COMPARISONS OF EXISTING AND CY 2003 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 PM PEAK HR. TRAFFIC:						
Akoni Pule Hwy. (Northwest)	57	392	58.2	57.0	57.1	62.2
Akoni Pule Hwy. (Front)	52	529	58.0	57.0	57.5	62.2
Kawaihae-Mahukona Road	50	666	61.3	59.2	63.0	66.2
Queen Kaahumanu Highway	54	845	60.6	58.4	62.4	65.5
Kawaihae-Waimea Road	57	685	60.4	61.7	60.3	65.6
CY 2003 PM PEAK HR. TRAFFIC WITH THE PROJECT (FULL BYPASS):						
Akoni Pule Hwy. (Northwest)	57	2,655	66.5	65.3	65.4	70.5
Bypass Highway (Front)	55	3,790	67.5	65.6	67.4	71.7
Bypass Highway (Southeast)	55	5,041	68.7	66.9	68.6	72.9
Queen Kaahumanu Highway	54	3,317	66.5	64.3	68.4	71.5
Kawaihae-Waimea Road	57	1,190	62.8	64.1	62.7	68.0
Main Entrance Road	50	1,500	62.0	57.2	61.6	65.5
Shopping Center Entrance Rd.	40	522	53.7	49.3	54.6	57.8
Residential Entrance Road	40	999	56.5	52.1	57.4	60.7

Notes:

The following assumed traffic mixes of autos, medium trucks, and heavy trucks were used for existing and future conditions:

(a) Queen Kaahumanu Highway: 91.0% autos, 4.5% medium trucks, and 4.5% heavy trucks or buses.

(b) Akoni Pule Highway: 91.6% autos, 5.9% medium trucks, and 2.5% heavy trucks or buses.

(c) Kawaihae-Mahukona Road: 91.6% autos, 4.5% medium trucks, and 3.9% heavy trucks or buses.

(d) Kawaihae-Waimea Road: 87.0% autos, 10% medium trucks, and 3.0% heavy trucks or buses.

(e) Bypass Highway: 92% autos, 5% medium trucks, and 3% heavy trucks or buses.

(f) Interior Roadways: 95.0% autos, 2.5% medium trucks, and 2.5% heavy trucks or buses.

TABLE 4

EXISTING AND CY 2003 DISTANCES TO 60, 65, AND 70 Ldn CONTOURS

STREET SECTION	60 Ldn SETBACK (FT) EXISTING	CY 2003	65 Ldn SETBACK (FT) EXISTING	CY 2003	70 Ldn SETBACK(FT) EXISTING	CY 2003
Akoni Pule Hwy. (Northwest)	80	285	37	132	17	61
Bypass Highway (Front)	N/A	339	N/A	157	N/A	73
Bypass Highway (Southeast)	N/A	410	N/A	190	N/A	88
Queen Kaahumanu Highway	132	330	61	153	29	71
Kawaihae-Waimea Road	134	194	62	90	29	42
Main Entrance Road	N/A	131	N/A	61	N/A	28
Shopping Center Entrance Rd.	N/A	41	N/A	19	N/A	9
Residential Entrance Road	N/A	63	N/A	29	N/A	13

Notes:

(1) All setback distances are from the roadways' centerlines.
(2) See TABLE 3 for traffic volume, speed, and mix assumptions.
(3) Ldn assumed to be equal to PM Peak Hour Leq plus 0.8 dB along all roadways.
(4) Setback distances are for unobstructed line-of-sight conditions.
(5) Soft ground conditions assumed along all roadways.

Akoni Pule Highway, traffic noise levels are less than 65 Ldn. For these reasons, the existing levels of roadway traffic noise 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.

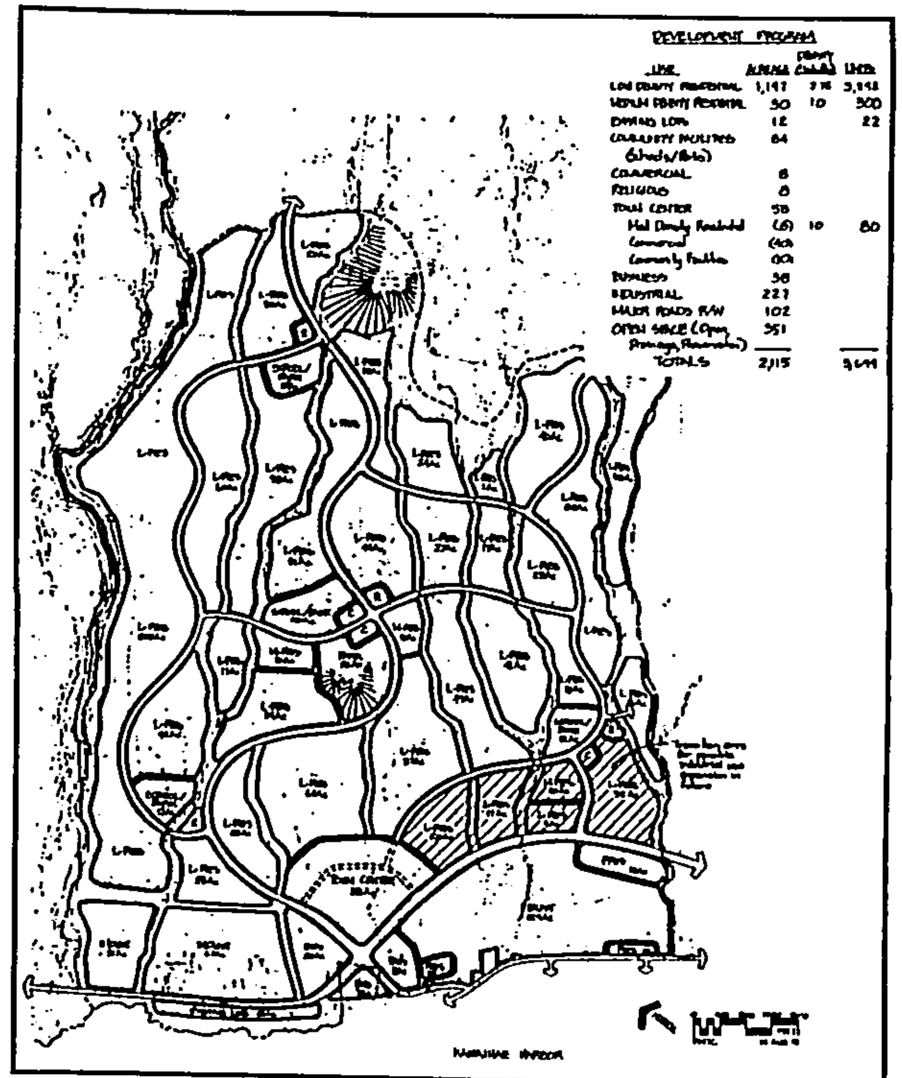
CHAPTER VI. FUTURE TRAFFIC NOISE ENVIRONMENT

Predictions of future traffic noise levels were made using the traffic volume assignments of **Reference 5** for CY 2003 without the project, as well as with the project and its recommended roadway network. **FIGURE 8** identifies the major roadways of the preferred project development alternative for which traffic noise levels were calculated. It was assumed that the planned Kawaihae Bypass Highway will be completed by CY 2003, including the section between the project and Queen Ka'ahumanu Highway. The future projections of project plus non-project traffic on the roadways which would service the project are shown in **TABLE 3** for the PM peak hour of traffic. As indicated in **TABLE 3**, by CY 2003, traffic volumes on all existing roadways will increase significantly, and major improvements to the roadway network, such as the planned Kawaihae Bypass Highway, will be required with or without the project. If these roadway improvements are implemented to accommodate the projected future traffic volumes, traffic noise levels in the project environs will increase significantly (by 2.4 to 9.4 Ldn) above existing levels. If the required roadway improvements are not implemented to maintain current levels of service, future traffic noise level increases will be less than those indicated in **TABLE 3** due to increased congestion and reduced average vehicle speeds.

TABLE 4 summarizes the predicted setback distances to the 60, 65, and 70 Ldn traffic noise contour lines along the roadways servicing the project and attributable to both project plus non-project traffic by CY 2003. The setback distances in **TABLE 4** 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 4**, relatively large setback distances to the 65 Ldn contour of 132 to 190 FT from the centerlines of the improved Akoni Pule Highway and the planned bypass highway are predicted in CY 2003.

TABLE 5 presents the predicted increases in traffic noise levels associated with non-project and project traffic by CY 2003, and as measured by the Ldn descriptor system. As indicated in TABLE 5, the increases in traffic noise along Akoni Pule Highway and the planned bypass highway due to project traffic are less than or comparable to those increases expected from non-project traffic. Similar conclusions apply along Queen Ka'ahumanu Highway and Kawaihae-Waimea Road. Project traffic noise increases are expected to be greatest relative to non-project traffic along the section of the planned bypass highway between the project and Queen Ka'ahumanu Highway.

As a result of the construction of the proposed mauka-makai highway and collector roads on the project site, traffic noise levels are expected to increase significantly at the inland areas mauka of the planned bypass highway. By CY 2003, following the construction of these new roadways, traffic noise levels along the interior roadways are expected to increase to levels as high as those indicated in TABLES 3 and 4. Because of the development of the currently vacant project site, background ambient noise levels will increase significantly by 15 to 25 dB at the mauka (or inland) portions of the project site. However, as indicated in TABLE 4, traffic noise levels are anticipated to be less than the FHA/HUD standard of 65 Ldn at setback distances of 19 to 61 FT from the centerlines of these interior roadways.



PROJECT 10-YEAR MASTER PLAN AND IDENTIFICATION OF PRIMARY ROADWAYS SERVICING THE PROJECT

FIGURE 8

TABLE 5

CALCULATIONS OF PROJECT AND NON-PROJECT TRAFFIC NOISE CONTRIBUTIONS (CY 2003)

STREET SECTION	NOISE LEVEL INCREASES (Ldn) DUE TO NON-PROJECT TRAFFIC	PROJECT TRAFFIC
Akoni Pule Hwy. (Northwest)	6.7	1.6
Bypass Highway (Front)	6.3	3.1
Bypass Highway (Southeast)	2.4	4.4
Queen Kaahumanu Highway	3.4	2.5
Kawaihae-Waimea Road	0.9	1.5
Main Entrance Road	N/A	65.5
Shopping Center Entrance Rd.	N/A	57.8
Residential Entrance Road	N/A	60.7

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 2003 are predicted to range from 3.1 to 4.4 Ldn along the planned Kawaihae Bypass Highway. This degree of increase in traffic noise levels attributable to the project is considered to be significant. Existing and planned land uses along the bypass highway alignment are primarily light industrial or vacant, but planned uses also include residential developments. For these reasons, traffic noise impacts along the bypass highway are possible if adequate noise mitigation measures are not incorporated into the development of the residential lots which are adjacent to the planned bypass highway.

Setback distances of approximately 157 to 190 FT from the centerline of the planned bypass highway will be required to meet FHA/HUD noise standards under unobstructed line-of-sight conditions between the roadway and residences of the project. Under conditions of noise shielding by terrain features or man-made obstructions, setback distances required to meet the FHA/HUD noise standard of 65 Ldn would be significantly less, and be probably less than 190 FT from the roadway centerline. The project's 10-Year Master Plan indicates that these setback distances may be achievable. If they are not achievable, use of sound attenuating walls or berms between the highway and the residences will be required.

Potential noise impacts along the other sections of roadways which will service the project are possible, both in respect to existing and planned noise sensitive receptors along these roadways. Existing residences located along these roadways 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 berms and/or 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 the various roadway improvement projects.

CHAPTER VIII. OTHER NON-TRAFFIC NOISE CONSIDERATIONS

Noise from On-Site Industrial and Commercial Activities. Noise impacts from industrial uses on the makai lands of the project are possible if adequate setbacks are not provided between these industrial uses and the residential lands on the inland portions of the project site. Noise levels from industrial uses, such as power generating stations, can exceed 70 dB at 400 FT distance. Industrial equipment tend to have relatively high noise levels. Practically all powered tools or machinery will generate noise levels in excess of 65 dB at the operator position. **FIGURE 9** and **TABLE 6** present typical ranges of noise levels for various equipment which may be used in an industrial workplace environment. Other outdoor equipment, such as refrigeration machines or large fans, typically exceed 65 dB at 15 to 30 FT distance.

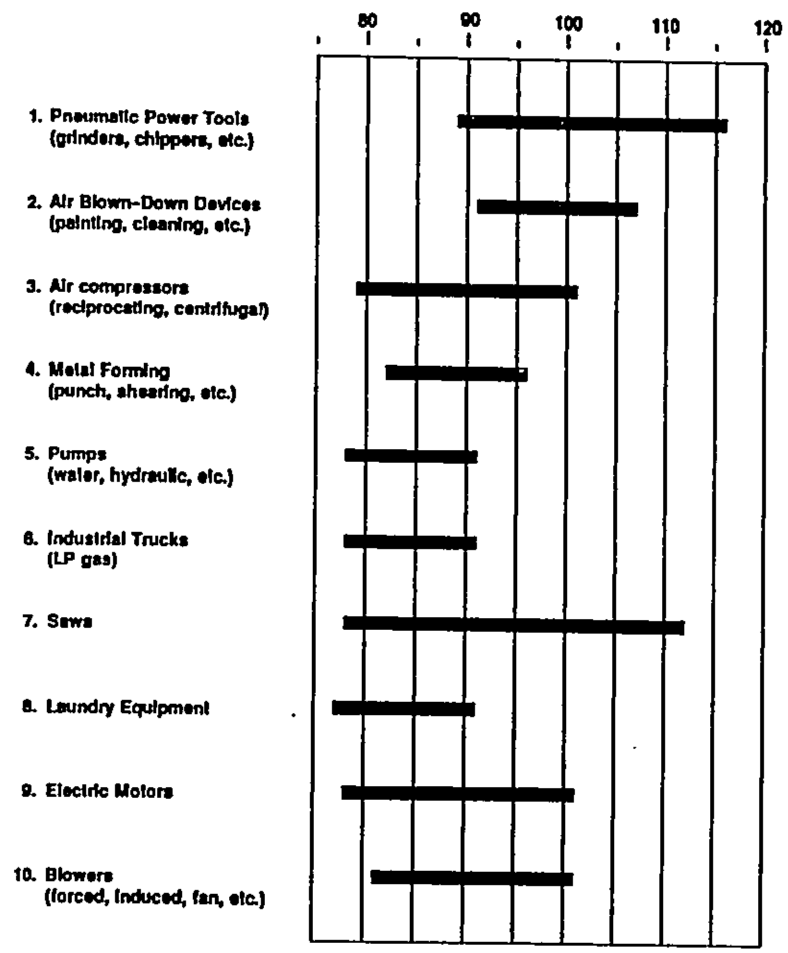
The extent to which noise from one industrial or commercial activity leaks out to adjoining properties depends upon the location (or setback distances) of the noise source from the property boundaries and the degree of closure around the noise source. It is possible to totally enclose some noisy business establishments with properly designed wall and ceiling/floor systems to prevent workplace noise from escaping to adjoining properties. However, considerations such as ventilation, material flow, and customer servicing can make total closure impractical. Also, it may not be possible to totally enclose outdoor mechanical equipment, such as cooling towers, ventilation fans, material handling equipment, or condensing units.

Adherence to the property line noise level limits of the State DOH noise regulations (**Reference 8**) is recommended within the project, even though these regulations have not been adopted by Hawaii County. These limits for the various land use categories are as follows:

a. Single Family Residences: 55 and 45 dB (A-Weighted) for the daytime and nighttime periods, respectively.

FIGURE 9

RANGE OF INDUSTRIAL MACHINERY/EQUIPMENT SOUND LEVELS*



*Measured at operator positions.

TABLE 6

MEASURED SOUND LEVELS OF INDUSTRIAL EQUIPMENT

OPERATION	SOUND LEVEL (dB)
Steam cleaning	109-114
Buffing and polishing	103-104
Use of bed planer	95-97
Use of compressed air for blowdown	102
Use of abrasive cut-off saw	104-108
Operation of paint spray booth	92
Use of large bandsaw	96-97
Operation of motor generator sets, battery shop	95-102
Use of portable pneumatic sander	96-98
Operation of abrasive cut-off wheels	92-96
Use of pneumatic wire brushes	94-98
Use of 4" belt sander	96-97
Use of saw	100-106
Use of pneumatic hoists	98
Use of surface planer	100
Use of table saw	96-98

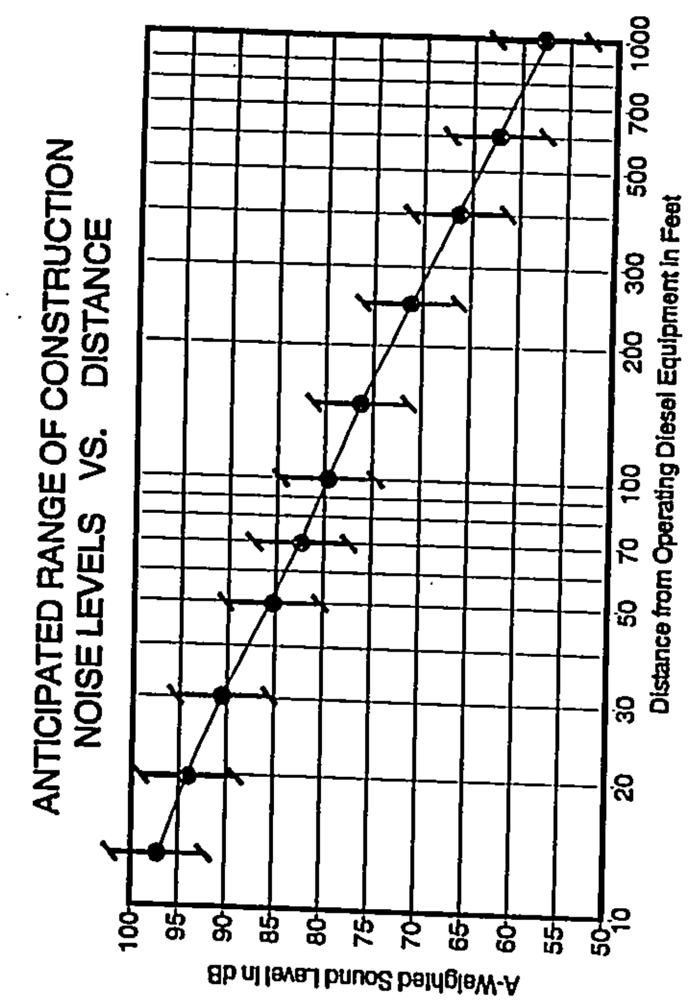
b. Multi-Family Residences and Commercial: 60 and 50 dB (A-Weighted) for daytime and nighttime periods, respectively.

c. Industrial and Agricultural: 70 dB (A-Weighted) for both daytime and nighttime periods.

