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May 19, 1989

Mr. Bruce Tsuchida
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Honolulu, Hawaii 96817

Subject: Kukuiula Planned Community
Final Environmental Impact Statement (FEIS)

I am pleased to accept the Final Environmental Impact Statement for the proposed **Kukuiula Planned Community**, as satisfactory fulfillment of the requirements of Chapter 343, Hawaii revised Statutes, and the Executive Order of August 23, 1971. This Environmental Impact Statement will be a useful tool in the process of deciding whether the action described therein should be allowed to proceed. My acceptance of that statement is an affirmation of the adequacy of that statement under the applicable laws, and does not constitute an endorsement of the proposed action.

Roland D. Sagum III

for TOM H. SHIGEMOTO
Planning Director

cc: Marvin T. Miura, Ph.D., Director, OEQC
Bill Campbell, A & B Properties, Inc.

FINAL

Kukuiula Planned Community
ENVIRONMENTAL IMPACT STATEMENT
Kukuiula, Kauai, Hawaii

A&B Properties, Inc.
Honolulu, Hawaii

April 1989

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KUKUIULA PLANNED COMMUNITY

ENVIRONMENTAL IMPACT STATEMENT

KUKUIULA, KAUAI, HAWAII

TMK: 2-6-03:por.1,4,23, por.31, por.32 and
2-6-04:10,11,16,18,38,39,40,44,45

PREPARED FOR:

A&B Properties, Inc.
Honolulu, Hawaii

This document has been prepared pursuant to
Chapter 343, Hawaii Revised Statutes

SUBMITTED BY:

Bruce T. Tsuchida, Project Manager

April 20, 1989
Date

PREPARED BY:

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APRIL 1989

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Introduction and Summary

SECTION 1
INTRODUCTION AND SUMMARY

1.1 INTRODUCTION AND PURPOSE

Alexander and Baldwin, Incorporated (A&B), through their development subsidiary A&B Properties, Inc., a Hawaii based corporation, plans to develop approximately 1,000 acres of land in the Koloa District on the Island of Kauai. In 1982 the Kauai County General Plan was updated and resulted in approximately 219 acres (Phase I) of A&B land being changed from "agriculture" to "project district." This change encouraged A&B to investigate development potentials for this parcel. Subsequently, planning and research studies indicated great potential for a larger project (Phase II), which is the subject of this Environmental Impact Statement (EIS).

The 219 acres designated "urban residential" in the General Plan were reclassified "urban" by the State Land Use Commission in 1985. A&B Properties, Inc., received County zoning approval on August 9, 1988 for development of 213 acres of the 219-acre site into residential, commercial and park uses. Six acres still remain in the "agriculture" zoning designation because this proposed "General Commercial" area is related to the proposed marina and resort development in Phase II. Rezoning of this 6-acre site will be sought at a later date.

The remaining 800+ acres of this 1,000-acre development is still designated "agriculture" and "open" in the County General Plan, and "agriculture" under the State Land Use system. This EIS has been developed as part of the requirements of the County's General Plan amendment process. The purpose of this EIS is to identify and evaluate significant environmental impacts that may result from the development. Mitigation measures to reduce or eliminate adverse impacts on the environment were evaluated and are discussed in the following sections. This EIS has been prepared in accordance with Chapter 343, Hawaii Revised Statutes and the Rules and Regulations of the Office of Environmental Quality Control.

1.2 PROJECT LOCATION

The Kukuiula Planned Community Project is located on the southern coast of the Island of Kauai (Figure 1-1). This project will encompass approximately 1,000 acres in the Koloa District that are currently in sugarcane cultivation and pasture. The site is bordered on the east by Poipu Road, to the south by Lawai Road, Lawai Valley to the west, and steep slopes to the north. The project is within close proximity of the commercial center in Koloa Town and resort developments in Poipu (Figure 1-2).

1.3 PROPOSED ACTION

This project is planned to be developed in two major phases (Phase I and Phase II). Phase I consists of 219 acres and Phase II consists of approximately 800 acres. Because the request for a General Plan Amendment will focus mainly on Phase II, Table 1-1 itemizes the proposed land uses by phases. The project description, impacts and mitigation measures, however, address the entire 1,000-acre project.

Approximately 4,000 single-family and multi-family units are planned to be developed on about 550 acres of land. Single-family lots cover approximately 440 acres which can be developed into 2,600 lots at a density of about 5 to 6 lots per acre. Multi-family housing is planned for approximately 1,400 units on 110 acres at densities of 10 and 20 units per acre.

Two commercial areas, about 6 acres each, are planned for two different types of commercial uses. The site near the intersection of Lawai and Poipu Roads is planned for a neighborhood commercial area to include convenience shops and personal services. The second commercial site located near the proposed marina and resort facilities at Kukuiula Bay will support marina/resort uses.

A 100 to 150-boat 10-acre marina is proposed at Kukuiula Bay. A channel extending inland to the marina facilities will require dredging to provide water access to this new facility. Adjacent to this marina will be a resort hotel with approximately 500 rooms.