Under the State DOH regulations, the daytime period begins at 7:00 AM and ends at 10:00 PM, when the nighttime period begins. Along a boundary line which separates different land uses, the land use category with the lower noise limits takes precedence in determination of the allowable noise limits. Prospective tenants of the industrial and commercial subdivisions should be made aware of the noise limits, so that the noisier establishments congregate in the industrial areas at the makai end of the project site and at maximum setback distances from the residential areas.

Where adequate setbacks are not available, enclosure of the noise source, the construction of sound attenuating walls, or the installation of silencers or mufflers are standard noise mitigation measures which can be used to reduce noise levels to required property line limits.

Construction Noise. Audible construction noise will probably be unavoidable during the entire project construction period. The total time period for construction is unknown, but it is anticipated that the actual work will be moving from one location on the project site to another during that period. Actual length of exposure to construction noise at any receptor location will probably be less than the total construction period for the entire project. Typical levels of noise from construction activity (excluding pile driving activity) are shown in FIGURE 10. The impulsive noise levels of impact pile drivers are approximately 15 dB higher than the levels shown in FIGURE 10, 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



CONSTRUCTION NOISE LEVELS VS. DISTANCE

FIGURE 10

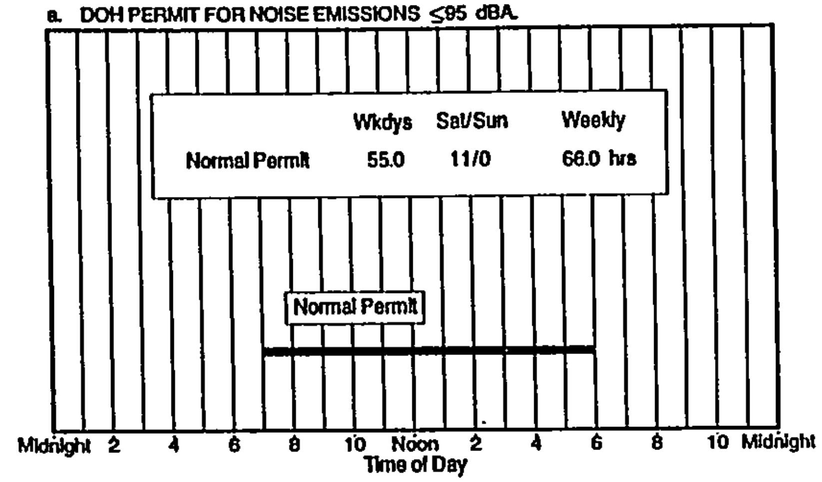
to the administrative controls available for its regulation. Instead, these impacts will probably be limited to the temporary degradation of the quality of the acoustic environment in the immediate vicinity of the project site.

Mitigation of construction noise to inaudible levels will not be practical in all cases due to the intensity of construction noise sources (80 to 90+ dB at 50 FT distance), and due to the exterior nature of the work (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 7 depicts the allowed hours of construction for normal construction noise (levels which do not exceed 95 dB at the project's property line) and for construction noise which exceeds 95 dB at the project's property line. Noisy construction activities are not allowed on holidays under the DOH permit procedures.

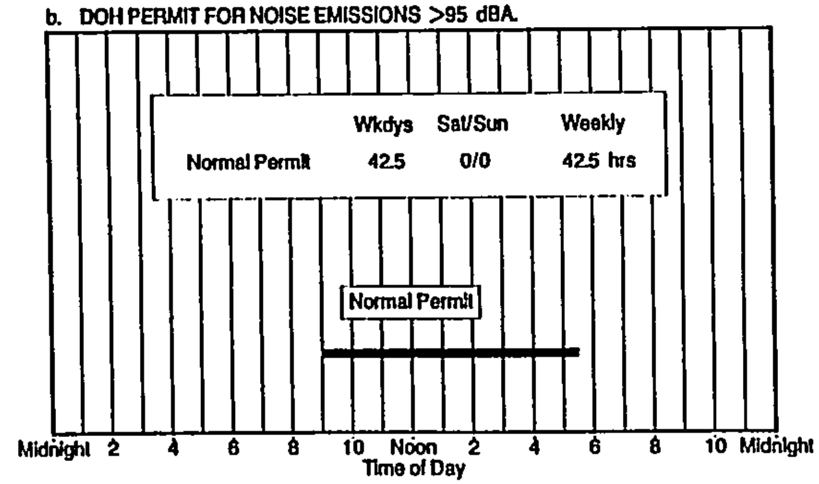
TABLE 7

AVAILABLE WORK HOURS UNDER DOH PERMIT PROCEDURES FOR CONSTRUCTION NOISE

a. DOH PERMIT FOR NOISE EMISSIONS ≤95 dBA.



b. DOH PERMIT FOR NOISE EMISSIONS >95 dBA.



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) Existing and Future Traffic Assignments for Kawaihae 10-Year Master Plan; Wilbur Smith Associates; September 19, October 3, and October 15, 1991.

(6) October 23-24, 1990 24-Hour Traffic Counts; Station 11-E, Kawaihae-Waimea Roads at Queen Ka'ahumanu Highway; Hawaii State Department of Transportation.

(7) May 4-5, 1988 Vehicle Type Classification Counts; Station C-12-F, Akoni Pule Highway, 100 Yards North of Kawaihae Wharf; 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_{Bd}	L_{pd}
9. Night Sound Level	L_n	L_{An}	L_{Bn}	L_{pn}
10. Day-Night Sound Level	L_{dn}	L_{Adn}	L_{Bdn}	L_{pdn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$	$L_{Adn(Y)}$	$L_{Bdn(Y)}$	$L_{pdn(Y)}$
12. Sound Exposure Level	L_S	L_{SA}	L_{SB}	L_{Sp}
13. Energy Average value over (non-time domain) set of observations	$L_{eq(e)}$	$L_{Aeq(e)}$	$L_{Beq(e)}$	$L_{peq(e)}$
14. Level exceeded x% of the total set of (non-time domain) observations	$L_{x(e)}$	$L_{Ax(e)}$	$L_{Bx(e)}$	$L_{px(e)}$
15. Average L_x value	L_x	L_{Ax}	L_{Bx}	L_{px}

(1) "Alternative" symbols may be used to assure clarity or consistency.

(2) Only B-weighting shown. Applies also to C,D,E,....weighting.

(3) The term "pressure" is used only for the unweighted level.

(4) Unless otherwise specified, time is in hours (e.g., the hourly equivalent level is Leq(1). Time may be specified in non-quantitative terms (e.g., could be specified as Leq(WASH) to mean the washing cycle noise for a washing machine.

APPENDIX G

MARKET RESEARCH AND ANALYSIS
By Real Estate Services, Inc.

MARKET RESEARCH AND ANALYSIS

DEPARTMENT OF HAWAIIAN HOME LANDS

KAWAIHAE PLANNING AREA

COUNTY OF HAWAII

PREPARED FOR:

R.M. TOWILL CORPORATION

DEPARTMENT OF PLANNING AND LAND DEVELOPMENT

PREPARED BY:

REAL ESTATE SERVICES, INC.

PETER T. YOUNG, CREA CRB CRA SCV

MAY 1991

TABLE OF CONTENTS

DEPARTMENT OF HAWAIIAN HOME LANDS
KAWAIHAE MASTER PLAN

POPULATION, HOUSING, COMMERCIAL, INDUSTRIAL AND GOLF DEMAND ASSUMPTIONS AND CONCLUSIONS

REAL ESTATE SERVICES, INC.
PETER T. YOUNG

MAY 1, 1991

The following are the assumptions and conclusions of population estimates, housing needs and demands, commercial, industrial and golf demand and feasibility as they relate to the Kawaihae Planning Area of the Department of Hawaiian Home Lands.

SUMMARY OF ASSUMPTIONS AND CONCLUSIONS

POPULATION PROJECTIONS

ASSUMPTIONS:

> Population and housing demand assumptions consider two main components. These estimates assume that: (1) The population projections illustrated in the State's M-K Series reflect the most predictable population estimates for the region; and (2) the M-K Series estimates do not necessarily include the Governor's request to build 3,500 housing units at Kawaihae over the next ten years.

Most analysis considers the State's M-K Series estimates as the primary source of projected population for the region. Community Resources, Inc. slightly modified these estimates and distributed the population estimates over the various districts in the region. Based on these assumptions, the following are the population estimates for the market area:

OFFICIAL STATE POPULATION AND ECONOMIC PROJECTIONS FOR HAWAII COUNTY, 1990-2010 (STATE M-K SERIES)

Resident population	1990	1995	2000	2005	2010
	124,600	142,500	160,400	180,800	206,100

DISTRICT POPULATION BREAKDOWN - COMMUNITY RESOURCES, INC.

	1990	1995	2000	2005	2010
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	56,700	64,800	73,000	82,300	93,800

These summaries do not include the population increases that would result from the development of the Kawaihae site. They reflect projected regional trends of population growth. It is my understanding, and an underlying assumption in this report, that the Governor has a stated goal of building approximately 3,500 housing units at Kawaihae over the next ten (10) years. Using the 'typical' household size of approximately 2.75 persons per household, this indicates a population increase at the Kawaihae project of approximately 9,625 persons.

COMMERCIAL PROPERTY DEMAND

ASSUMPTIONS:

> The commercial demand estimates are based on several assumptions. The estimates assume that: (1) The population estimates in the M-K Series are accurate; (2) the number of houses and 'typical' family sizes to be built in the Kawaihae project (3,500 homes in ten years) will be accomplished; (3) other regional development will accommodate regional commercial demands; (4) development standards (ie. infrastructure design and implementation) reflect County standards; and (5) commercial development at Kawaihae is timed to meet and anticipate market demands.

Assuming the estimated direct population increase of approximately 9,625 persons, the indicated direct market demand for commercial space includes a community center (an indicated 30,000 square feet of direct demand) and several (possibly 3 to 4) free-standing convenience stores with associated support uses (ie. gas station and offices, each on approximately 3/4 acres of land) over the initial ten (10) year development term.

The location of the initial commercial community center should be near the project perimeter on a major roadway to conveniently accommodate the additional regional demand. If this is the case, a larger (50,000 to 100,000 square feet of leasable space on 20 to 30 acres of land) center could be considered to be developed, serving the immediate and a portion

of the regional demands. It is unlikely to anticipate that there is sufficient local and regional demand for the construction of a large-scale regional shopping center on the site within the initial 10 year term. The location of the convenience stores should be situated in and around the residential development on major roadways and/or at high traffic intersections.

The commercial space demand is not isolated to the retail aspect of commercial space. A segment of the commercial demand is seen in the expansion of the Kawaihae Harbor and the need for maritime and support facilities serving the harbor needs. Commercial office space, situated conveniently near the harbor, is part of this overall commercial demand.

INDUSTRIAL PROPERTY DEMAND

ASSUMPTIONS:

> The Industrial property demand estimates and conclusions are based on several assumptions. These conclusions assume that: (1) the Kawaihae Harbor is developed according to current master plans; (2) industrial development standards at Kawaihae reflect the 'typical' standard (ie. County standard roads, graded lots and infrastructure availability); and (3) the Kawaihae lands are developed to meet and anticipate market demands in a timely manner.

The project's proximity to Kawaihae Harbor enhances the industrial land opportunities. According to representations of the Department of Hawaiian Home Lands, approximately 50 individuals and companies have inquired about the availability of commercial and industrial space at Kawaihae.

A total of approximately 125 acres of industrial use land has been requested by four organizations. In addition, over forty others have made direct requests for land. Among these are requests from local petroleum companies, Hawaii Electric Light Company (HELCO) and Sungshin Cement Industrial Co., a concrete manufacturing company.

An estimate of approximately 250 acres of industrial land, in both light and general industrial uses is the indicated demand that can be satisfied at the Kawaihae site. In addition, a 'reserve' for possible expansion of approximately 50 to 100 acres should be considered.

The estimate of industrial land demand assumes that the land will be developed in a manner similar to other industrial subdivisions and will be available at competitive rates. The recent experience at the Department of Hawaiian Home Lands Kaei Hana II industrial subdivision is not reflective of the 'typical' industrial subdivision.

The estimates assume a developed subdivision with some site improvements on each lot (ie. grading) and sufficient infrastructure to accommodate the indicated vehicular traffic that the subdivision would demand (ie. County standard roads and water systems).

POPULATION SUMMARIES FROM VARIOUS SOURCES

Most analysis considers the State's M-K Series estimates as the primary source of projected population for the region. Community Resources, Inc. slightly modified these estimates and distributed the population estimates over the various districts in the region. Based on these assumptions, the following are the population estimates for the market area:

OFFICIAL STATE POPULATION AND ECONOMIC PROJECTIONS FOR HAWAII COUNTY, 1990-2010 (STATE M-K SERIES)

	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 (STATE M-K SERIES)

(Note: Percentages of wage and salary work force (excluding the self-employed).

	%	%	%	%	%
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/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%

Source: Hawaii State Department of Business and Economic Development, 1988b.

COMMUNITY RESOURCES, INC. (CRI)

Community Resources, Inc. (CRI) has developed some additional projections of future West Hawaii jobs and labor supply, for the years 2005 and 2020. The CRI analysis results in a total projected West Hawaii jobcount of 37,700 for the year 2005 and 45,000 for 2010.

DISTRICT POPULATION BREAKDOWN - COMMUNITY RESOURCES, INC.

	1990	1995	2000	2005	2010
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	56,700	64,800	73,000	82,300	93,800

WEST HAWAII REGIONAL PLAN (OFFICE OF STATE PLANNING)

The Office of State Planning's West Hawaii Regional Plan extends to the year 2005. It projects a year 2005 county wide 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.

WEST HAWAII REGIONAL PLAN (OSP)

(2005)	COUNTY	WEST HAWAII	NO. KONA	SO. KOHALA
Per Plan		79,000		
Maximum Build-out		99,000		

HAWAII COUNTY INFRASTRUCTURE NEEDS ASSESSMENT STUDY

		COUNTY	WEST HAWAII	NO. KONA	SO. KOHALA
(1995)	-A		59,200		
	-B		63,500		
	-C		71,700		
(2005)	-A		84,100	43,200	19,200
	-B		105,500	54,300	24,100
	-C		125,400	64,600	28,600

COUNTY OF HAWAII GENERAL PLAN

Three sets of projections were developed for the Hawaii County's comprehensive review program, series A, B and C.

Series A is the most conservative projection. It assumes the demise of the sugar industry and modest expansion in the visitor industry. The overall 1985-2005 rate of growth for series A of 2.0% per annum is less than the 2.9% rate of growth of employment in the County during the last of the five years.

Series B projections were developed as a medium series. Theses projections lie between series A and C. Sugar employment is maintained and the overall per annum employment growth rate anticipated in Series B is approximately 3.7%.

Series C is an optimistic outlook of the County's future. It is assumed that 17,800 hotel rooms plus additional condominium units will be built in the County by 2005. The average annual growth rate of employment in series C is 4.7%

District Distribution (Hawaii County General Plan)
(Year 2005 Projections)

District	Series A	Series B	Series C
Puna	39,790	49,910	58,340
S. Hilo	44,115	55,335	65,790
N. Hilo	1,211	1,519	1,806
Hamakua	5,363	6,721	7,896
N. Kohala	5,363	6,721	7.896
S. Kohala	19,203	24,087	28,638
N. Kona	43,250	54,250	64,500
S. Kona	10,899	13,671	16,254
Kau	3,806	4,774	5,676

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%
WH 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%

ESTIMATED IMPACTS OF "MAXIMUM BUILD-OUT" SCENARIO ON JOBS, POPULATION, AND HOUSING NEEDS (OSP)

Impact areas	Existing	Proposed	Total
Maximum build-out:	5,790	32,884	38,674
Hotel Units:	3,874	12,842	16,716
Resort residential units:	1,916	20,042	21,958
New Jobs (Countywide):			46,107
County Population:			217,512
Existing County population:		111,800	
Population supported by jobs:		95,440	
Resort Residents:		62,000	

ESTIMATED IMPACTS OF "MAXIMUM BUILD-OUT" SCENARIO ON JOBS, POPULATION, AND HOUSING NEEDS (OSP)

Impact areas	Existing	Proposed	Total
West Hawaii Population:			99,000
Existing West Hawaii Population:		37,000	
Added Population:		62,000	
Housing Needs (Countywide):			32,353

ESTIMATED IMPACTS OF 2005 "PLANNING" SCENARIO ON JOBS, POPULATION, AND HOUSING NEEDS (OSP)

Impact areas	Existing	Proposed	Total
Resort destination Nodes:	5,790	17,850	23,640
Hotel Units:	3,874	7,856	11,730
Resort residential units:	1,916	9,994	11,910
New Jobs (Countywide):			25,869
County Population:			170,472
Existing County population:		111,800	
Population supported by jobs:		53,550	
Resort Residents:		5,122	
West Hawaii Population:			79,000
Existing West Hawaii Population:		37,000	
Added Population:		42,000	
Housing Needs (Countywide):			18,152

KEALAKEHE PLAN (KPMG - PEAT MARWICK)

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 Regional Plan or the County Series A projections, but is otherwise consistent with them.

	COUNTY	WEST HAWAII	NO. KONA	SO. KOHALA
(2005)	217,000	102,000		

PROJECTED WEST HAWAII SOCIAL AND ECONOMIC TRENDS (CRI - KPMG)

	1990	1995	2000	2005	2010
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

	1990	1995	2000	2005	2010
From Visitor Unit Development in Hawaii County (Cumulative) (1)	50	7,470	12,050	16,130	17,080
New Indirect and Induced Jobs from Development in Hawaii County (Cumulative) (2)	20	2,800	4,520	6,050	6,410
Total New Hawaii County Jobs Based on Visitor Unit Development	70	10,270	16,570	22,180	23,490
Persons Per Housing Unit - Hawaii County	2.80	2.80	2.75	2.75	2.75

HOUSING DEMAND/NEEDS SUMMARY - TOTAL NEED

OFFICE OF STATE PLANNING
West Hawaii Regional Plan

	COUNTY	WEST HAWAII	NO. KONA	SO. KOHALA
According to Plan (By 2005)	18,152			
According to 'Maximum Build-out' (By 2005)	32,353			

HAWAII COUNTY
COUNTY INFRASTRUCTURE NEEDS ASSESSMENT

		COUNTY	WEST HAWAII	NO. KONA	SO. KOHALA
	-A		19,800		
(1995)	-B		21,200		
	-C		23,900		
	-A		28,000		
(2005)	-B		35,200		
	-C		42,800		

The document refers to the need for 31,000 new units by 2005.

PROJECTED WEST HAWAII SOCIAL AND ECONOMIC TRENDS (CRI - KPMG)

	1990	1995	2000	2005	2010
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

(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.

QUEEN'S HOSPITAL
Needs Assessment Study

COUNTY	WEST HAWAII	NO. KONA	SO. KOHALA
		4,650	5,350

MING CHEW
Puako Mauka Market Analysis - North & South Kohala

	COUNTY	WEST HAWAII	NO. KONA	SO. KOHALA
1986-1990				820
1991-1995				890
1996-2000				610
Total				2,320

COMMUNITY RESOURCES, INC (W/KPMG PEAT MARWICK)

	COUNTY	WEST HAWAII	NO. KONA	SO. KOHALA
1990		2,330	800	500
1995		6,040	2,920	1,540
2000		11,170	5,800	3,020
2005		17,020	9,130	4,830
2010		25,150	13,680	7,440

HOUSING DEMAND/NEEDS SUMMARY - ANNUAL NEED

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Housing Market Analysis

	COUNTY	WEST HAWAII	NO. KONA	SO. KOHALA
For Sale	800/yr	600/yr		
For Rent	1,000/yr	750/yr		
Total	1,800/yr	1,350/yr		

OFFICE OF STATE PLANNING
West Hawaii Regional Plan

	COUNTY	WEST HAWAII	NO. KONA	SO. KOHALA

According to Plan
1,070/yr

According to 'Maximum Build-out'
1,900/yr

PARKER RANCH 2020 PLAN
Parker Ranch 2020 Plan

	COUNTY	WEST HAWAII	NO. KONA	SO. KOHALA
1990				261/yr
1995				332/yr
2000				231/yr

HAWAII COUNTY
County Infrastructure Needs Assessment

		COUNTY	WEST HAWAII	NO. KONA	SO. KOHALA
	-A		1,165/yr		
(1995)	-B		1,250/yr		
	-C		1,405/yr		
	-A		1,650/yr		
(2005)	-B		2,070/yr		
	-C		2,520/yr		

The document refers to need for 31,000 new units by 2005 - this equates to approximately 1,825 units per year for West Hawaii.

QUEEN'S HOSPITAL
Needs Assessment Study

	COUNTY	WEST HAWAII	NO. KONA	SO. KOHALA
Queens Med (2005)			233/yr	270/yr

KPMG - PEAT MARWICK
Kealakehe Plan - Market Analysis

	COUNTY	WEST HAWAII	NO. KONA	SO. KOHALA
Low Income		300/yr	(rental)	
Moderate Income		200/yr	(<$100,000)	
Gap Group		100/yr	(<$125,000)	
Market		400/yr	(<$190,000)	
Total		1,000/yr		

MING CHEW
Puako Mauka Market Analysis - North & South Kohala

	COUNTY	WEST HAWAII	NO. KONA	SO. KOHALA
1986-1990				164/yr
1991-1995				178/yr
1996-2000				122/yr
Total				155/yr

HALLSTROM APPRAISAL GROUP
Signal Puako - Market Analysis

	COUNTY	WEST HAWAII	NO. KONA	SO. KOHALA
1990				1,697/yr
1995				1,452/yr
2000				612/yr
2005				451/yr
2010				509/yr

COMMERCIAL PROPERTY DEMAND

There are three basic types of Shopping Centers (Hawaii County General Plan):

1) Neighborhood Centers

Provide: Convenience goods, e.g., foods, drugs, and personal services.
Major Shops: Supermarket and/or drug store.
Number of Shops: 5 to 15
Acreage: 5 to 10 acres.
Approximate Size: 50,000 square feet
Approximate Market: 3,000 people.

2) Community Centers

Provide: Convenience goods, plus "soft line" items, such as clothing, and "hard line" items, such as hardware and small appliances.
Major Shops: Variety or junior department store.
Number of Shops: 20 to 40.
Acreage: 10 to 30.
Approximate Size: 50,000 SF to 150,000 SF
Approximate Market: 15,000 people.

3) Regional Centers

Provide: Full range of merchandise and services.
Major Shops: Full size department store.
Number of Shops: 40.
Approximate Size: 400,000 square feet
Approximate Market: 50,000 people

COMMERCIAL DEMAND SUMMARIES

KEALAKEHE MASTER PLAN
Kealakehe Plan - Market Analysis Commercial Space

	Low	High
1995	23,900 SF	32,100 SF
2000	38,400 SF	52,100 SF
2005	55,400 SF	74,600 SF
2010	66,000 SF	88,900 SF

Kealakehe Plan - Market Analysis Office Space

	Low	High
1995	3,100 SF	4,200 SF
2000	5,000 SF	6,800 SF
2005	7,200 SF	9,700 SF
2010	8,600 SF	11,600 SF

PARKER RANCH 2020 PLAN
Parker Ranch 2020 Plan

	Waimea
1990	193,400 SF
1995	311,500 SF
2000	393,500 SF

KPMG - PEAT MARWICK
Puako Mauka - Market Analysis

Assume 25 % of Regional Demand

	Resident Demand	Total Demand
1990	37,000 SF	51,000 SF
1995	73,000 SF	101,000 SF
2000	95,000 SF	136,000 SF

Assume 30 % of Regional Demand

	Resident Demand	Total Demand
1990	45,000 SF	73,000 SF
1995	89,000 SF	144,000 SF
2000	116,000 SF	195,000 SF

HALLSTROM APPRAISAL GROUP
Signal Puako - Market Analysis

Summary calculations for commercial property demand were based on an island average of 88.87 square feet of commercial space per household. Their analysis concludes a latent commercial demand of 20,000 to 35,000 square feet. Project related and regional demands indicate a demand for approximately 257,732 square feet over the initial ten (10) years of their development (encompassing a land area of approximately 17.75 acres), and a similar amount over the balance of the development. This equates to an overall demand of approximately 515,000 square feet of commercial space demand on a total land area of approximately 35 acres over the next 15 to 20 years.

MING CHEW
Department of Hawaiian Home Lands - Kawaihae - Office Demand

	N/S Kona	N/S Kohala
1985-1990	50,000 SF	60,000 SF
1991-1995	60,000 SF	60,000 SF
1996-2000	40,000 SF	70,000 SF
Total	100,000 SF	190,000 SF

COMMERCIAL LANDS VALUES

There is limited market evidence of commercial property land values in the Kawaihae area due to the limited number of fee simple properties and limited sales. A broader search of transactions indicates that commercial property values are in the following ranges:

North Kona	\$ 15.00 to \$ 30.00 per square foot
Waimea	\$ 10.00 to \$ 25.00 per square foot
Waikoloa	\$ 10.00 to \$ 15.00 per square foot
Honokaa	\$ 5.00 to \$ 10.00 per square foot
Hilo	\$ 10.00 to \$ 20.00 per square foot

Based on these ranges, the following are preliminary projections of fee simple land values for preliminary forecasting purposes for the various uses:

Convenience Store	25,000 square feet	\$ 10.00 to \$ 20.00 /SqFt
Neighborhood Center	7.5 acres	\$ 7.50 to \$ 15.00 /SqFt
Community Center	10 to 30 acres	\$ 7.50 to \$ 15.00 /SqFt

SUMMARY LIST OF COMMERCIAL LAND TRANSACTIONS

The following sales offer some degree of similarity to the Kawaihae area. Several areas were considered in this review.

WAIMEA COMMERCIAL CORE

TAX MAP KEY	LAND AREA	SALES PRICE	SALES DATE	$/SF
3/6-5- 3: 2	5.07 Ac	\$2,800,000	08/24/89	\$12.68
3/6-5- 3: 44	2.27 Ac	\$1,000,000	02/09/90	\$10.11
3/6-5- 5: 5	12,999 SF	\$ 159,000	06/27/85	\$12.23
3/6-5- 7: 77	42,636 SF	\$ 635,000	08/15/90	\$14.89

WAIMEA SECONDARY COMMERCIAL CORE

TAX MAP KEY	LAND AREA	SALES PRICE	SALES DATE	$/SF
3/6-4- 6: 2	22,146 SF	\$ 195,000.00	8/22/85	\$ 8.81
3/6-4- 6: 55	20,165 SF	\$ 100,000.00	10/20/87	\$ 4.96
3/6-4- 6: 79	14,218 SF	\$ 96,000.00	7/23/87	\$ 6.75
3/6-4- 6: 80	14,197 SF	\$ 95,000.00	7/23/87	\$ 6.70
3/6-4- 6: 82	43,560 SF	\$ 330,000.00	6/10/87	\$ 7.58
3/6-4- 6: 83	24,959 SF	\$ 105,000.00	5/24/88	\$ 4.21
3/6-4- 6: 84	37,635 SF	\$ 190,000.00	6/06/88	\$ 5.05

WAIKOLOA PROPERTIES

TAX MAP KEY	LAND AREA	SALES PRICE	SALES DATE	$/SF
3/6-8- 3: 23	2.15 Ac	\$1,350,000	03/20/89	\$14.41
3/6-8- 3: 25	3.51 Ac	\$1,875,000	02/15/89	\$12.26

These properties are situated near or at the center of the commercial core of Waimea and in the Waikoloa area. The Waimea commercial core falls within the boundaries boarded by 'Sparky's' to the west and the 'Waimea Center' to the east. The area is developed with commercial retail, office and neighborhood shopping center use.

Kinohou is situate on the 'Honokaa' side of Waimea on the commercial fringe of Waimea. Waikoloa is a master planned community situated between Kailua-Kona and Waimea.

KAILUA-KONA / KEAUHOU PROPERTIES

TAX MAP KEY	LAND AREA	SALES DATE	SALES PRICE	$/SF
3-7-5-004-009	1.96 Ac	05/16/88	\$930,000	\$ 10.89
3-7-5-004-047	12,186 SF	03/17/89	\$220,000	\$ 18.05
3-7-5-004-050	8,870 SF	09/26/88	\$133,000	\$ 15.00
3-7-5-004-051	12,729 SF	10/14/88	\$203,600	\$ 16.00
3-7-5-008-028	15,076 SF	08/12/88	\$270,000	\$ 17.91
3-7-5-019-028	11,625 SF	12/29/88	\$269,000	\$ 23.14
3-7-7-008-102	8,408 SF	11/23/88	\$160,000	\$ 19.03
3-7-8-014-024	6,603 SF	03/00/90	\$290,000	\$ 43.92
3-7-8-014-087	16,983 Ac	08/17/89	\$220,000	\$ 12.95
3-7-8-014-088	16,984 Ac	03/22/89	\$180,000	\$ 10.60

These properties are situated near the commercial core of Kailua-Kona and in the vicinity of Keauhou. They represent sales of property that allow commercial or related development. Some of the properties have a 'resort' zoning, yet are in areas that could be considered for a commercial use.

HILO PROPERTIES

TAX MAP KEY	LAND AREA	SALES DATE	SALES PRICE	$/SF
3/2-3-009-003	2,064 sq ft	04/18/90	$42,500	$20.59
3/2-3-009-016+	3,747 sq ft	02/12/90	$47,500	$12.68
3/2-2-014:053	27,495 sq ft	10/10/86	$250,000	$ 9.09
3/2-2-016:015	8,354 sq ft	05/25/85	$143,000	$17.12
3/2-2-034:038	22,500 sq ft	03/02/87	$130,000	$ 5.79
3/2-4-025:016+	47,849 sq ft	04/15/86	$350,000	$ 7.31

HILO TRANSACTIONS INVOLVING OLDER IMPROVEMENTS

TAX MAP KEY	LAND AREA	SALES DATE	SALES PRICE	$/SF
3-2-2-008-008	6,843 sq ft	02/09/90	$94,000	$13.74
3-2-2-035-024	8,300 sq ft	10/18/90	$168,000	$20.24
3-2-3-011-008	7,274 sq ft	08/13/90	$150,000	$20.70
3-2-3-012-028	8,424 sq ft	05/23/90	$105,000	$12.46
3-2-3-012-029	6,150 sq ft	12/14/90	$86,827	$14.12
3-2-3-012-033	11,567 sq ft	01/22/91	$185,000	$15.99

These properties are situated in the commercial core of Hilo. The first list involves vacant land transactions. The second list involves properties that had improvements that were old at the time of sale and could be considered for demolition.

CONVENIENCE STORE ANALYSIS

Convenience Store Project Summary:

Land Area:	25,000 square feet
Building Size:	5,000 square feet (2-story)
	1,000 square feet (gas station)
Tenant Mix:	Convenience Store (2,500 square feet)
	Gas Station (free-standing - 1,000 SF)
	Office/Retail (up to 5 spaces-2,500 SF)

The market area for this type of development is primarily the immediate resident population in the surrounding community. Secondary markets include a portion of the resort population (visitors travelling through the community) and neighboring communities (either commuting through the area or visiting).

Estimated costs associated with the Convenience Store.

Land: 25,000 SF @ $ 15.00/SF		$ 375,000
Building:		
5,000 SF @ $ 100.00/SF	$ 500,000	
1,000 SF @ $ 75.00/SF	$ 75,000	$ 575,000
Site Work:		$ 25,000
Supervision and Profit: (15% of cost)		$ 150,000
Total Cost:		$1,125,000

NEIGHBORHOOD CENTER ANALYSIS

Neighborhood Center Project Summary:

Land Area:	7.5 acres
Building Size:	50,000 square feet
Tenant Mix:	Food Store anchor (25,000 square feet)
	Office/Retail (10 to 15 - 25,000 SF)

The primary market area for this type of development is the surrounding residential community. Secondary markets include a portion of the resort population (visitors travelling through the community) and neighboring communities (either commuting through the area or visiting).

Estimated costs associated with the Neighborhood Center.

Land: 7.5 acres @ $ 10.00/SF	$ 3,300,000
Building:	
50,000 SF @ $ 100.00/SF	$ 5,000,000
Site Work:	$ 100,000
Supervision and Profit: (15% of cost)	$ 1,260,000
Total Cost:	$ 9,660,000

COMMUNITY CENTER ANALYSIS

Community Center Project Summary
- Number of Shops: 20 to 40.
- Land Area: 10 to 30 acres
- Approximate Size: 50,000 SF to 150,000 SF
- Approximate Market: 15,000 people.

In my opinion, it is reasonable to plan for the neighborhood center to expand to a community center level. This expansion would be based on population growth in the immediate and surrounding areas, as well as the expansion of the Harbor facilities and the need for maritime relate commercial and support facilities.

Depending on the timing of the harbor facilities expansion, the related commercial needs could be in the 20,000 square foot to 30,000 square foot level in related professional and support office space.

REGIONAL SHOPPING CENTER ANALYSIS

- Number of Shops: 40+
- Approximate Size: 400,000 square feet
- Approximate Market: 50,000 people

Several factors limit the immediate development, and long term planning, for a regional shopping center at Kawaihae. The immediate limiting factor is population (both actual numbers and distribution.)

As noted, a regional center requires approximately 50,000 in surrounding population in order to justify its development. M-K Series estimates do not indicate this level of population in the foreseeable future in the Kawaihae area.

There are several sites in North Kona under consideration for expansion to a regional center capacity. The regional population is centralized in this area and it is likely that Kona's commercial expansion will satisfy the foreseeable regional needs.