TABLE 1-1

LAND USE ALLOCATIONS
PHASES I AND II

Land Use	PHASE I Acreage	PHASE I Units	PHASE II Acreage	PHASE II Units
Single Family	123	738	320	1,900
Low-Density Multi-Family	44	440	40	400
High-Density Multi-Family	28	560	0	0
Commercial	*12	--	0	--
School			7	--
Resort	0	--	20	**500
Park	6	--	10	--
Marina	0	--	10	--
Major Roadways	***	--	30	--
Cane Haul Road	0	--	10	--
Sewage Treatment Plant	0	--	18	--
Golf Course	0	--	200	--
Open Space/Buffer	6	--	135	--
TOTAL	219	1,738	800	**2,800

* Six acres are designated "agriculture" according to County zoning.

** 500 hotel rooms are planned for the resort development at Kukuiula Bay.

***Acreage for the major roadway through the Phase I area is included in acreage for single and multi-family residential uses.

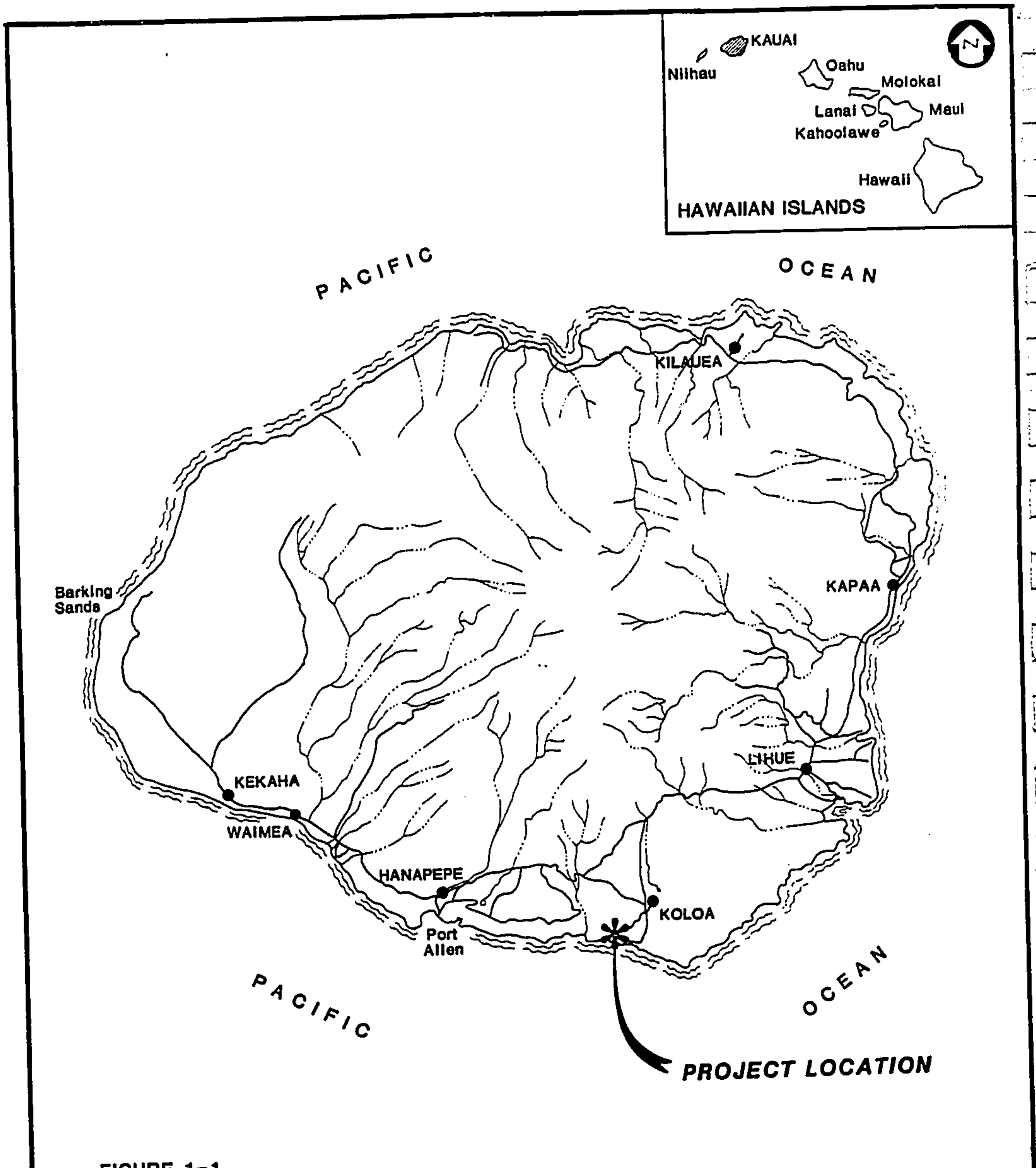

FIGURE 1-1

LOCATION MAP

KUKUIULA PLANNED COMMUNITY

Koloa, Kauai, Hawaii

For: A&B Properties, Inc.

By: R. M. Towill Corporation

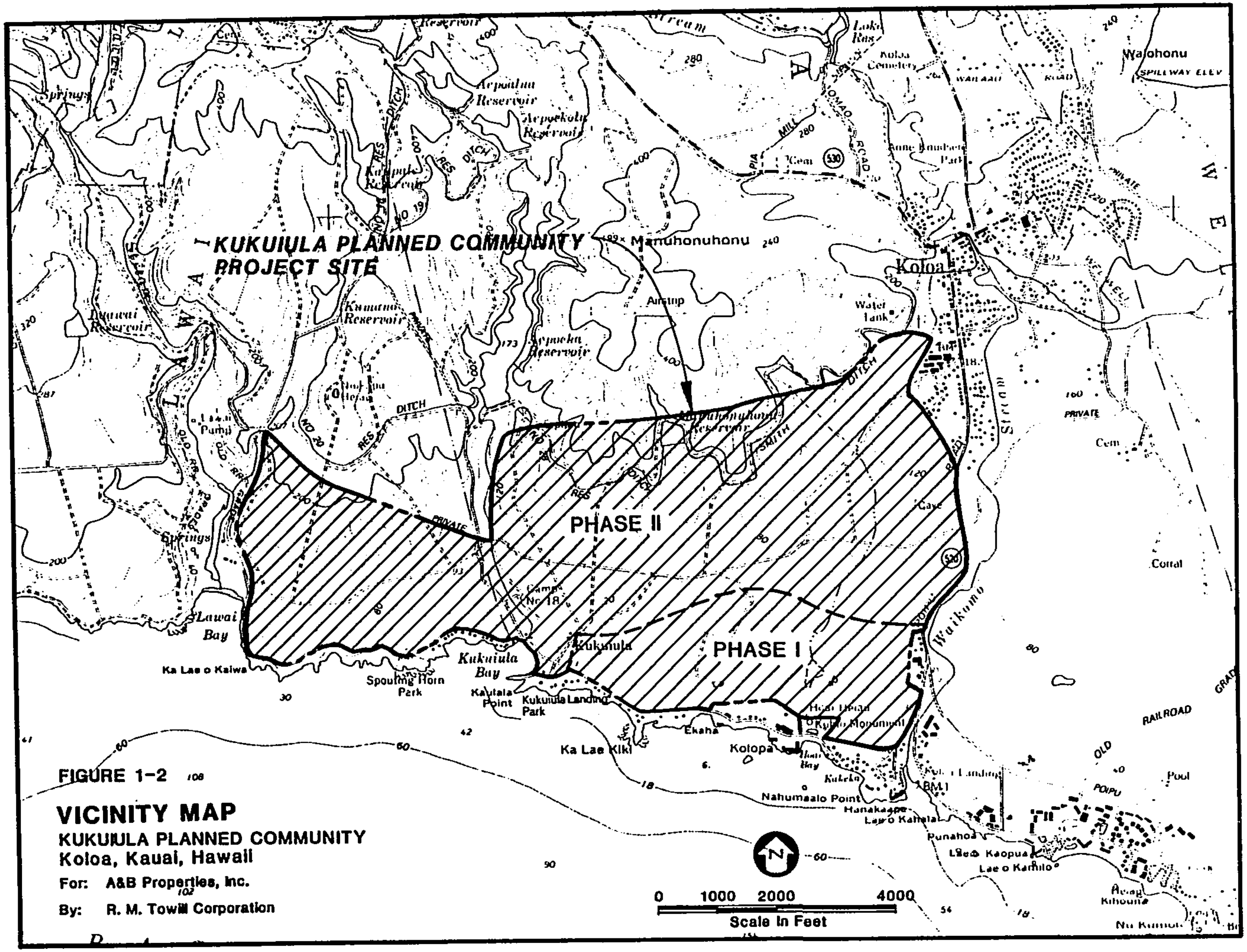

FIGURE 1-2

VICINITY MAP

KUKUIULA PLANNED COMMUNITY
Koloa, Kauai, Hawaii

For: A&B Properties, Inc.

By: R. M. Towill Corporation

Recreational facilities include an 18-hole golf course, a clubhouse with swimming and tennis facilities, walkways and bikeways, and three neighborhood parks. The largest of the three park sites near the Prince Kuhio Park contains archaeological features which will be incorporated as part of the park design.

Development of the infrastructure includes sewer, water, drainage, roadways, electric, cable television and telephone facilities. A new wastewater treatment and disposal facility is planned within the site. This facility has the potential of being developed into a regional wastewater treatment plant. The sewerage collection system includes a network of gravity sewer lines, force mains and pumping stations.

Potable water supply requires the development of a new well, two new storage tanks and a complete internal water distribution system. Upgrades to the existing transmission lines may be needed. The new source/storage facilities will be tied into the existing water facilities.

The golf course fairways will be used as a series of major retention basins and as a major drainage swale to capture the storm water runoff mauka of the golf course and route its flows to an outlet at Kukuiula Bay. Drainage from areas makai of the golf course will be directed by underground drain lines to retention basins on site and possibly to a box culvert which will outlet near the Beachhouse Restaurant.

Major roadways include a four-lane divided roadway servicing the southern portions of the project, a two-lane collector road servicing the northern sectors of the project, and a two-lane connector street traveling north from the new divided roadway to the northern collector road, paralleling Poipu Road. Internal roadway systems will be developed in increments. Improvements are planned at the intersection of Lawai and Poipu Roads with the new four-lane divided roadway. This intersection will be reconfigured into a cross intersection and include signalization and storage lanes. Landscaping is planned along these three major roadways and along the cane haul road that traverses the central area of the site.

A new electric substation and telephone switching station will be developed within the site, if needed.