INDUSTRIAL PROPERTY DEMAND

There are two distinct types of industrial development. One sector is service-oriented and is affected by population and the level of activity of other business activities. The other sector, basic industries, is mostly influenced by outside markets.

The following is a summary of the proposed breakdown of industrial zoned land for the County of Hawaii as illustrated in the Draft of the Hawaii County General Plan.

District	Industrial Acreage
Puna	3,380
South Hilo	6,259
North Hilo	98
Hamakua	437
North Kohala	661
South Kohala	2,034
North Kona	5,068
South Kona	768
Kau	525
Total	19,230

INDUSTRIAL DEMAND SUMMARIES

HALLSTROM APPRAISAL GROUP
Signal Puako - Market Analysis

Summary calculations for industrial property demand were based on an island average of 1 acre of industrial land for every 77.61 residences. Their analysis concludes an industrial property demand of approximately 50 acres.

MING CHEW
Department of Hawaiian Home Lands - Kawaihae

Summary calculations for industrial property demand were based on an indicated average of 8 acres of industrial land for every 1,000 people. Their analysis concludes an industrial property demand of approximately 107 acres in North/South Kona and 137 acres for North/South Kohala.

	N/S Kona	N/S Kohala
1985-1990	32 Ac	
1991-1995	37 Ac	
1996-2000	38 Ac	
Total	107 Ac	137 Ac

Summary calculations for industrial property demand conclude an industrial property demand of approximately 40 to 60 acres.

INDUSTRIAL LAND VALUES

There are no fee simple industrial properties in Kawaihae. Currently, the Kaei Hana II industrial subdivision is the only related use in the area. A broader search of transactions indicates that industrial property values are in the following ranges:

Kawaihae	\$ 2.50 to \$ 3.50 per square foot
North Kona	\$ 10.00 per square foot
Hilo	\$ 4.00 to \$ 7.50 per square foot

Note: The Kawaihae estimates are based on lease rent negotiations. As indicated previously, the Kaei Hana II subdivision is sub-standard compared to other industrial subdivisions. It is assumed that the 'new' developments at Kawaihae will be similar to the market place with County standard roads, utilities and graded sites.

Based on these ranges, the following are preliminary projections of developed fee simple land values for preliminary forecasting purposes for the various uses:

1/2 acre sites	\$ 7.50 to \$ 10.00 per square foot
1 acre sites	\$ 5.00 to \$ 7.50 per square foot
5 acre sites	\$ 2.00 to \$ 5.00 per square foot

SUMMARY OF INDUSTRIAL PROPERTY TRANSACTIONS

The industrial development in West Hawaii is concentrated in three primary areas. These areas are situated in Kawaihae, Kaloko Properties and the Liliuokalani Trust Industrial subdivision. The most recent of these developments is the Kaloko Properties development situated on the Queen Kaahumanu Highway between the Keahole Airport and Kailua.

KALOKO LIGHT INDUSTRIAL TAX MAP KEY	LAND AREA	SALES DATE	SALES PRICE	\$/SF
3-7-3-051-026	1.00 acre	05/05/89 DEED	\$370,000	\$ 8.49
3-7-3-051-029	1.00 acre	07/20/89 DEED	\$349,000	\$ 8.01
3-7-3-051-031	1.00 acre	03/20/90 DEED	\$425,000	\$ 9.76
3-7-3-051-036	1.05 acre	06/19/89 DEED	\$370,000	\$ 8.09
3-7-3-051-037	1.00 acre	07/20/89 DEED	\$376,000	\$ 8.63
3-7-3-051-044	1.00 acre	03/07/90 DEED	\$450,000	\$10.33
3-7-3-051-047	1.00 acre	12/15/89 DEED	\$365,000	\$ 8.38

INDUSTRIAL SUBDIVISION ANALYSIS CONSIDERING KALOKO PROPERTIES AS MODEL

The industrial development in West Hawaii is concentrated in three primary areas. These areas are situated in Kawaihae, Kaloko Properties and the Liliuokalani Trust Industrial subdivision. The most recent of these developments is the Kaloko Properties development situated on the Queen Kaahumanu Highway between the Keahole Airport and Kailua.

Below is a summary of estimates that reflect the development expense to build a 50-lot industrial subdivision following the patterns of the Kaloko Properties development (presumed one-acre subdivided lot size). The total proposed project area is approximately sixty acres, allowing for roads, etc. As indicated previously, the sales activity of the Kaloko Properties development was analyzed.

Other costs incurred in the development include land, marketing, interest, supervision and profit. Below is a summary of the revenue and expenses estimated for a fifty (50) lot industrial subdivision.

Development Expenses:	
Site Improvements (\$ 100,000/lot)	\$ 5,000,000
Marketing (10% of Gross Revenue)	\$ 1,250,000
Development Supervision	\$ 125,000
Interest	\$ 500,000
Contingency	\$ 500,000
Land (60 +/- acres @ \$ 2.50/SF)	\$ 6,534,000
Total Development Costs	\$13,909,000

LAND CAPITALIZATION RATE

The estimated land capitalization rate is derived from the market place. Based on evidence in the market place, through activities and statements of lessors of commercial and industrial land and other income producing property, a land capitalization can be derived.

Previous land capitalization rates used by the Department of Hawaiian Home Lands has been at approximately six to seven percent (6%-7%) of the fee simple value of the property. According to recent Bishop Estate policy, industrial and other lease rents are based on a land capitalization rate of eight percent (8%) of the fee simple vacant value of the property. A similar State of Hawaii, Department of Land and Natural Resources, Division of Land Management, lease was calculated at a seven percent (7%) land capitalization rate. Based on discussions with others, land capitalization rates are on an increasing trend and current rates most approximate the 8% level.

GOLF COURSE ANALYSIS

Consideration has been made at the possibility of planning and developing a golf course at Kawaihae. The following summary of golf course analysis was taken, in part, from the February 1990 publication called "Analyzing the Market, Environmental Impacts, and the Benefit Assessment of the Golf Industry in Hawaii", Hawaii Real Estate Research and Education Center/Hawaii Resort Developers Conference.

Golf courses are closely associated with nearly all major resorts and residential developments in Hawaii, including major housing projects by the State and by the City and County of Honolulu. Among their contributions, a golf course:

- provides recreation and access to the land for 100 to 300 golfers per day;

- provides attractive greenery and vistas, while generally preserving the natural topography, drainage patterns, physical features, historic sites and critical habitats, with the golfers paying for maintaining the greenery;

- can buffer homes or a resort from neighboring activities which may be objectionable, including agricultural operations, airports and highways;

- can provide attractive and cost-effective drainage control which allows rainwater to seep down into the ground to recharge the groundwater supply;

- can be used to dispose of treated wastewater, with any seepage of water being stripped of nutrients and contaminants by the filtering action of the grasses and soil, and with this seepage adding to the groundwater supply;

- can enhance the economic viability of a housing project, with a portion of the funds received from the sale of the 'market-priced' homes - which tend to be the more expensive homes fronting the golf course - being used to subsidize the cost of building the 'affordable' homes and to help finance the cost of roads, sewers, water development, drainage and various other costs of development;

- typically generates over $2.7 million per year in revenues to golf course operators;

- generates from 30 to 80 or more jobs per year, of which 5 to 14 jobs are managerial, professional or technical positions and 15 to 22 jobs are grounds maintenance jobs; and

- enhances the appeal and value of neighboring developments;

Resources required for golf courses include 140 to 230 acres or more of land and from 0.2 million gallons per day (mgd) to over 1 mgd of water. In dry areas brackish water is often used and is sometimes supplemented with treated water. Chemicals are used on golf courses, but pose little risk given spot treatment of specific problems.

GOLF ECONOMIC PRICING MODEL

Paul A. Samuelson has defined the elasticity of demand as a concept to indicate the degree of responsiveness in the quantity demanded to changes in market price. Demand is considered elastic when a cut in price raises quantity so much as to increase total revenue. It is considered unitary when a percentage cut in price results in an exactly compensating percentage rise in quantity so that revenues remain the same. Demand would be considered inelastic is a cut in price results in a drop of total revenues.

This definition is important because it may be advantageous for some courses to keep greens fees high to discourage too much play. Too much play causes damage to the turf and can reduce the pleasure and satisfaction of the game because of long delays due to crowding. Further, some players equate high greens fees with prestige. This may be very important to some of the Japanese players who might be willing to pay a very high price to have played a prestige course.

The following examples illustrate the above:

Case A - High Prices at Resort Courses. Assume a 200 acre course is of sufficient quality it can charge $100 per round, which would give it 35,000 paid rounds a year. If it were to reduce the price to $50, it could attract 60,000 rounds, but its cost of maintenance would jump from $1,698 per acre to $2,367. What is the impact of revenues? (Note: Maintenance numbers based on NGF's "Golf Maintenance Survey," August 1987).

The two cash flow statements would be:

	$100 Green Fee 35,000 rounds	$50 Green Fee 60,000 rounds
Revenues	$3,500,000	$3,000,000
Maintenance	339,600	473,400
Net Cash	$3,160,400	$2,526,600

Case B - High Prices at Daily Fee Course. Because of a lower quality, a daily fee course finds that if it charges $75 per round, it will have 25,000 paid rounds per year. By lowering the price to $40, it can attract 60,000 rounds. (Assume the maintenance costs are the same as the previous example.)

	$75 Green Fee 25,000 rounds	$40 Green Fee 60,000 rounds
Revenues	$1,875,000	$2,400,000
Maintenance	339,600	473,400
Net Cash	$1,535,400	$1,926,600

MAXIMUM FEE AFFORDABILITY ESTIMATE

Interpretation of price/demand statistics for golfers (primarily mainland golfer statistics) indicates that virtually all golfers could pay an average of $10 per round. However, roughly 18 percent of the players could not afford, on average, more than $20 per round. These players are the mainstay of the municipal golf course clientele. Many of these are senior citizens on fixed incomes. Approximately half the players cannot afford more than $35 per round on a regular basis. Regular basis is assumed to be 28 rounds annually as suggested by NGF data.

Approximately nine percent of the players can afford to pay more than $75 per round regularly. Locally, these are the players who are members of private clubs. Of the visitors, these are the players who stay at Hawaii's resort hotels. It might be noted that similar demographics exist on the Japanese playing market, except of nine percent in the beyond $75 per round category, it appears 14.4 percent of the Japanese market would qualify.

Without more precise data, the study cannot report these assumptions as a result having statistical significance. The basic implication of the analysis is that most of the new courses should not have green and cart fees higher, on average, than $60 to $75.

It might be noted that the $75 green and cart fee recommendation derived from the analysis of the demand function is consistent with the maximum fee affordability estimate.

Annual revenues generated by a golf course vary over a wide range, depending upon the type of golf course, green and cart fees, discounts to residents and/or visitors who are staying at a given resort, the number of rounds per year, the size of the pro shop and whether or not the clubhouse has a restaurant and bar and, if it does, its quality and hours. Green and cart fees range from $20 per round to over $100. Assuming a conservative average of 150 players per day spending an average of $50 per person on green and cart fees, equipment, clothing, food and beverages, etc., then the revenues would amount to about $2.7 million per year.

By the year 2000 there will be a need for approximately 14 courses in addition to the existing courses plus those required to satisfy pent-up demand. The report does not indicate on which islands these additional courses will be needed. Future demand for golf courses in the year 2000 is summarized according to the following segments (State):

- Local population	3.38 courses
- Population of people aged 60 years +	3.43 courses
- Visitor Counts (Except for Japanese)	0.15 courses
- Japanese Visitor Counts	7.25 courses
	14.21 courses

The pent-up demand on the Big Island of Hawaii is 4 courses and the distribution of the probable need is:

a. 1 municipal course
b. 0-1 daily fee course
c. up to 4 resort courses

Proposed Golf Course Facilities

The following are proposed golf course facilities in Hawaii County:

Kohala Ranch	Mauna Kea 2nd 18 holes
Signal Puako	Mauna Lani 2nd 18 holes
Waikoloa	Royal Vista
Kohanaiki	O'oma Resort
Kaupulehu	TSA
Kukio	Kealakehe Municipal
Hawaiian Riviera	South Kohala REsort

Upon full development, the property assessment on a golf course is about $16 million. This is based on current property assessments for golf courses of $625,000 per hole (the current criterion on Oahu), plus $5 million for the clubhouse and other improvements such as maintenance area, parking roads, water systems, sewers, drainage, etc.

Hawaii County property assessment for golf courses is currently $40,000 per acre. This is based on the sale of the Kona Country Club. Based on my review of the transaction, the completely developed golf course was sold for $ 10,000,000.00 in July 1986. The price included approximately $ 2,500,000.00 worth of personal property. The indicated selling price for

the 27 hole developed course was $ 7,500,000.00. The property has a land area of 347.345 acres. This is the only known recent sale of a golf course in Hawaii County.

According to a recent planning action, Nansay is proposing a new golf course on its lands at Ouli on the Waimea-Kawaihae Road. Covering approximately 200 acres, the course will be an 18 hole, privately-owned course. Apparently golf 'memberships' will be sold and local play will be allowed. Construction estimates put the cost of construction in the $20 to $30 million range. (This figure is close to the estimated cost of $16 to $20 million for a course recently completed at Waikoloa.)

SUMMARY OF DEVELOPMENT AGREEMENT CONSIDERATIONS

The following is a summary of several of the provisions in the Queen Emma Foundation Development Agreement with Mauna Kea Properties. The development agreement is currently in effect and covers approximately 10,000 acres of land adjoining the Kawaihae project.

This summary gives the reader a overview of many of the types of opportunities available in development agreements. The Queen's Hospital/Mauna Kea agreement is an excellent comparison as it deals with land similar to the Kawaihae lands and involves a similar land area.

Like the subject, the land covered under the Development Agreement is in and around Kawaihae. Though the DHHL Kawaihae lands do not have ocean frontage and probable resort use, many of the uses called for in the Development Agreement are similar to the Hawaiian Home Lands property (ie. residential, commercial, industrial and golf course).

The Development Agreement is under the control of Mauna Kea Properties, Inc.. Several years ago there was an attempt to market (sell) the rights under the agreement. The marketed price was approximately $5 million. Apparently Mauna Kea Properties has since changed its mind about marketing the Development Agreement and is discussing the development of the Foundation lands.

The review here gives the reader an overview of many of the provisions of the Development Agreement (ie. term, cost recovery, rental amounts, development schemes and other generalized information). This summary is not a complete review of all of the terms; it merely highlights many of the salient points that may be considered in the Discussion of a possible development agreement for the Hawaiian Homes Lands at Kawaihae.

QUEEN EMMA FOUNDATION/MAUNA KEA PROPERTIES DEVELOPMENT AGREEMENT SUMMARY

Date of Agreement: September 3, 1981 (renewed in 1984)

Landowner: Queen Emma Foundation

Developer: Mauna Kea Properties

Background:

The original Development Agreement covering this land was executed on December 10, 1964 between Queen's Hospital, owner of the land, and Olohana Corporation, a development company

controlled by Laurence Rockefeller. The original agreement was amended at various times. Mauna Kea Properties, Inc., at the time a wholly owned subsidiary of UAL, Inc., subsequently acquired the interest of Olohana Corporation in the Queen's Development Agreement. The Second Amendment of Development Agreement dated September 3, 1981 is now the controlling document covering these lands.

Lands Covered Under Option:

The Development Agreement covers about 944 acres of land including the 371 acres with resort potential situated along the ocean front and located directly northerly of the Mauna Kea Resort.

The Development Agreement also gives Mauna Kea Properties, Inc. the option to develop an additional area of approximately 1,015 acres. These mauka-oriented lands are situated on the southerly and northerly side of the Kawaihae Road.

The Development Agreement also provides that if Queen's decides to negotiate for the development of any part of its mauka lands containing 8,366 acres presently subject to a lease to Richard Smart expiring in 1993, then Queen's must give Mauna Kea Properties, Inc. the first opportunity to negotiate for such development.

A summary of the lands under option is shown below:

Item	Land Area (acres)
Premises	944
Option Lands	1,015
Additional Premises	8,366
Total	10,325

Term of Agreement:

The original term of the Agreement was from December 10, 1964 to December 10, 1984. By the Renewal of Second Amendment of Development Agreement dated April 6, 1984, the term of the Development Agreement has been extended from December 10, 1984 to December 10, 1994. Under the terms of the Development Agreement, the term can be extended to December 10, 2004.

Renewal Options:

Developer shall have the right, at its option, to extend the term of the Agreement for two successive periods of ten years each (One extension has been exercised.); provided, however, that the Agreement shall then be in full force and effect and developer shall have made reasonable efforts to implement the development scheme as and when economically feasible for developer to do so, giving due consideration to all its other commitments and economic conditions of the times.

Development Scheme:

A proposed general development scheme of land uses for the subject property was prepared by the developer. The developer may request amendments in said development scheme from time to time by submitting written requests therefor to Foundation. The developer will make reasonable efforts to implement such development scheme, as amended, from time to time, as and when economically feasible for developer to do so. According to the Agreement, the Foundation agrees that its approval of the development scheme will not be withheld if such development scheme is reasonable with respect to the development of the premises and such adjacent property considered as a whole.

Payment of Expenses:

Developer will pay or cause to be paid (i) all charges, costs and expenses whatsoever for labor, materials, equipment and services of every nature directly or indirectly used for or in connection with the implementation of the development scheme and (ii) all costs of the preparation of leases to be issued by Foundation, including legal fees, surveying, descriptions and printing costs. Developer will also pay all real estate taxes and assessments on the premises, general or special. Developer shall have the right to contest any such tax or assessment and shall not be deemed in default the time it is contesting the same in good faith with due diligence.