1.4 SUMMARY OF IMPACTS AND MITIGATION MEASURES

1.4.1 Land Uses and Ownership

The project will result in the removal from production of approximately 600 acres of McBryde Sugar Company's sugarcane fields. However, the low profitability of the sugar industry has encouraged McBryde to investigate diversification in other areas of agriculture. The loss of these cane lands will not have a significant impact on McBryde's agricultural operations. The balance of the project's land consists of poor pasturelands and the development will improve the productivity of these lands and enhance the environment.

To minimize impacts to existing homeowners along Lawai Road a 100-foot setback will be incorporated along the mauka side of Lawai Road beginning at the edge of Metropolitan Mortgage Company's development going west to the proposed commercial area.

1.4.2 State and County Land Use Classifications

The State Land Use system classifies 219 acres of the site "urban" and the remaining 800 acres "agriculture." A&B will seek reclassification of the land to "urban" from the State Land Use Commission after approval is received from the County on the General Plan Amendment request.

The County General Plan designates 219 acres "urban residential" and the 800 acres "open" and "agriculture." This EIS is required to be submitted concurrently with the General Plan Amendment to reclassify the "open" and "agriculture" lands to "urban residential" and "resort."

County zoning for the 219-acre parcel is currently designated residential, commercial, agriculture and park/open space. The remaining 800 acres and 6 acres designated agriculture in the 219-acre site will eventually require zoning approval for the proposed uses.

The project is contiguous with existing urban development and will have no adverse impacts on the State and County land use and zoning designations.

1.4.3 Soils

Soils consist generally of Waikomo stony/rocky silty clay and Lihue silty clay soils. The Waikomo soils will require expensive excavation because they are shallow to bedrock, unlike the Lihue soils which are deep and well drained. Erosion is already evident in the steeper northern slopes of the project. This area will be grassed to prevent further erosion. An Erosion Control Plan will be prepared prior to construction to protect receiving waters and reduce soil erosion. Siltation basins will be incorporated into the design of the drainage system both during and after construction.

1.4.4 Noise

During construction, noise impacts will be unavoidable. However, properly muffled construction equipment and the incorporation of State Department of Health regulations on construction noise limits and curfew hours will be required during construction.

Noise levels from increased traffic and marina activities are projected to be within State and Federal standards. To reduce noise generated from traffic, landscaping will be used along the major roadways. A landscaped strip along both sides of the cane haul road will be planted to mitigate noise generated by its use. A berm may also be incorporated into the landscaping along the cane haul road. The golf course abuts the majority of the cane road thereby increasing the distance to residential development. Additionally, a reduced speed limit will be enforced on the cane road in sections that pass through the project.

1.4.5 Air Quality

According to the Federal Clean Air Act, a residential development is not considered a direct source of air pollution. However, a residential development is considered an indirect source of air pollution because it will generate additional vehicular traffic. Carbon monoxide emissions from new motor vehicles are expected to decrease in the future because of tighter emission control standards. In addition, fuel and fuel additives are regulated to reduce the amount of lead emissions. However, the projected vehicular traffic will increase carbon monoxide concentrations in the vicinity of the project.

The efficiency of the proposed roadway system will contribute to the reduction of carbon monoxide emissions by reducing the idling time at intersections and the slow movement of traffic. Improvements are planned at several intersections to incude signalization and storage lanes. Other improvements, as recommended in paragraph 1.4.14, "Circulation System," will also contribute to the efficient movement of traffic. Car pooling and bus service may also help to mitigate traffic-related air pollution. Technological advancements in motor vehicle engines and emission control equipment may be developed to burn cleaner fuels before full occupancy of the project. Additionally, in the future, the State may adopt a more stringent motor vehicle inspection and maintenance program to ensure that emission control devices are properly maintained.

The removal of cane lands is a long-term direct benefit because it will reduce the amount of particulate generation and pollutant emissions resulting from the burning of cane fields. New residents that will reside within a one-mile radius of areas still requiring cane burning may be adversely impacted. Prospective residents will be informed through a disclosure statement in the deed of the potential air and noise pollution that may result. Enforcement of the State's agricultural burning regulations will help to minimize impacts.

The continued use of the cane haul road will generate fugitive dust. This road could be oiled and/or paved to minimize the generation of dust. The prèsent practice of watering the road near residential areas appears to be an effective measure. A landscape buffer strip will be planted along both sides of the cane road as a mitigation measure. The golf course is planned to be constructed along both sides of this cane road, acting as an additional buffer for proposed residential development.

Indirect emissions from electric power generation due to increased electrical demand may be reduced by the use of solar energy. Installation of solar water heaters, designing homes to maximize indoor light without increasing indoor heat and the use of landscaping to provide shade may lessen the electrical power demand.

Solid waste will be landfilled at Kekaha Landfill, thus air pollution emissions associated with refuse and landfills would be minimal. Conservation and recycling programs could also reduce solid waste generation, thereby reducing their associated emissions.

Emissions from the boat operations at the marina will be minimal.

Compliance with safety guidelines for the spraying of chemicals for golf course maintenance should mitigate potential air quality impacts.

1.4.6 Flora and Fauna

The proposed development will remove existing vegetation and disturb existing animal species. However, there were no rare, threatened or endangered plant or animal species found on the site.

1.4.7 Marine Biology

A marine biological survey was performed in Kukuiula Bay to identify existing conditions and to assess potential impacts resulting from the dredging of a navigational channel for access to the proposed marina. The survey indicated a prevailing low diversity of marine biota activity in the area and found no rare, threatened or endangered species. The threatened monk seal and the green sea turtle, chelonia mydos, however, are known to occur in the area and the endangered humpback whale may transit the area between December and March. Precautionary measures to assure that endangered species are not affected can be a part of the special conditions for construction of the marina.

Construction of the marina will create new habitat for marine algae and juvenile fish. Impacts from the marina operations are minimal, since the currents move rapidly into offshore waters, causing mixing and dilution. In addition, other pollutants associated with marina operations, are not expected to have significant adverse environmental impacts.

1.4.8 <u>Archaeology</u>

The archaeological survey identified numerous archaeological sites within the project boundaries. Three significant sites have been recommended for preservation. Two heiaus and a large habitation and agricultural site containing a series of raised aqueducts (auwai) not known to be found anywhere in Hawaii except in Koloa will be preserved. The larger heiau site was discovered during this survey in the middle of the cane lands in the western part of the proposed project, partially covered by field boulders. This unnamed heiau is not listed in the National and State Registers of Historic Places. In addition to the sites recommended for preservation, a Portuguese oven site, an elevated section of a railway berm and four caves, recently (September 1988) placed back on the State Register of Historic Places will be preserved. All other significant archaeological sites not recommended for preservation will be subject to a program of subsurface testing followed by intensive excavation of selected sites and features. These sites may also be incorporated into open space or landscaped areas wherever possible. A preservation plan and archaeological data recovery plan will be prepared and submitted for approval by the appropriate governmental agencies prior to any work performed on the sites. In the event burials are found, reinterment will be performed according to Department of Health regulations. An area will be designated for reinterments on site with proper blessing ceremonies.

1.4.9 <u>Agriculture</u>

Approximately 600 acres of land presently in sugarcane cultivation will be withdrawn from cultivation. This acreage represents 0.3 percent of the State inventory and 1.4 percent of Kauai's inventory of cane lands. Adverse impacts resulting from the withdrawal of these cane lands are not considered significant, because of the questionable economic viability of the sugar industry. Competition from foreign countries and other sugar sources has resulted in negative profitability for the sugar industry. There are about 25,000 acres of Classes A, B and C (LSB System) agricultural lands on Kauai that are not being used productively.

McBryde Sugar Company is expanding into other agricultural pursuits. The Company has diversified into production of macadamia nuts and is currently experimenting with coffee and tea. If McBryde's diversified agricultural programs prove to be successful, the agricultural industry on Kauai will benefit.

The reduction of "prime" agricultural lands will not occur immediately. Agricultural lands will be converted to urban use on a phased basis. This area is anticipated to be one of the latter phases of the project because of McBryde's diversified agricultural pursuits.

The proposed project is contiguous to urban and resort development in the Koloa District. This area also has a relatively high demand for new housing resources. The proposed development will help to meet the needs of this growing community. In addition to the variety of housing products proposed, recreational facilities, open space and commercial uses are proposed to complement the overall development.

1.4.10 Visual Resources

The development will change the visual quality of the existing landscape. Its current use as cane fields and scrub brush pasture with rock outcrops will be replaced by pavement, structures, planned landscaping, a golf course, parks and open space. The residential development will provide people the opportunity to enjoy dramatic ocean views from their homes.

From the perspective of the existing homeowners living on Lawai Road, the project could be seen as having a negative visual impact. To minimize visual impacts, a 100-foot wide setback will be established on the mauka side of Lawai Road from the edge of Metropolitan Mortgage Company's development to the proposed commercial area. This area can be developed with landscaping, a pedestrian/bike path and/or parking. In any case, the proposed project will not obstruct the more dramatic ocean views that are currently enjoyed by existing Lawai Road area homeowners.

1.4.11 Social and Economic Conditions

This development will complement the projected growth of the Koloa District. Poipu, located in the Koloa District, is one of Kauai's major resort destinations. This project will provide additional visitor accommodations, numerous employment opportunities, recreational facilities and a variety of housing products. The project's proposed contribution of support facilities over the next 20 to 25 years is consonant with the projected population and economic growth of this community.

1.4.12 Flooding and Drainage

The proposed drainage system will improve the existing drainage conditions by capturing, retaining, and diverting most of the storm water runoff mauka of the existing developments. The golf course will serve as a series of retention basins and swale to capture most of the mauka stormwater runoff and route these flows to an outlet at Kukuiula Bay. Flows will be discharged into Class A receiving waters. Drainage makai of the golf course will be carried by underground drain lines to retention and siltation basins on site and to an existing ocean outlet.

1.4.13 Potable Water

The new water source and storage facilities proposed will provide a surplus of developed water during the earlier phases of the development. When completed, the overall development will require approximately 1.9 million gallons (mg) of water per day, which is more than the projected 1.7 mg expected from the new well. Careful testing of the well will be required to determine the well's actual capacity and to protect the aquifer. Until testing of the well is performed, it cannot be determined if another new well will eventually be required. The new well will be developed in accordance with Department of Health regulations and Board of Water Supply standards.

1.4.14 Circulation System

Although the traffic volumes will increase with the proposed development, improvements to some of the existing roadway system and the possible extension of the connector road paralleling Poipu Road to Koloa Town will improve existing traffic circulation in the immediate vicinity of the site.