Performance Schedule:

Developer agrees to implement or cause to be implemented the development scheme, as revised from time to time, when economically feasible for developer to do so; provided, however, if the Development Agreement has been extended to December 10, 1994, developer shall not be subject to any time table for completion of the development scheme.

Parcel Development Charge:

Developer may charge and collect from the lessee of any parcel of the premises a parcel development charge (the "development charge"). Each such development charge shall include a proportionate share of the following costs and expenses: (i) direct costs of improvements, (ii) direct expenses of developer, (iii) general and administrative expenses of developer and (iv) development costs of developer, together

with a reasonable profit to developer on such costs and expenses.

No part of any premium charged to any lessee shall be included as part of the development charge. Each development charge shall be set by the developer and agreed to by the Foundation and in the absence of agreement by arbitration. Developer shall have the right to require a development charge to be payable in full at the time of the execution of the leases or to prorate such development charge, with interest, over any period up to and including the first 25-year period of the term of such lease. All development charges and proceeds of the sale of buildings constructed on the premises shall be payable to an be the property of the developer, and Foundation shall have no rights whatsoever thereto.

Development Leases:

From time to time prior to development, subdivision and improvement of specific tracts of the premises, developer and Foundation will enter into leases of specific tracts of the premises selected by the developer for the purposes of development thereof in accordance with plans, specifications and program for such tract approved by Foundation. Developer will agree in such leases to complete or cause to be completed the development and subdivision of the specific tracts of the premises subject to such leases, the construction of homes and other suitable buildings on the parcels thereof, the sale and lease of such buildings to qualified persons and arrangements for leasing the parcels to such persons in accordance with the plans, specifications and program for such tract approved by Foundation, except for those parcels of such tract which in the opinion of developer cannot be feasibly and economically developed and subdivided.

The respective terms of said leases shall be for such period as would enable developer to mortgage its interest in said leases with institutional leasehold mortgagees; provided, however, that such term shall not exceed fifty-five (55) years. Each such lease shall yield to Foundation a rental of $1.00 per year and shall contain such terms and conditions which will enable developer to mortgage its interest in said leases with institutional leasehold mortgagees.

Each said development lease shall provide a schedule containing the lease rentals and provisions thereof covering the entire term of each lease of each subdivided parcel to be leased. The rentals under each such parcel lease for the first thirty (30) years of such lease shall be as mutually agreed upon by the Foundation and developer. In the absence of agreement, the annual rent for the first ten (10) years thereof shall be established by arbitration, valued as if it were unimproved;

the annual rent for the second ten (10) years thereof shall be 150% of the annual rent during the first ten (10) years and the annual rent for the third ten (10) years thereof shall be 150% of the annual rent during the second ten (10) years thereof.

Each such lease shall provide for reopening of the rent at the expiration of the thirtieth year and at the expiration of each fifteen (15) years thereafter. In each case, the annual rent for the ensuing fifteen (15) years shall be such sum as is mutually agreed upon, and in the absence of agreement, as is established by arbitration, valued as it were unimproved.

In valuing such parcel as unimproved, the existence of all onsite improvements and offsite improvements shall be excluded. "Onsite improvements" mean all physical improvements which are located on the parcel demised by the lease or on the parcel in which the interest is demised by the lease, such as (but not limited to) buildings, walkways, driveways, walls, trees, shrubs, landscaping and pools; "offsite improvements" mean all physical improvements which are located elsewhere than on the parcel demised by the lease or on the parcel in which the interest is demised by the lease and which are to be used in common by occupants of all lands for which benefit such improvements have been constructed, such as (but not limited to) roads, sewer lines, sewage treatment plants and underground utility lines.

Residential and Apartment Leases:

From time to time prior to or upon completion of development, subdivision and improvement of tracts for construction of buildings for residential and apartment uses, developer will submit to Foundation the names of prospective lessees for parcels within said tracts and, upon approval thereof by Foundation, Foundation will enter into a 55-year lease with each such prospective lessee. Each such lease shall contain such terms and conditions as shall enable the prospective lessee to mortgage its interest in such lease with institutional leasehold mortgages.

Simultaneously with the execution of the new lease, developer shall surrender to Foundation that portion of the premises which is to be demised pursuant to such new lease. In each such case, developer shall have the right to require the payment by lessee of the development charge for such parcel and shall have the right to require the payment by lessee of such charge or charges as developer shall deem appropriate (without the necessity of any approval therefor by Foundation) for the sales price of buildings on such parcel and for a premium for designating lessee as the person to whom the lease is to be issued.

Each such lease shall provide that, for the first twenty-five (25) years thereof, Foundation shall collect all rents received under said lease and ,after deducting the Hawaii general excise tax and any unusual expenses of collection incurred by Foundation, and after deducting and reimbursing to developer any unusual expenses reasonably incurred by developer in the maintenance or servicing of facilities and improvements on the premises not otherwise reimbursed to developer, will pay to developer fifty percent (50%) of such rentals.

The amount of such unusual expenses to be reimbursed to developer shall be only such amount agreed to, in its sole discretion, by Foundation; provided, however, that the absence of such agreement shall not be subject to arbitration.

Industrial, Hotel and Commercial Leases:

From time to time prior to or upon completion of development, subdivision and improvements of tracts for construction of buildings for industrial, hotel and commercial uses, developer will submit to Foundation the names of prospective lessees for parcels within said tracts and, upon approval thereof by Foundation, Foundation will enter into a seventy-five (75) year lease with each such prospective lessee. Said lease shall contain such terms and conditions which will enable developer to mortgage its interest in said leases with institutional leasehold mortgagees.

Simultaneously with the execution of the new lease, developer shall surrender to Foundation that portion of the premises which is to be demised pursuant to such new lease. In each such case, developer shall have the right to require the payment by lessee of the development charge for such parcel and shall have the right to require the payment by lessee of such charge or charges as developer shall deem appropriate (without the necessity of any approval therefor by Foundation) for the sales price of buildings on such parcel and for a premium for designating lessee as the person to whom the lease is to be issued.

Each such lease shall provide that, for the first twenty-five (25) years thereof, Foundation shall collect all rents received under said lease and ,after deducting the Hawaii general excise tax and any unusual expenses of collection incurred by Foundation, and after deducting and reimbursing to developer any unusual expenses reasonably incurred by developer in the maintenance or servicing of facilities and improvements on the premises not otherwise reimbursed to developer, will pay to developer fifty percent (50%) of such rentals.

The amount of such unusual expenses to be reimbursed to developer shall be only such amount agreed to, in its sole discretion, by Foundation; provided, however, that the absence of such agreement shall not be subject to arbitration.

Parcel Leases to Developer or its Nominee:

Developer shall have the right, at its option, to cause Foundation to issue a lease on a portion or portions of the premises to developer or its nominees on the same terms and conditions as set forth in said paragraphs except that (i) the rental, all of which shall be retained by the Foundation as its sole property, shall for the first twenty-five (25) years of said term, be fifty percent (50%) of the rent provided for; and (ii) such leases shall provide that developer or its nominees shall have the absolute right to sublease all or any part of the premises demised by said lease.

Golf Course Lease:

A separate master lease shall be entered into by Foundation and developer or developer's designee covering a portion of the premises selected by developer upon which any golf course (or courses) is to be constructed in accordance with the approved development scheme. Such portion of the premises shall be used solely for the purposes of a golf course and the related facilities provided for in said lease. The lessee shall pay to the Foundation as rent the following percentages of the sales prices for which the following items are sold on the premises demised by said lease:

Beverage Sales	3%
Food Sales	1%
Pro Shop Merchandise Sales	5%
All Other Sales and Income	nothing

Any such lease shall be for a term of seventy-five (75) years. The lessee shall pay any and all expenses in connection with the construction and operation of the golf course.

Provisions Regarding Condominiums:

The Development Agreement provides that the Foundation will from time to time, upon request in writing by developer, join with developer in submitting such portions of the premises as shall be specified by developer to a Horizontal (Condominium) Property Regime in accordance with such Declarations and Bylaws as shall be specified by developer and approved by Foundation, which approval shall not be unreasonably withheld. The Agreement allows Condominium Conveyance Documents and Planned Unit Developments.

Option Rent:

Mauna Kea Properties, Inc. is required to pay $2.50 per annum for each acre of Option Land for which its development option is exercised. The $2.50 per acre is payable until a development lease for that portion of Option Land is executed. On February 16, 1971, this option was exercised for 500 acres of the Option Lands. Of this 500 acres, about 46.8 acres have been leased to other parties and 453.2 acres remain subject to the rental payment. Mauna Kea Properties, Inc. is thus required to pay the rent for the 453.2 acres at the rate of $2.50 per acre per annum, payable semi-annually in advance on January 1 and July 1 of each year.

APPENDIX H

TRAFFIC IMPACT STUDY
By Wilbur Smith Associates

KAWAIHAE MASTER PLAN

TRAFFIC IMPACT STUDY

Prepared for

R.M. Towill Corporation

by

Wilbur Smith Associates

November 4, 1991

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TABULATIONS

ILLUSTRATIONS

1. INTRODUCTION

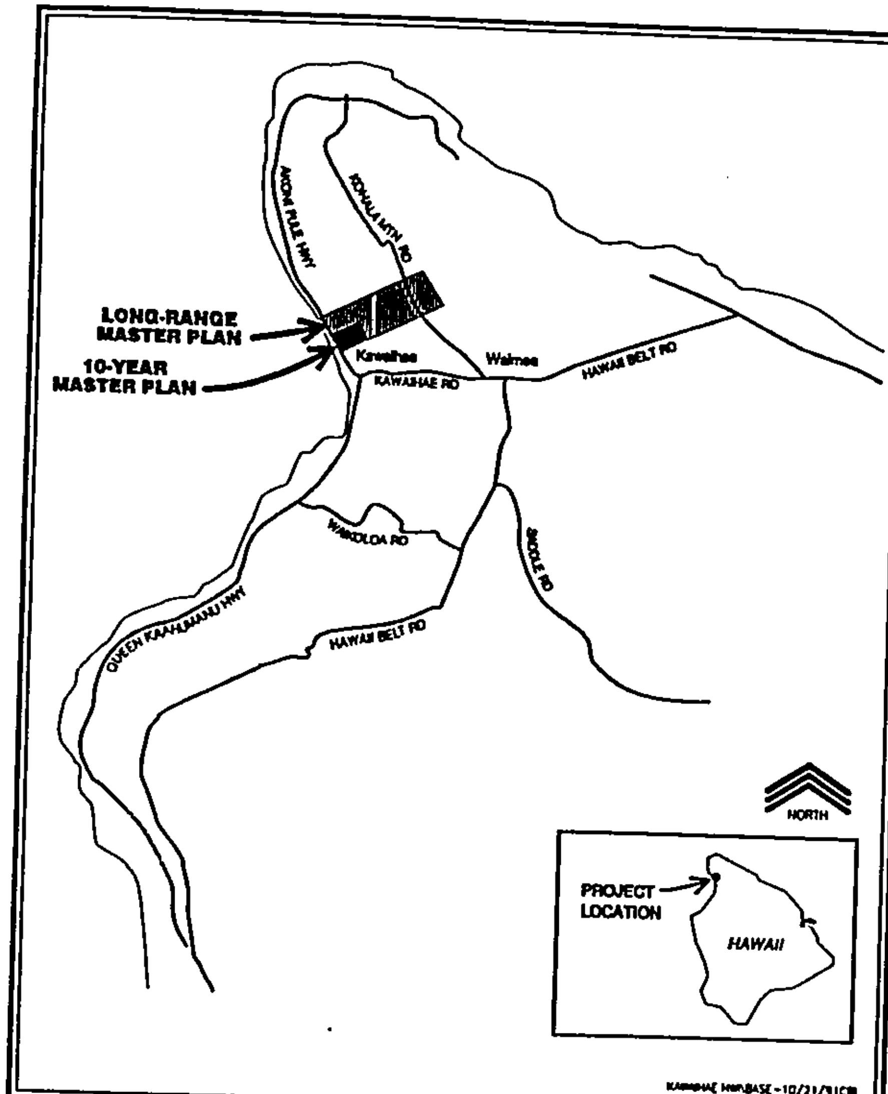
The Kawaihae Long Range Master Plan addresses the development of a new master-planned community on the southwestern slopes of the Kohala Mountains on the island of Hawaii. The Long Range Master Plan covers the more than 10,000 acres of land in this area that are currently administered by the State Department of Hawaiian Home Lands.

The Long Range Master Plan envisions a broad range of land uses. The primary focus is to develop residential uses. The Plan also includes amenities to service the residential community, which will include a major town center, neighborhood commercial centers, schools, parks, cultural centers, and open space. Additional uses will be developed to provide income to support the overall development program. These uses include a regional commercial/business center, industrial areas, a golf course, and a Hawaiian cultural resort.

Initial development will occur on 2,200 acres in the southwest corner of the Long Range Master Plan area. A more detailed Ten-Year Master Plan has been developed for this area, with this area expected to be largely developed between the years 1993 and 2003. The Ten-Year Master Plan area will include most of the commercial land uses and the higher density residential areas. The location of the Ten-Year and Long Range Master Plan areas are depicted in Figure 1.

The traffic study focuses on the travel needs and traffic impacts with development of the Ten Year Master Plan area. An initial assessment of the number of trips generated by the Long Range Master Plan is presented herein. No analysis is made of the traffic impacts of the Long Range Master Plan since its time horizon is unknown, and would extend well beyond the Year 2010 for which travel information is available for areas outside the Master Plan area. The key elements contained in this report are:

- Existing traffic conditions in the project vicinity.
- Forecast future traffic volumes on area roadways for the year 2003 without the development of the Ten-Year Master Plan project.
- Trip generation estimates for the numbers of weekday and peak hour vehicle trips by the planned development within the 2,200 acre Ten-Year Master Plan area.
- Assignment of the traffic generated by the Master Plan developments to the planned roadway system.
- Assessment of the adequacy of the planned roadway system to accommodate the traffic with the full development of the Ten-Year Master Plan area. This would include the following:
  - Adequacy of the internal circulation system to accommodate future volumes.



SITE MAP

Kawaihae Development Traffic Impact Study

1

- Accessibility to the regional roadway systems.
- Traffic impacts on adjacent major roadways including Akoni Pule Highway, Kawaihae Road, Queen Kaahumanu Highway and the planned Kawaihae Road-Waimea Bypass (based on alignments and descriptions of planned roadways available from State DOT.)

o Identification of locations where mitigative measures may be appropriate to minimize project impacts. These may include:

- Additional lanes;
- Reconfiguration of the roadway network, such as additional access;
- Access controls; and,
- Intersection improvements, such as turn lanes, signals, grade separations, etc.

o Estimate of number and general distribution of vehicle trips with full development of the entire 10,000 acre Long-Range Master Plan.

o Adequacy of the internal circulation system to accommodate future traffic generated by the Long-Range Master Plan. Recommendations to improve the roadway system are included.

2. EXISTING CONDITIONS

The Master Plan area extends mauka from the present Kawaihae community. Existing residential and commercial areas are located along the Kawaihae Road and Akoni Pule Highway, which form the makai boundary of the Master Plan area. Kawaihae Harbor and related industrial uses are located makai of Kawaihae Road opposite of the Ten-Year Master Plan area.

The area is presently served by a system of rural two-lane highways. The low level of development within the South and North Kohala areas result in comparatively light to moderate traffic volumes on most of the roadways. The harbor does contribute significant levels of truck activity.

Roadway System

At present, Kawaihae Road and Akoni Pule Highway provide access to the developments at the makai edge of the Master Plan area, while the Kohala Mountain Road traverses the mauka portions of the Long Range Master Plan area. Queen Kaahumanu Highway connects this area to Kona. All are State highways and are typical of rural two-lane arterials.

(a) Kawaihae Road runs between Waimea and Kawaihae in the east-west direction. This two-way two-lane minor arterial has a 22-foot pavement width and intersects with the south end of Akoni Pule Highway, the north end of Queen Kaahumanu Highway, south end of Kohala Mountain Road, and Mamalahoa Highway. The capacity of Kawaihae Road has been estimated at 2,140 vehicles per hour[1] (vph) total for both directions. Kawaihae Road has a posted speed limit of generally 45 mph.

(b) Akoni Pule Highway is a two-lane two-way arterial which runs from Kawaihae to Hawi in the north. It has 12 foot lanes and full shoulders giving it an estimated capacity of 2,430[2] vph total for both directions.

(c) Kohala Mountain Road is a two-way two-lane arterial between Waimea and Kawaihae. The Kohala Mountain Road has an 18-foot pavement width and an estimated capacity of 1,000[3] vph total for both directions. The low capacity is due to adverse conditions by way of the road running through a mountainous area with narrow bridges, narrow shoulders and frequent curves. The road has not been considered a high accident facility by the State DOT as most of the accidents were of one vehicle non-collision type.

1 As reported in the *Traffic Assessment Report for the Kohala Ranch Project IV* by Traffic Management Consultant October 3, 1990.

2 Ibid.

3 Ibid.

(d) Queen Kaahumanu Highway is a two-lane two-way major arterial between Kawaihae and Kona providing access to major resorts. The posted speed limit is generally 55 mph along most sections of the road.

Existing Traffic Volumes

Existing weekday peak hour traffic volumes were derived from a number of sources, namely: 24-Hour counts from the State DOT ranging from May to October 1990, the TMC report (October 3, 1990) and turning moved counts conducted at the Kawaihae Road/Queen Kaahumanu Highway intersection on May 25, 1991. Based on these counts, the volumes were adjusted to reflect existing conditions incorporating the effect of growth and seasonal variation.

Existing peak hour volumes in the vicinity of the Master Plan area are depicted in Figure 2. Present volume levels are relatively low with peak hour volumes typically ranging between 200 to 500 vehicles in each travel direction on the major roadways in the area.

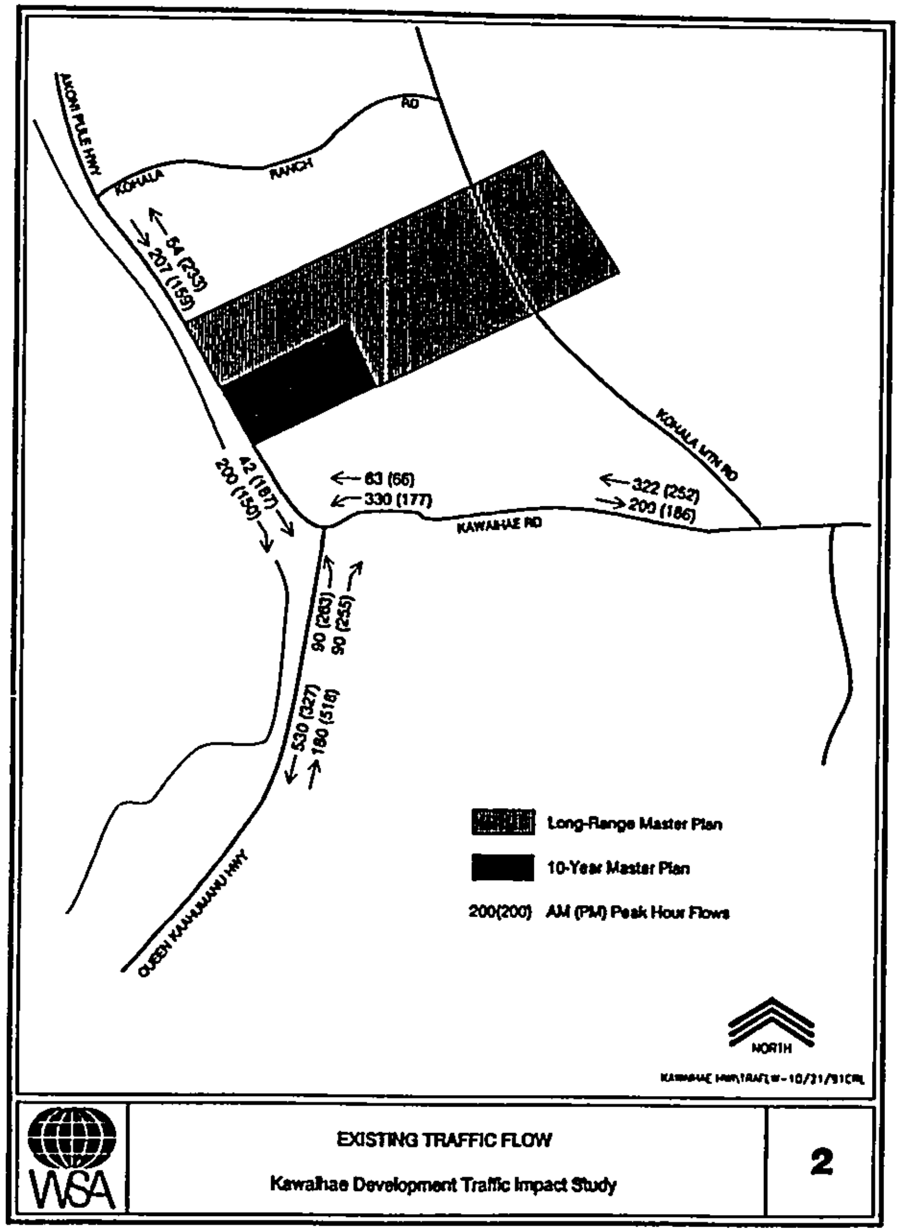
Methodology for Analyzing Levels-of-Service

The Transportation Research Board (TRB), a division of the National Science Foundation, has developed standardized methods for use in evaluating the effectiveness and quality of service for roadways and streets. Different methodologies are available for analyzing rural highway segments, STOP sign-controlled intersections, and traffic signal-controlled intersections, each of which was used in evaluating present or future conditions within the Kawaihae area.

The TRB evaluation methods use a concept known as level-of-service (LOS). This concept describes facility operations on a letter basis from A to F, which signify excellent to unacceptable conditions, respectively. The methods generally compare traffic volumes on a facility to the facility's theoretical capacity. Capacity is estimated based on the facility's physical characteristics (e.g. number of lanes), traffic conditions (e.g. types of vehicles), and type of traffic controls. The comparisons are frequently referred to as the Volume-to-Capacity (V/C) ratio. The methodologies are described in the *Highway Capacity Manual*.[4]

Rural Highway Sections - The level-of-service criteria for two-lane rural highways, in sections without interruption due to STOP sign or traffic signal controls, are defined primarily in terms of percent time delay behind slower vehicles, with speed and capacity utilization as secondary measures. Level-of-service for two-lane, two-way highways is describes as follows:

4 *Highway Capacity Manual, Special Report 209*, Transportation Research Board, 1985.



LOS	PTD	RPH	Description
A	30	420	Free flow.
B	45	750	Platoons begin to form.
C	60	1,200	Traffic flow stable, but long platoons begin to form
D	75	1,800	Traffic flow stable but platoons begin to combine into longer chains of vehicles and control speeds
E	75*	2,800	Platooning intense and speeds become significantly slower
F	--	--	Heavily congested with volumes exceeding capacity

LOS = Level-of-Service.
PTD = Percent of time delay. Percent of time, on average, that vehicle speed is controlled by slower moving vehicles.
RPH = Service Flow Rate per hour. Both directions.
* = More than 75.

This was used primarily to evaluate existing conditions along Kawaihae Road, Akoni Pule Highway and Kohala Mountain Road.

Unsignalized Intersections - This standard procedure provides a comparative measure of delay at STOP sign-controlled intersections for those movements which must yield to the conflicting movements at the intersection. These include:

- Left-turn out of the side street;
- Right-turn out of the side street; and
- Left-turn into the side street.

The general indicator of intersection delay is determined by calculating the one-hour capacity for each key movement, based on the conflicting traffic volumes, and then comparing the number of vehicles making that maneuver to the calculated capacity. The unused or "reserve" capacity for that movement is then used to identify a level of service for that movement. The level of service at STOP sign-controlled intersection is as follows:

LEVEL OF SERVICE CRITERIA FOR UNSIGNALIZED INTERSECTIONS		
Reserve Capacity (pcph*)	Level of Service	Expected Delay to Minor Street
≥ - 400	A	Little or no delay
300 - 399	B	Short traffic delays
200 - 299	C	Average traffic delays
100 - 199	D	Long traffic delays
0 - 99	E	Very long traffic delays
Negative value	F	Exceeds capacity with extreme traffic delays and warrants improvements.

pcph* = Passenger cars per hour.
Source: *Highway Capacity Manual*, Transportation Research Board, 1985
Wilbur Smith Associates; October 1991.

The conditions are usually most critical for the left-turn movements from the minor, STOP sign-controlled roadway onto the major through roadway.

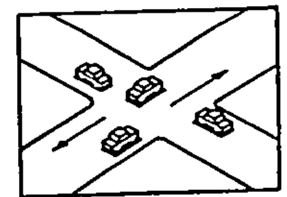
Signalized Intersections - The analysis of conditions at traffic signal-controlled intersections use the *Planning Method* approach.

The "Planning" method provides a summation of critical movement volumes at the intersection for the peak one-hour period being analyzed, based on the turning movement counts and number of lanes. The standards generally used to assess signalized intersections using this method are:

U	(Under Capacity)	Critical Movement Volume	0 - 1,200	Vehicles
N	(Near Capacity)	Critical Movement Volume	1,201 - 1,400	Vehicles
O	(Over Capacity	Critical Movement Volume	over 1,400	Vehicles

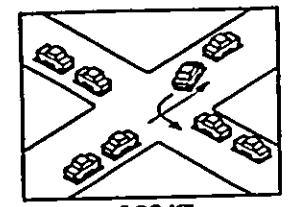
For the purpose of this study, the critical movement volume has been divided by the theoretical capacity of 1,400 to produce a volume-to-capacity (V/C) ratio. The general relationships between levels-of-service, volume-capacity ratios and delay times are summarized in Figure 3.

LEVEL OF SERVICE "A" - V/C = 0 TO 0.60
Describes operations with very low delay, i.e., less than 5 seconds per vehicle. This occurs when signal progression is extremely favorable, and most vehicles arrive during the green phase. Most vehicles do not stop at all.

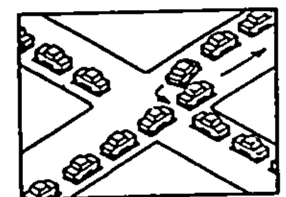

LOS 'A'

LEVEL OF SERVICE "B" - V/C = 0.61 TO 0.70
Describes operations with delays in the range of 5 to 15 seconds 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" - V/C = 0.71 TO 0.80
Describes operation with delay in the range of 15 to 25 seconds per vehicle. Occasionally vehicles may wait more than one red signal phase. The number of vehicles stopping is significant at this level, although many still pass through the intersection without stopping.

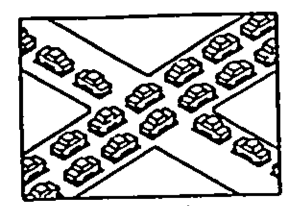

LOS 'C'

LEVEL OF SERVICE "D" - V/C = 0.81 TO 0.90
Describes operations with delay in the range of 25 to 40 seconds per vehicle. At LOS "D", the influence of congestion becomes more noticeable. Many vehicles stop, and the proportion of vehicles not stopping declines. Noticeable numbers of vehicles fail to clear signal during the first green phase.


LOS 'D'

LEVEL OF SERVICE "E" - V/C = 0.91 TO 1.00
Describes operations with delay in the range of 40 to 60 seconds per vehicle. These high delay values generally indicate poor progression, long cycle lengths, and high V/C ratios. Vehicles frequently fail to clear the signal during the first green phase.

LEVEL OF SERVICE "F" - V/C GREATER THAN 1.00
Describes operations with delay in excess of 60 seconds per vehicle. This condition often occurs with oversaturation, i.e., when arrival flow rates exceed the capacity of the intersection.


LOS 'F'

SOURCE: Highway Capacity Manual, 1985.

WSA | LEVEL OF SERVICE DIAGRAM
Kawaihae Development Traffic Impact Study | 3

Existing Traffic Conditions

At present, the only traffic signal-controlled intersection in the vicinity of the project is at Kawaihae Road (Lindsay Road) and Mamalahoa Highway (Hawaii Belt Road) in Waimea. Major intersections with STOP sign controls include the Kawaihae Road intersections with Kohala Mountain Road, Queen Kaahumanu Highway, and Akoni Pule Highway. Kawaihae Road is the through route at each intersection. Existing conditions were analyzed at each of these intersections.

Existing AM Peak Hour Traffic Condition - The morning peak hour occurs from 7:00 AM to 8:00 AM in the Waimea area and from 6:00 AM to 7:00 AM in the Kawaihae area. The overall traffic conditions in the AM peak have been mostly operating at LOS A. The right- and left-turn movements from Queen Kaahumanu Highway on to the Kawaihae Road operate at LOS D. The left-turn movements from Kohala Mountain Road towards Honokaa on Kawaihae Road operate at LOS D. The signalized intersection between Kawaihae/Lindsay Road and Hawaii Belt Road was generally under capacity during the morning peak.

Existing PM Peak Hour Traffic Condition - The afternoon peak hour occurs between 3:30 PM and 4:30 PM. The demand on Queen Kaahumanu Highway/Kawaihae Road unsignalized intersection exceeds capacity and operates at LOS F for right- and left-turns from Queen Kaahumanu Highway. For the intersection between Hawaii Belt Road and Kawaihae/Lindsay Road the planning level analysis indicates LOS A with volume-to-capacity (V/C) 0.58. The left turns from Kohala Mountain Road on Kawaihae Road towards Honokaa operate at LOS C. The rest of the intersections operate satisfactorily at mostly LOS A and one at LOS B.

3. TRAFFIC GROWTH AND IMPACTS WITHOUT PROJECT

The following section presents the analysis of future traffic conditions under a scenario where no development occurs on the Hawaiian Homelands site above Kawaihae.

Roadway Improvement Assumptions

Under this scenario, it was assumed that the planned Kawaihae-Waimea Bypass would be built to connect Queen Kaahumanu Highway and the Hawaii Belt Road. The planned bypass would be located generally parallel to and approximately 0.5 to 2.0 miles south of Kawaihae Road, and would intersect Queen Kaahumanu Highway near its present intersection with Kawaihae Road. The bypass would have two lanes in the mauka direction and one lane in the makai direction. It was assumed that a traffic signal would be installed at the intersection of Queen Kaahumanu Highway and the Kawaihae Bypass Road.

Kawaihae Road would remain in its current alignment from Queen Kaahumanu Highway to Akoni Pule Highway. It was assumed that the bypass would not extend across the Kawaihae Master Plan area (Hawaiian Home Lands) prior to development of the area.

Trip Generation

Traffic growth through year 2003 without the project was estimated in two growth components:

1) A percentage growth factor based on past trends; and

2) Traffic generated by the proposed Kohala Ranch project located north of and adjacent to the Hawaiian Homelands area.

Traffic counts conducted by State DOT indicate that regional growth in the area has sustained an average 17 percent per year increase in traffic flows; although, some years have experienced much higher growth rates. To account for growth in the region, it was assumed that the trend of 7 percent per year would continue on through Year 2003, resulting in a total factor of 84 percent growth over existing traffic flows. It was assumed that development associated with the port at Kawaihae Harbor was included in this growth factor.

Traffic generated by planned Kohala Ranch developments was superimposed on this flow to reflect background traffic in the year 2003. A departure from the assumptions used in the Kohala Ranch Project Study[1] was in the classification of recreational homes. To be conservative, recreational homes were treated as normal residential units[2] for the purpose of trip generation. The resulting trip generation for this project amounted to 1,003 PM peak hour trips and 715 AM peak hour trips for the planned 883 single family homes that were assumed to be built by year 2003. This is summarized in Table 1.

[1] October 3, 1990.

[2] ITE land use 210.

Table 1

KOHALA RANCH TRIP GENERATION
THROUGH YEAR 2003
Kawaihae Master Plan Traffic Impact Study

Land Use	Assumed Intensity	AM Peak Hour Trips			PM Peak Hour Trips			Daily
		Inbound	Outbound	Total	Inbound	Outbound	Total	
Single Family Dwelling Units	863 Dwelling Units	149	425	573	530	283	813	8,014
Apartments	56 Dwelling Units	8	38	47	38	18	56	526
Golf Course	343 Acres	74	18	93	27	107	134	1,356
Totals		231	488	718	593	410	1,003	9,896

Wilbur Smith Associates, September 11, 1991.

Trip Distribution

According to an earlier study in the area,[3] 16 percent of new traffic would have been distributed north towards Hawi, 36 percent inland towards Waimea and 48 percent to the south of the area. However, trip distribution was modified for this study to reflect the more recent traffic flow forecasts for the County's 2010 Long-Range Plan. Accordingly, the following rates were used:

- 18.3 percent towards Hawi (north);
- 39.8 percent to South of the area; and
- 41.9 percent towards Waimea (mauka).

Peak Hour Conditions without the Project

Future levels of service were calculated for the intersection of Kawaihae Road and Queen Kaahumanu Highway for year 2003 without the project and for the key roadway segments.

Roadway Intersections - The intersection of Kawaihae Road and Queen Kaahumanu Highway would operate at Level of Service (LOS) C during the AM Peak Hour (V/C = 0.77). The Kawaihae Road/Queen Kaahumanu Highway intersection would operate at LOS D (V/C = 0.83) during PM peak hour.

Roadway Segments - The major roadways in the area would also operate at reasonable levels of service. The Kawaihae Bypass would operate at LOS A mauka of Queen Kaahumanu Highway intersection while Kawaihae Road would operate at LOS B north of the same intersection with volume capacity ratio of 0.47 during the AM peak hour. During PM Queen Kaahumanu Highway would operate at LOS D (V/C = 0.74) while the Kawaihae Bypass would operate at LOS A mauka of Queen Kaahumanu intersection and Kawaihae Road at LOS C north of the same intersection. A summary is shown in Table 2.

The planned roadway improvements would be adequate to accommodate the forecast traffic flows for conditions without the project.

3 Belt Collins & Associates, October 20, 1987.

Table 2

YEAR 2003 ROADWAY LEVELS-OF-SERVICE WITHOUT PROJECT
PLANNED IMPROVEMENT SCENARIO
Kawaihae Master Plan Traffic Impact Study

Roadway Segment	Lanes	Capacity	Demand	V/C	LOS
AM Peak Hour					
Kawaihae Bypass					
Mauka of Queen Kaahumanu	1 Down	1,300	448	0.34	A
	2 Up	2,200	287	0.13	A
Kawaihae Road makai of Queen Kaahumanu	2	2,650	1,244	0.47	B
Queen Kaahumanu	2	2,500	1,559	0.62	C
PM Peak Hour					
Kawaihae Bypass					
Mauka of Queen Kaahumanu	1 Down	1,300	424	0.33	A
	2 Up	2,200	315	0.14	A
Kawaihae Road					
Makai Queen Kaahumanu	2	2,650	1,848	0.70	C
Queen Kaahumanu	2	2,500	1,858	0.74	D

Wilbur Smith Associates; September 17, 1991.