1.4.15 Solid Waste

Solid waste will be disposed of by the Kauai County Department of Public Works at the Kekaha Landfill. The County's plans to construct a transfer station near Koloa Town will reduce the distance that refuse collection vehicles must travel. A&B will coordinate with and participate in the Kauai County Dept. of Public Works long range planning of this transfer station. Commercial and resort facilities will utilize private collection services. Other solid waste disposal methods to assist in increasing the life span of the landfill site include shredding, baling, resource recovery and incineration.

1.4.16 Wastewater Treatment and Disposal

The development of a new wastewater treatment, collection and disposal system will assist the County in its plans for a regional wastewater system. A&B will coordinate the sizing of improvements and schedule of construction with the Kauai County Department of Public Works. Land will be set aside for expansion of this facility to accommodate the additional 1.5 million gallons per day (mgd) projected in the County's Facility Plan for the Koloa-Poipu area, as cesspools and private wastewater treatment plants are taken out of service.

1.4.17 Power and Communications

A new electric substation and telephone switching station will probably be required. The new facilities required will be coordinated with Kauai Electric Company and the Hawaiian Telephone Company. These new facilities will be linked to the existing systems and improve service in the Koloa-Poipu area. Underground power and communication lines are proposed and will include electric, telephone and cable services.

1.4.18 Fire and Police Services

The project will be serviced by the Kauai Fire Department from a substation in Koloa Town. The fire department also assists in search and rescue operations on land and in the water. The Waimea substation of the Kauai Police Department will provide police service. Fire service is adequate to serve this future development. Additional police officers will be needed as the population in the Koloa area increases.

1.4.19 Medical Facilities

The Koloa branch of the Waimea Dispensary, Koloa Branch of the Garden Island Medical Group, and the Koloa Office of the Kauai Medical Group will serve the new development. Ambulance service is provided by Pacific Ambulance Service which operates out of Waimea, Hanapepe and Lihue. The fire department and the Coast Guard also provide emergency service.

1.4.20 Schools

The existing Koloa Elementary School and the Kauai Intermediate and High School are currently operating at capacity. A&B will reserve land adjacent to the Koloa Elementary School for expansion of their facilities. Ultimately, the proposed project is expected to increase enrollment at Koloa Elementary School by approximately 400 students. Kauai Intermediate and High School is projected to increase by 250 students. The projected 20 to 25-year project time frame will have an annual increase for the elementary and intermediate and high schools of 18 and 12 students, respectively.

1.4.21 Recreational Facilities

The development will increase the variety of recreational facilities in the Koloa-Poipu District. Water-related recreational facilities will include a new marina which can accommodate 100 to 150 boats. Space will be reserved for expansion of the existing boat launching ramp and related facilities in the immediate vicinity creating additional oceanfront land for the public. An 18-hole golf course, which will be open to the public, is planned. The clubhouse will probably also have public tennis and swimming pool facilities. Three neighborhood parks are also proposed to be developed on site.

Pedestrian/bike paths are proposed along the major roadways and along Lawai Road from the Lawai Beach Resort to the end of Lawai Road to the west. A 100-foot setback, which has been established along Lawai Road in the Phase I area, will also include parking facilities.

1.5 RELATIONSHIP TO PLANS AND POLICIES

The proposed development is generally consistent with the overall goals and objectives for the development of the County and the State of Hawaii. This planned community provides for a variety of housing choices, recreational facilities, improved public facilities, additional visitor accommodations and both short term construction jobs and long term permanent employment. The growing Koloa-Poipu community will benefit considerably from the proposed development.

1.6 NECESSARY PERMITS AND APPROVALS

The following is a list of permits and approvals required prior to implementation of this project:

AUTHORITY	APPROVAL REQUIRED
Federal Government	
Dept. of the Army Corps of Engineers	COE Permit for Proposed Channel Dredging
State of Hawaii	
Land Use Commission	District Boundary Amendment
Department of Health	NPDES Permit for new Wastewater Treatment Plant
Department of Land and Natural Resources	Conservation District Use Permit for Proposed Channel Dredging
	Preservation Plan & Archaeological Data Recovery Plan
Department of Business and Economic Development	Coastal Zone Management Federal Consistency Clearance for Proposed Channel Dredging

County of Kauai	
County Council and Planning Department	General Plan Amendment
	Zoning Permit
	SMA Permit
	Shoreline Setback Variance
	Preservation Plan & Archaeological Data Recovery Plan
	Subdivision Approval
	Area-Wide Clearinghouse
Department of Public Works	Grading Permit
	Drainage Master Plan Approval
	Sewer Master Plan Approval
	Subdivision Plat Map Approval
	Erosion Control Plan
Building Department	Building Permits

1.7 ALTERNATIVES CONSIDERED

Alternative plans that were tested ranged from a 700-acre development to a 2,000-acre development. Major existing constraints, such as the cane haul road, were removed in some schemes to analyze different options.

The proposed plan evolved in response to financial feasibility factors, community concerns and needs, and to minimize adverse impacts.

The "no action" alternative would continue the use of the site as barren pasture lands and sugarcane fields. Residents in the vicinity would continue to be exposed to smoke from cane burning, flooding during storms, continued use of cesspools or private treatment plants and possible brush fires from the dry pasture lands.

Advantages of the "no action" alternative would include continued use of portions of the land for sugarcane cultivation and no adverse impacts from the proposed development.

The major disadvantages of the "no action" alternative would be the absence of a unique mix of housing types to meet visitor, part-time and local residential needs; improved infrastructure facilities; numerous employment opportunities; and increased land and water related recreational facilities.

SECTION 2

Project Description

SECTION 2
PROJECT DESCRIPTION

2.1 OVERVIEW

The Kukuiula Planned Community Project is located in the Koloa District on the south side of the "Garden Island" of Kauai. The project will utilize approximately 1,000 acres of land. The site is currently being used for sugarcane cultivation and marginal pasturelands. The proposed land uses include single-family lots, multi-family units, an 18-hole golf course, a resort complex, a marina, three neighborhood park sites, a sewage treatment plant, two commercial areas, walkways and bikeways, greenbelts, and open space buffer areas (see Figure 2-1).

This project is proposed to be developed in two major phases. Phase I consists of 219 acres which already has received the necessary County and State land use designations for urban development, except for 6 acres still zoned agriculture. Rezoning of this 6 acres will be requested as part of Phase II. Phase II, consisting of approximately 800 acres, still requires County and State land use approvals. This EIS describes the project and related impacts and mitigation measures as one project. The subsection "Project Phasing and Costs," in this section, itemizes the project land uses by phases.

2.2 THE MASTER PLAN

The master plan for the Kukuiula Planned Community provides flexible guidelines for the future development of the project. Various factors including actual absorption rates and financing details will necessitate modifications in the location, density and market characteristics of land uses and product types. Construction of the initial increments of the project is expected to start by the year 1990. Complete project implementation is expected to take approximately 20 to 25 years to the year 2010 or 2015.