4. PROJECTED TRAFFIC CONDITIONS WITH TEN-YEAR PLAN

This section presents an analysis of future traffic conditions for Year 2003 based upon full development of the 2,200 acres of the Hawaiian Home Lands included within the Ten-Year Master Plan area.

Roadway Improvements

With development of the Ten-Year Master Plan area, it was assumed that additional portions of the planned Kawaihae Bypass would be built. The portion of the bypass from Queen Kaahumanu Highway to the Hawaii Belt Road is expected to be built with or without the project. In the following analysis, two possible scenarios were tested for the remainder of the planned bypass from Queen Kaahumanu Highway through the project site.

1. First, it was assumed that the Kawaihae Road would remain in its current configuration where it runs along the shoreline and that a bypass would not be constructed on this makai segment, except where it passes through the Hawaiian Home Lands property. It was found that significant congestion would result under this scenario.

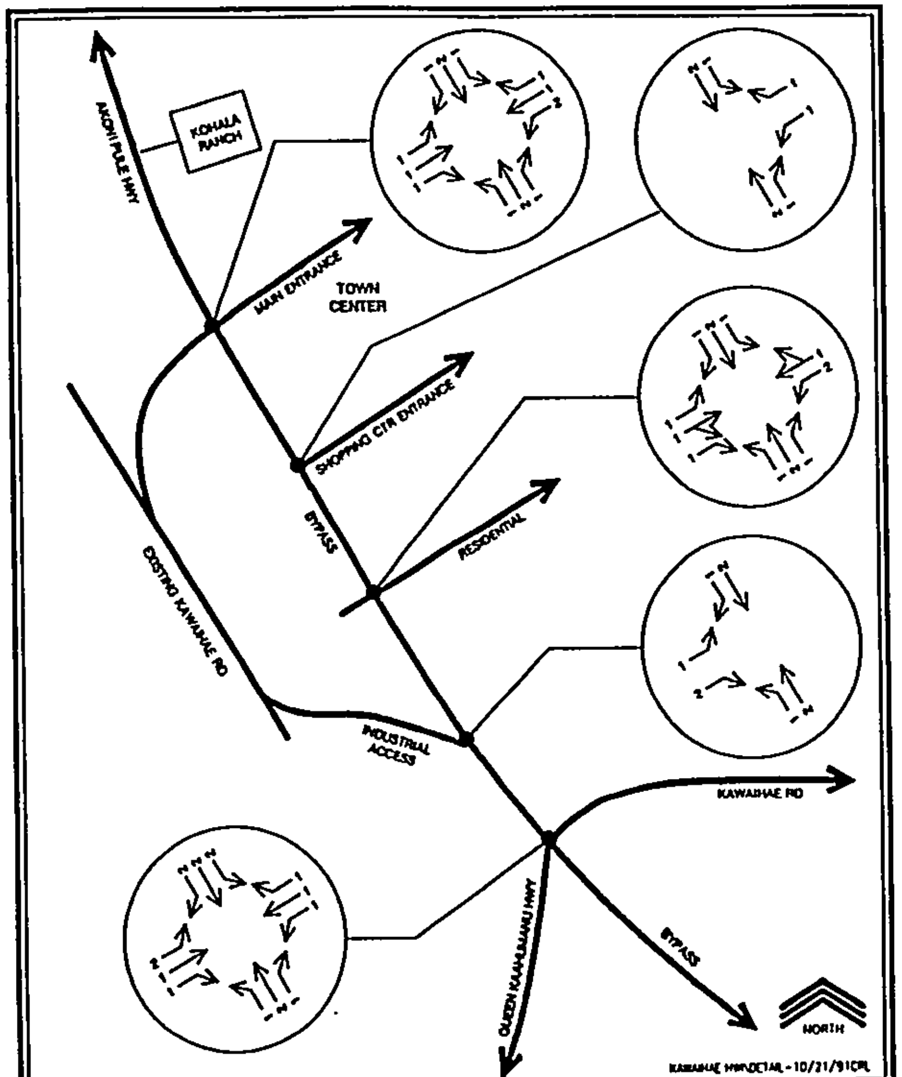
2. A second scenario was also addressed where the bypass would be completed through properties on the south side of the project, connecting with Queen Kaahumanu Highway.

These connections are illustrated in the figures that follow in this section.

It was assumed that traffic signals would be installed at the key intersections along the Bypass Road where it passes through the project area and at the intersection of Bypass Road with Queen Kaahumanu Highway.

An initial analysis was made with the assumption that all major roads leading to the project would be constructed as two-lane roads, with turning pockets at the key intersections to separate left-turns and right-turns from the through traffic movements. Where the bypass turns in the mauka direction, it was assumed that a truck climbing lane would be added in the uphill direction. In the following analysis, this future roadway configuration is referred to as the "as planned" scenario.

Because of the substantial amount of traffic growth that is forecast for the area, it was anticipated that additional roadway capacity may be appropriate to accommodate the projected traffic flows. This future roadway configuration is referred to as the "alternative geometry" scenario in the following analysis. The principal difference between the alternative geometry scenario and the planned scenario is that the bypass would be constructed as a four-lane road through the project and to the south of the project. Also, the number of turn lanes was increased at some locations from single left-turn lanes to double left-turn lanes. The assumed geometry for this analysis is illustrated in Figure 4.



FULL BYPASS WITH INDUSTRIAL ACCESS ROAD ALTERNATIVE GEOMETRY

Kawaihae Development Traffic Impact Study

4

Trip Generation

The trip generation rates were based on methodology contained in *Trip Generation*, 5th edition published by the Institute of Transportation Engineers (ITE). The empirical techniques were based on the correlation between vehicle trips and land use intensity (of a particular land use type). The trip generation rates used in this study are shown in Table 3.

The main trip generators in the project area are the 3,672 residential units, the 247 acre industrial area, the 150,000 sq. ft. shopping center in the town center, the 70,000 sq. ft. neighborhood retail, the 156,000 sq. ft. business park and the 4 schools. For the purpose of this analysis, if corresponding trip rates were not available (as in business park), it was assumed that 20 percent of the available land area was in fact gross leasable area (i.e., a floor-area-ratio of 0.20 was assumed). Also, it was assumed the schools have 500 students each.

Trip generation for inbound and outbound vehicle trips for each particular generator is shown in Table 4. Not all of these trips would leave the project area; some may be bound for other areas within the project. (For example, some of the AM peak hour outbound residential trips might be linked to a stop at the grocery store and/or a school.) To account for internal trips, a weighted reduction factor was used: 37 percent for AM and 32 percent for PM. The reduction factor was based on the assumption that 25 percent of the residential trips would be internal; 90 percent of the neighborhood retail trips would be internal, 25 percent of the retail trips would be internal; and 20 percent of the employment based generators would be internal to the Master Plan area. Trips associated with community facilities like parks, schools, religious facilities, etc. were assumed to be 100 percent internal to project.

The sum of peak hour trip generation for a large number of land use types that generate a large number of trips will usually be less than the sum of all peak hour generation. This occurs because the peak hour of each use is the highest one-hour period over a two hour peak. The highest one-hour period for each land-use does not usually occur at exactly the same time. To account for this, a 10 percent reduction was introduced to compensate for non-concurrent peaking.

During the AM peak hour the majority of residential trips would be outbound while for employment-based generators (like industrial), the majority of trips would be inbound (See Table 4). Similarly, the inverse would be true for the PM peak. Estimates of project trip generation are summarized below:

For the AM peak hour:

- The 3,672 residential units in the Ten-Year Master Plan project area would generate 477 inbound vehicle trips and 1,359 outbound trips (before reduction) during the AM peak hour.
- Neighborhood retail (70,000 sq. ft.) would generate 86 inbound and 50 outbound trips.
- The 150,000 sq. ft. shopping center (in the town center) would have 144 inbound and 84 outbound trips.

Table 3

TRIP GENERATION RATES
Kawaihae Master Plan Traffic Impact Study

Land Use	ITE Land Use Code	AM Peak Hour Trip Rates			PM Peak Hour Trip Rates			Daily	Measure
		Inbound	Outbound	Total	Inbound	Outbound	Total		
Residential	210	0.13	0.37	0.50	0.49	0.27	0.76	7.78	Per Dwelling Unit
Light Industrial	110	6.23	1.28	7.51	0.87	6.39	7.26	51.80	Per Acre
Business Park	770	1.35	0.24	1.59	0.33	1.15	1.48	14.37	Per 1,000 sq. ft.
Neighborhood Retail	820	1.23	0.72	1.95	3.85	3.85	7.70	83.39	Per 1,000 sq. ft.
Shopping Center	820	0.96	0.56	1.52	3.19	3.19	6.38	68.58	Per 1,000 sq. ft.
Gymnasium	495	0.67	0.41	1.08	0.39	0.99	1.38	13.80	Per 1,000 sq. ft.
Religious	560	0.47	0.27	0.74	0.39	0.33	0.72	9.32	Per 1,000 sq. ft.
Government Offices	733	2.00	0.25	2.25	0.89	1.97	2.86	25.00	Per 1,000 sq. ft
Park	411	1.12	1.12	2.24	1.12	1.12	2.24	2.24	Per Acre
Elementary School	520	0.18	0.12	0.30	0.006	0.004	0.01	1.09	Per Student
High School	530	0.28	0.13	0.41	0.02	0.06	0.08	2.38	Per Student

Source: *ITE Trip Generation*, 5th Edition

Wilbur Smith Associates, September 17, 1991.

Kawaihae Master Plan Traffic Impact Study — **WSA** Engineers-Planners

Table 4
TRIP GENERATION
Kawaihae Master Plan Traffic Impact Study

Land Use	Assumed Intensity	AM Peak Hour Trips			PM Peak Hour Trips			Daily
		Inbound	Outbound	Total	Inbound	Outbound	Total	
Residential	3,672 Dwelling Units	477	1,359	1,836	1,790	991	2,781	28,568
Light Industrial	247 Acres	1,539	316	1,855	215	1,578	1,793	12,795
Business Park	156,000 sq. ft.	211	38	249	52	180	231	2,246
Neighborhood Retail	70,000 sq. ft.	86	50	137	270	270	539	5,837
Shopping Center	150,000 sq. ft.	144	84	228	479	479	957	10,287
Gymnasium	14,000 sq. ft.	9	6	15	5	13	19	186
Religious	11,000 sq. ft	5	3	8	4	4	8	104
Government Offices	42,000 sq ft.	84	11	95	37	83	120	1,050
Park	44 Acres	49	49	98	49	49	98	99
Elementary School	1,500 Students	270	180	450	9	6	15	1,635
High School	500 Students	140	65	205	10	30	40	1,190
10-Year Plan Total		3,014	2,161	5,175	2,929	3,838	6,612	63,998
Long Range Plan								
Residential	4,034 Dwelling Units	524	1,493	2,017	1,977	1,089	3,066	31,365
TOTAL		3,538	3,654	7,192	4,906	4,772	9,678	95,362

Wilbur Smith Associates; September 17, 1991.

- For employment based generators (247 acres light industrial, 156,000 sq. ft. business park and 42,000 sq. ft. government offices), there would be a total of 1,834 inbound and 365 outbound trips.
- All other land uses (14,000 sq. ft. gym, 11,000 sq. ft. religious, 44 acre park, 3 elementary schools and 1 high school) would have a total of 473 inbound and 303 outbound trips.
- The Ten-Year Master Plan area, at full build-out, would generate a total of 3,014 inbound and 2,161 outbound vehicle trips during the AM peak hour.

For the PM peak hour:

- Residential areas would generate a total of 1,799 inbound and 991 outbound trips during the PM peak hour.
- Neighborhood retail would produce 270 inbound and 270 outbound trips.
- Shopping center (retail) would generate 479 inbound and 479 outbound trips.
- Employment based generators would generate a total of 304 inbound and 1,841 outbound trips.
- All other land uses would generate a total of 77 inbound and 102 outbound trips.
- The Ten-Year Master Plan area, at full build-out, would generate a total of 2,929 inbound and 3,683 outbound trips during the PM peak hour.

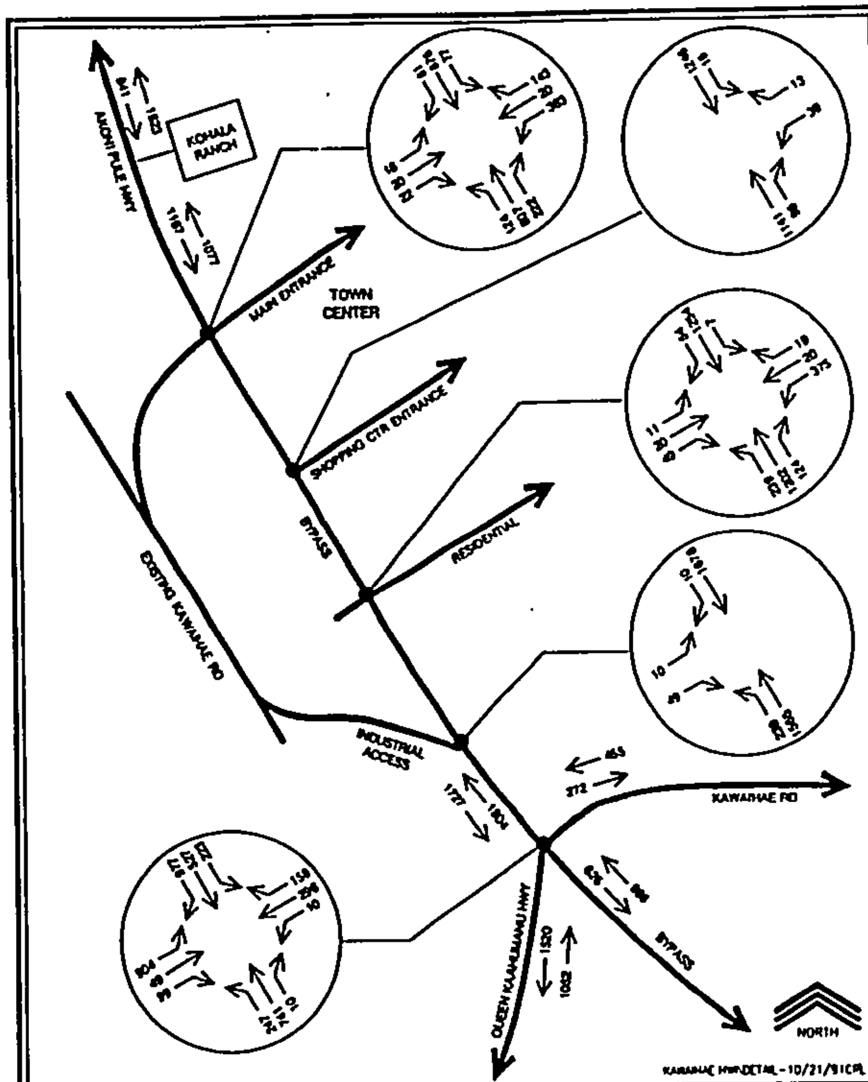
Trip Distribution and Assignment

According to an earlier trip distribution study in the area,[1] 16 percent of the traffic generated in this area would have been distributed to Hawi, 36 percent to Waimea, and 48 percent to the south of the area. However, a modified trip distribution, based on information from the County's Year 2010 Long-Range Plan used in this analysis. The revised distribution is as follows:

- 18.3 percent towards Hawi (north);
- 39.8 percent to South of the area; and
- 41.9 percent towards Waimea (mauka).

Traffic flows were assigned to the future roadway network according to the above assumptions. The resulting traffic flows for AM peak hour conditions are shown in Figure 5. PM peak hour flows are shown in Figure 6. The traffic flow projections shown in these two figures assumes that a full bypass would be constructed to the south of the project site. Forecast traffic operations with the project are discussed

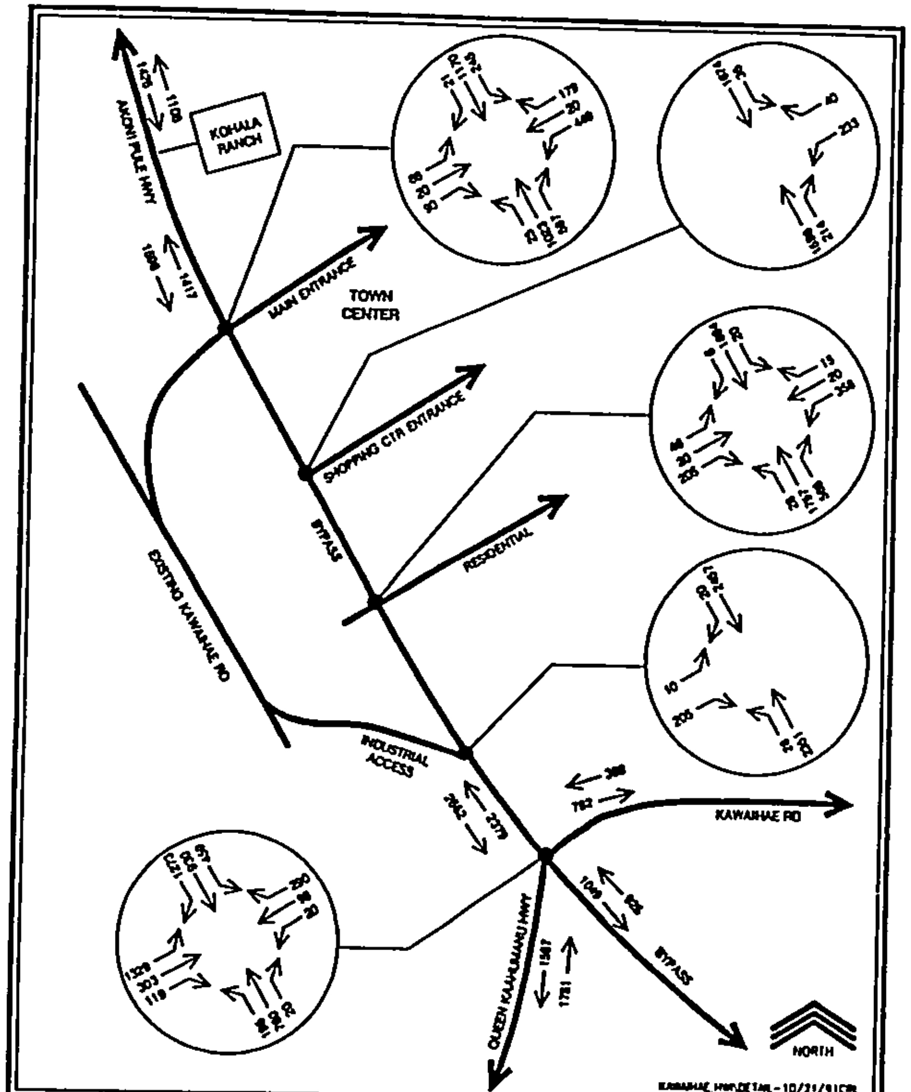
[1] Bell Collins & Associates, October 20, 1987.



FULL BYPASS WITH INDUSTRIAL ACCESS ROAD
CUMULATIVE AM PEAK

Kawaihae Development Traffic Impact Study

5



FULL BYPASS WITH INDUSTRIAL ACCESS ROAD
CUMULATIVE PM PEAK
Kawaihae Development Traffic Impact Study

6

below for conditions with and without the full Bypass Road from Queen Kaahumanu Highway through the Master Plan area.

Traffic Impacts on Planned Roadway System

Roadway conditions were initially analyzed with the "planned" alignments and widths as described earlier in this section. Projected intersection levels-of-service for the scenario with the parallel bypass are shown in Table 5 while the level of service for conditions with the full bypass are presented in Table 6. It is of note that the projected level of service at the intersection of the main entrance road and the Bypass Road is significantly higher than for conditions with the full bypass.

The projected levels of service on the major roadway segments are summarized in Table 7 for the AM peak hour and in Table 8 for the PM peak hour. Also shown on these two tables are projected levels of service if the bypass and Queen Kaahumanu Highway were widened to two four lanes.

AM Peak Hour Impacts:

- The planned Kawaihae Bypass would help relieve the anticipated congestion between Kawaihae and Waimea, mauka of Queen Kaahumanu Highway intersection. The two-lane Akoni Pule Highway would operate at LOS E (V/C = 0.89) north of Kohala Ranch Project. The Kawaihae Bypass (two lanes) south of the project (south of the merge point) and north of Queen Kaahumanu Highway intersection would operate at LOS F (V/C = 1.33). The Queen Kaahumanu Highway with a two-lane width would operate at LOS F (V/C = 1.03). The Akoni Pule Highway would operate at LOS D between Kohala Ranch and the project (V/C =0.85).

- With the existing two lanes, the Kawaihae Road between Kawaihae and Waimea would operate at LOS A; while the bypass between the same (two lanes plus a climbing lane) would operate at LOS A in the uphill direction (towards Waimea) and at LOS D in the downhill direction (V/C = 0.76).

- The intersection of Kawaihae Road and Queen Kaahumanu Highway would not be affected by whether the bypass is fully or partially constructed, since the merge point would be north of the intersection and all traffic to the south and Waimea (and back) would pass through this intersection. With the planned geometry, with left turn lanes and free right turns, the intersection would operate at LOS F (V/C = 1.28);.

PM Peak Hour Impacts:

- Akoni Pule Highway north of Kohala Ranch would operate almost at capacity at LOS E (V/C = 0.96). Akoni Pule Highway south of Kohala Ranch and north of the project would be at LOS F (V/C = 1.14).

- The Kawaihae Bypass south of the merge point (north of the Queen Kaahumanu Highway intersection) would operate at LOS F (V/C = 1.90). The Queen Kaahumanu Highway would also operate at LOS F (V/C = 1.33).
- Kawaihae Road (mauka of the Queen Kaahumanu Highway Intersection) would operate at LOS B (V/C = 0.53). Kawaihae Bypass would operate at LOS B uphill (V/C =0.48) and LOS D downhill (V/C = 0.71).
- The Kawaihae Road/Queen Kaahumanu Highway intersection would operate at LOS F in the PM peak hour (V/C = 1.62).

Alternative Geometry

The scenario with alternative geometry assumed that the Bypass Road would be four lanes wide and fully connected to the south of the project. The four-lane section would be at a point to the north of the project and would continue as a four-lane-wide roadway to the Queen Kaahumanu Highway intersection south of the project. Turn pockets would be needed at all of the key intersections. This would include double left-turn lanes for traffic leaving the project at the Main Entrance Road and at the Residential Access Road.

The alternative geometry at the intersection of Queen Kaahumanu Highway and the Kawaihae Bypass Road included six lanes on the southbound approach (double left-turns and double right-turns), a double left-turn for northbound movements from Queen Kaahumanu Highway and of a four-lane cross section on Queen Kaahumanu Highway to the south of this intersection. The number of lanes used in this scenario are depicted in Figure 4.

Forecast levels-of-service with alternative geometry (Table 9) represent a substantial improvement over conditions with the planned geometry scenario. During the PM peak hour, traffic conditions at the project site entrances would be typical of LOS C and LOS D operations, compared to LOS F with the "planned" geometry. Intersection operations during the AM peak hour would improve to the level-of-service LOS A to LOS C range.

It was not possible to identify a workable at-grade layout (LOS E or better) for the intersection of Queen Kaahumanu Highway and the Kawaihae Bypass Road that did not require less than three lanes for key movements. However, the assumed geometry was sufficient to reduce the PM peak hour V/C ratio from 62 percent over capacity to 6 percent over capacity. If the anticipated levels of area development and background traffic growth do occur by Year 2003, then a grade separation may be needed in this general time frame to avoid congested traffic conditions during the peak traffic hours.

Internal Circulation

The term, "Main Entrance Road" is used to refer to the east-west arterial that intersects the Kawaihae Bypass Road on the north side of the Town Centre; "Town Centre Road" refers to the east-west road on the south side of the Town Centre; and, "Residential Road" refers to the east-west road that intersects the Kawaihae Bypass Road farthest to the south on the property.

Table 5

INTERSECTION LEVELS-OF-SERVICE
WITH PARTIAL BY-PASS AND PLANNED GEOMETRY
Kawaihae Master Plan Traffic Impact Study

Intersection	AM Peak Hour		PM Peak Hour	
	V/C	LOS	V/C	LOS
Kawaihae Bypass/Main Entrance Rd.	1.43	F	1.67	F
Kawaihae Bypass/Shopping Center Rd.	–	A	–	A
Kawaihae Bypass/Residential Access	–	A	–	A
Kawaihae Rd./Queen Kaahumanu	1.28	F	1.62	F

Wilbur Smith Associates; September 17, 1991.

Table 6

INTERSECTION LEVELS-OF-SERVICE
WITH FULL BY-PASS AND PLANNED GEOMETRY
Kawaihae Master Plan Traffic Impact Study

Intersection	AM Peak Hour		PM Peak Hour	
	V/C	LOS	V/C	LOS
Kawaihae Bypass/Main Entrance Rd.	0.97	E	1.23	F
Kawaihae Bypass/Shopping Center Rd.	0.92	E	1.36	F
Kawaihae Bypass/Residential Access	1.33	F	1.73	F
Kawaihae Rd./Queen Kaahumanu	1.28	F	1.62	F

Wilbur Smith Associates; September 17, 1991.

Table 7

YEAR 2003 ROADWAY LEVELS-OF-SERVICE -- AM PEAK HOUR
Kawaihae Master Plan Traffic Impact Study

Roadway Segment	Lanes	Capacity	Demand	V/C	LOS
Planned Improvement Scenario					
Kawaihae Bypass					
Mauka of Queen Kaahumanu	1 Down	1,300	988	0.76	D
	2 Up	2,200	626	0.28	A
South of Project	2	2,650	3,531	1.33	F
Kawaihae					
Mauka of Queen Kaahumanu	2	2,150	727	0.34	A
Akoni Pule					
North of Project	2	2,650	2,244	0.85	D
North of Kohala Ranch	2	2,650	2,364	0.89	E
Queen Kaahumanu	2	2,500	2,572	1.03	F
Alternative Improvement Scenario					
Kawaihae Bypass					
Mauka of Queen Kaahumanu	1 Down	1,300	988	0.76	D
	2 Up	2,200	626	0.28	A
South of Project	4	7,200	3,531	0.49	B
Kawaihae					
Mauka of Queen Kaahumanu	2	2,150	727	0.34	A
Akoni Pule					
North of Project	4	6,900	2,244	0.32	A
North of Kohala Ranch	2	2,650	2,364	0.89	E
Queen Kaahumanu	4	8,900	2,572	0.37	B

Wilbur Smith Associates; September 17, 1991.

Table 8

YEAR 2003 ROADWAY LEVELS-OF-SERVICE -- PM PEAK HOUR
Kawaihae Master Plan Traffic Impact Study

Roadway Segment	Lanes	Capacity	Demand	V/C	LOS
Planned Improvement Scenario					
Kawaihae Bypass					
Mauka of Queen Kaahumanu	1 Down	1,300	925	0.71	D
	2 Up	2,200	1,049	0.48	B
South of Project	2	2,650	5,041	1.90	F
Kawaihae					
Mauka of Queen Kaahumanu	2	2,150	1,150	0.53	B
Akoni Pule					
North of Project	2	2,650	3,015	1.14	F
North of Kohala Ranch	2	2,650	2,532	0.96	E
Queen Kaahumanu	2	2,500	3,318	1.33	F
Alternative Improvement Scenario					
Kawaihae Bypass					
Mauka of Queen Kaahumanu	1 Down	1,300	925	0.71	D
	2 Up	2,200	1,049	0.48	B
South of Project	4	7,200	5,041	0.70	C
Kawaihae					
Mauka of Queen Kaahumanu	2	2,150	1,150	0.53	B
Akoni Pule					
North of Project	4	6,900	3,015	0.43	B
North of Kohala Ranch	2	2,650	2,532	0.96	E
Queen Kaahumanu	4	8,900	3,318	0.48	B

Wilbur Smith Associates; September 17, 1991.

Table 9
INTERSECTION LEVELS-OF-SERVICE
WITH FULL BY-PASS AND ALTERNATIVE GEOMETRY

Intersection	AM Peak Hour		PM Peak Hour	
	V/C	LOS	V/C	LOS
Kawaihae Bypass/Main Entrance Rd.	0.54	A	0.72	C
Kawaihae Bypass/Shopping Center Rd.	0.47	A	0.76	C
Kawaihae Bypass/Residential Access	0.77	C	0.86	D
Kawaihae Rd./Queen Kaahumanu	0.93	E	1.06	F

Wilbur Smith Associates; September 17, 1991.

With the fully-connected bypass, Residential Road would carry a substantial load of traffic for the residential area. Two suggested modifications to this road are listed below:

1. To accommodate projected traffic flows under the Ten-Year Master Plan scenario, a four to five lane cross-section would be needed near the intersection with the Kawaihae Bypass Road.

2. It would be advantageous to reconfigure the T-intersection on Residential Road where it intersects the road that leads to the mauka side of the Town Centre. Since most of the traffic on this road would likely be heading towards the residential areas mauka of this intersection, it might be reconfigured so that Residential Road were straight and the intersecting road formed the leg of the "T".

As anticipated, Main Entrance Road would also carry a substantial amount of traffic. The proposed 120 foot right-of-way near the town center would be sufficient to accommodate a six lane cross-section.

5. FULL DEVELOPMENT OF THE LONG RANGE MASTER PLAN

The following section presents an assessment of the Long Range Master Plan, which addresses the future development of the approximately 7,800 acres of land mauka and north of the Ten-Year Master Plan area.

Trip Generation

The Long Range Master Plan area would include an additional 4,034 residential units plus a golf course and other low intensity open space uses. As was shown in Table 4, during the AM peak hour, 524 vehicle trips would be inbound, and 1,493 outbound. The PM peak hour trip generation was 1,977 inbound and 1,089 outbound trips.

Trip Assignment

The directional distribution of trips for the full Long Range Master Plan area was assumed to be the same as the trip distribution for the Ten-Year Master Plan; i.e., 18.3 percent towards Hawi, 41.9 percent towards Waimea and 39.8 percent towards the south.

Roadway System

The development plan for the Long Range Master Plan areas envisions the extension of the Main Entrance Road mauka to Kohala Mountain Road, plus the provision of minor arterial and collector roadways to serve the planned developments in the areas outside the Ten-Year Master Plan area. As noted, these longer range development areas are planned to include lower density residential areas, extensive open space areas, and other uses which would likely generate lower levels of traffic and thus require less roadway capacity than the Ten-Year Master Plan area.

For this assessment, the roadway system was assumed as follows:

- o Kawaihae Bypass Road would have four lanes;
- o The Main Entrance Road would be extended mauka to and above Kohala Mountain Road as a two-lane roadway; and
- o An additional two-lane minor arterial roadway would be constructed parallel to and north of the Main Entrance Road to serve the project area north of the Ten-Year Master Plan area.

In addition, the Long Range Highway Plan for the Island of Hawaii includes a new north-south roadway that would extend from Waikoloa to or through the Hawaiian Home Lands. The Highway Plan describes this roadway as a two- to four-lane route extending from Paniolo Avenue in Waikoloa to Kohala Ranch.

Assessment of Long Range Master Plan Roadways

The assessment was limited to internal roadways and considered only the additional traffic generated within the project area. Increased through traffic could not be reflected since the development period for the Long Range Master Plan area would likely extend well beyond the Year 2010, which is the longest range information presently available.

Assessment of the additional traffic loadings from the development of the Long Range Master Plan area indicates the following:

- The makai end of the Main Entrance Road would carry approximately 250 and 300 additional vehicle trips, total for both directions, during the AM and PM peak hours, respectively. This increase could be accommodated by the planned roadway.
- The new mauka portions of the Main Entrance Road could accommodate project volumes as a two-lane roadway with turn lanes at cross streets.
- The new North Mauka-Makai Road, which parallels the Main Entrance Road, could accommodate project traffic as a two-lane roadway with turn lanes at cross streets.
- The estimated project traffic using the "Paniolo Avenue Extension" could be accommodated by a two-lane roadway. For the afternoon peak hour, an estimated 1,600 project vehicles would use the roadway, which would use about 80 percent of a two-lane roadway capacity (LOS D), without inclusion of "through" traffic.
- The Paniolo Avenue Extension would provide a shorter route for most project traffic to/from the Waimea direction than does use of the Kawaihae Bypass to reach Kawaihae Road or the Kawaihae-Waimea Bypass facility. This would constrain any future increases of project traffic on the Kawaihae Bypass facility between the Town Centre and Queen Kaahumanu Highway. The increased project traffic, estimated at 100 vehicles in the PM peak hour, exclusive of other traffic growth, would be within the capacity of the four-lane facility identified for the Ten-Year Master Plan. However, sufficient rights-of-way should be provided in the event that other growth to the north might require further widening of this roadway.

6. SUMMARY AND CONCLUSIONS

Existing traffic and traffic from other developments in the area (excluding the Kohala Ranch projects) is expected to increase by 84 percent during the span of the 10-year project (Year 2003). In addition to this, traffic from the Kohala Ranch project would also be added to the area roadways. Some major improvements are needed to offset the resulting impacts (in addition to the planned improvements).

With all the expected developments in the area, the planned roadway improvements would be able to accommodate projected traffic flows through year 1994, assuming straight-line growth. After this level of growth occurs, it would be necessary to either widen Kawaihae Road by two lanes or to connect the planned bypass road to accommodate traffic to/from areas south of the site. It is understood that it would not be desirable to widen Kawaihae Road. If Kawaihae Road is closed to through traffic, near the historical sites the Kawaihae Road Bypass would need to be four-lanes wide to accommodate projected traffic flows anticipated beyond year 1994 at acceptable levels of service.

Two other major roadway segments affected by the cumulative increases in traffic flows would be Akoni Pule Highway and Queen Kaahumanu Highway. Queen Kaahumanu Highway would eventually need to be four lanes wide to handle expected traffic. The Akoni Pule Highway, north to Kohala Ranch, may also require widening if the assumed anticipated levels of development occur at Kohola Ranch and areas further north. An alternative to this widening would be the connection of the "Paniolo Avenue extension" to Kohala Ranch.

The Kawaihae Road/Queen Kaahumanu Highway intersection would operate at LOS F even with the suggested lane additions. Possible solutions to the anticipated congestion at this location include:

1. Grade separation (a mauka-bound flyover).
2. Construction of an additional "branch" roadway from the Kawaihae Bypass about two miles mauka of the present intersection, to Queen Kaahumanu Highway near Hapuna Bay Road. This would divert traffic between Waimea and the South Kohala/Keahole Airport area from this Kawaihae Road/Queen Kaahumanu Highway intersection. The State DOT plans developed in the 1970s includes this connection to reduce travel distances and vehicle miles of travel for trips between Waimea and the South Kohala-Airport area.
3. Reduce the amount of development that occurs over the first 10 year period. It is anticipated that the need for a major improvement at this intersection would occur in the range of 80 to 90 percent of buildout of the Ten-Year Master Plan.