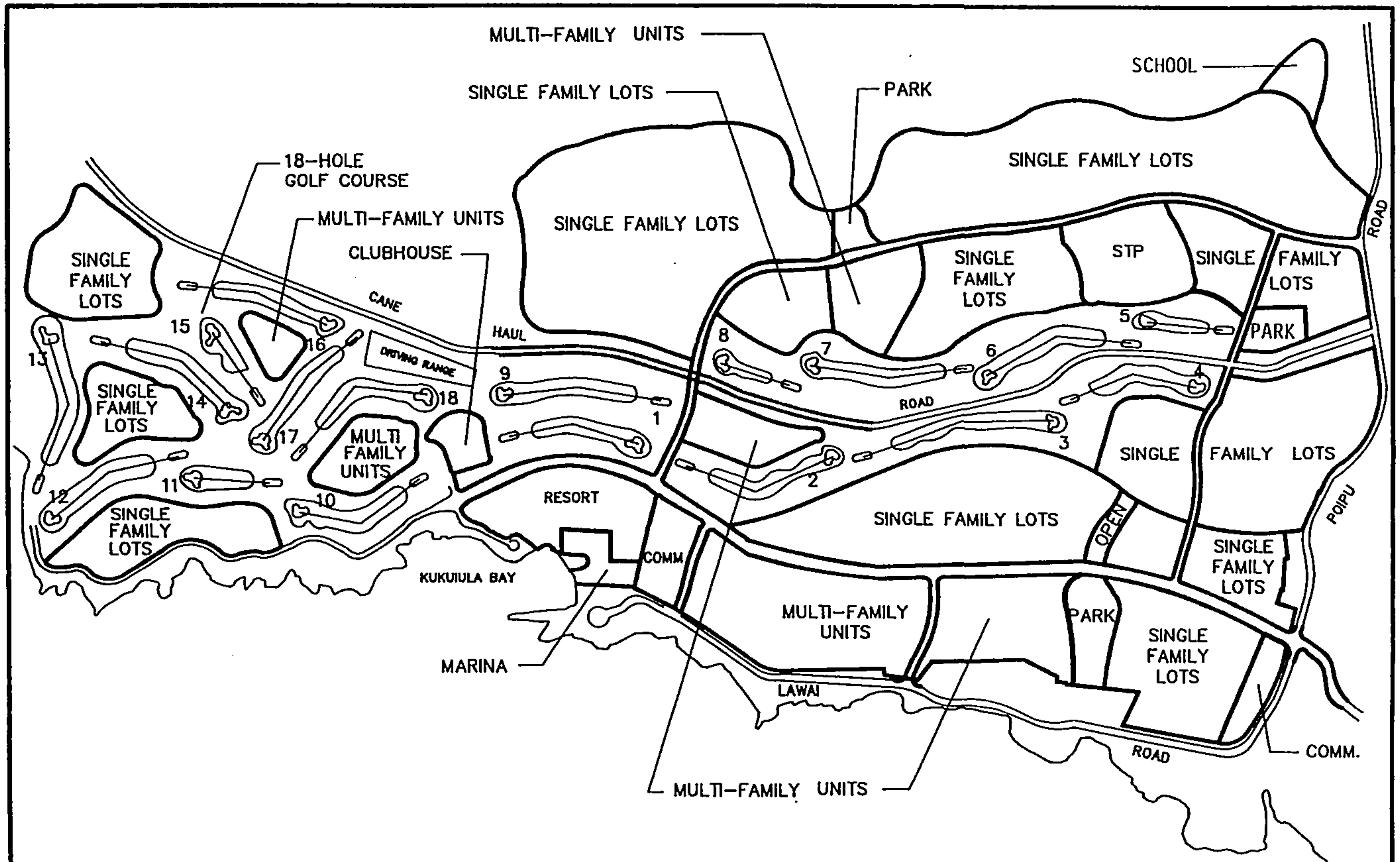

FIGURE 2-1

PROPOSED DEVELOPMENT PLAN
KUKUIULA PLANNED COMMUNITY
Koloa, Kauai, Hawaii

For: A&B Properties, Inc.
By: R. M. Towill Corporation

2.2.1 Residential

Residential development consists of single-family lots and multi-family units covering approximately 55 percent of the total 1,000+ acre development. Single-family residential development is planned for approximately 2,600 lots and multi-family development is planned for approximately 1,400 units.

2.2.1.1 Single-Family Residential

Two density types are planned for single-family development. The lower type of density is proposed in the western portion of the site; west of the Aepo Stream to Lawai Valley. Lots here are expected to average about 7,000 square feet on land currently in sugarcane. This lot size results in a density of approximately 5 lots per acre. Given the acreage, this area could yield approximately 300 lots. Most of the lots in this vicinity will have golf course frontage and/or dramatic views of the ocean, mountains or the Pacific Tropical Botanical Gardens in Lawai Valley. The climb in elevation from the ocean cliffs (elevation 55± feet) up to the cane haul road (elevation 230± feet) provides ocean views from almost anywhere in this area.

The second single-family density type will occur to the east of Aepo Stream to Poipu Road. The variation in slopes for this area from relatively flat land to steeper hillside slopes will create a variety of lot sizes. Lots are expected to range from 5,000 square feet to 8,000 square feet. Using this range of square footage, density is expected to be about 6 lots per acre (R-6) or about 2,300 lots. Panoramic ocean and mountain views can be enjoyed from lots at higher elevations. A few lots will have golf course frontage. The location of the golf course in the lower elevations will provide residents upslope with an additional visual amenity. The remaining single-family lots occur on the flatter areas of the site. Some of the lots in this area will also have golf course frontage.

2.2.1.2 Multi-Family Residential

Multi-family units have also been divided into two density categories: "low density multi-family" at 10 units per acre (R-10) and "medium density multi-family" at 20 units per acre (R-20). A mixture of R-10 and R-20 multi-family units is situated near the coastline, adjacent to existing multi-family development. Other blocks of land planned for R-10 density are located adjacent to the golf course.

The R-10 units will typically be two-story townhouses designed in clusters. One of the low density multi-family clusters is planned in the western section, integrated within the golf course layout. The northern section contains an R-10 site just south of the Manuhonuhonu Reservoir and adjacent to the seventh fairway. Another R-10 site is planned just makai of the cane haul road, stretching along the length of the second fairway.

R-20 units are expected to be three to four-story buildings and are proposed in an area adjacent to existing R-10 multi-family units and next to the proposed commercial area at the marina.

The varied densities and proximity to amenities create a wide range of housing types that will provide housing opportunities for all types of people.

2.2.1.3 Affordable Housing

The County of Kauai has recommended that A&B either provide 10 percent of the total unit count of the Phase I development for affordable housing on or off site, donate land to the County or sell single-family and multi-family housing units at below market prices. A&B plans to meet the affordable housing needs both on and off site for both phases of the development. A mix of single and multi-family housing will be provided for affordable housing needs. It has not been determined at this time what percent of the Phase II development would be reasonable or financially feasible for affordable housing. Affordable housing will probably be developed away from the resort oriented activities to provide a better environment for the expected younger age group buyers raising new families. Alternatively, on-site affordable housing may be integrated among market units rather than designating a specific area for this development. Employee housing will be made available to employees within the site and will be developed as part of or in conjunction with the affordable housing program.

2.2.2 Commercial

Two commercial areas have been designated for this development. The first, located near the intersection of Poipu Road and Lawai Road, is a neighborhood commercial area that could provide convenience stores and services for area residents. The second commercial area is planned to support the resort development and the marina at Kukuiula Bay. Shops here may include marina related stores, restaurants and gift shops. Each of these commercial areas will utilize approximately 6 acres.

2.2.3 Marina

Approximately 10 acres extending inland from a new 80 to 160-foot wide entrance channel in Kukuiula Bay are proposed to be developed for the marina (Figure 2-2). There are 100 to 150 boat slips planned for this marina. Slips are expected to accommodate vessels ranging in size from 25 feet to as large as 60 feet. Other facilities relating to the operation of the marina include administrative offices, parking, a marine supply store, a comfort station and a fuel dock. A two-story structure is planned at the entrance of the marina. This structure could house marina administrative offices on the ground level and a restaurant on the upper level. The fuel dock can be located on the peninsula fronting the restaurant. The comfort station probably will be located in the marina parking facilities. The adjacent commercial area can accommodate the marine supply store.

Wastewater from vessels can be disposed of by providing a pumping facility within the proposed marina facilities. This pumping facility can be integrated with the wastewater disposal system developed for the adjacent resort and commercial uses. Alternatively, wastewater from boats can be collected and then trucked to the wastewater treatment plant.

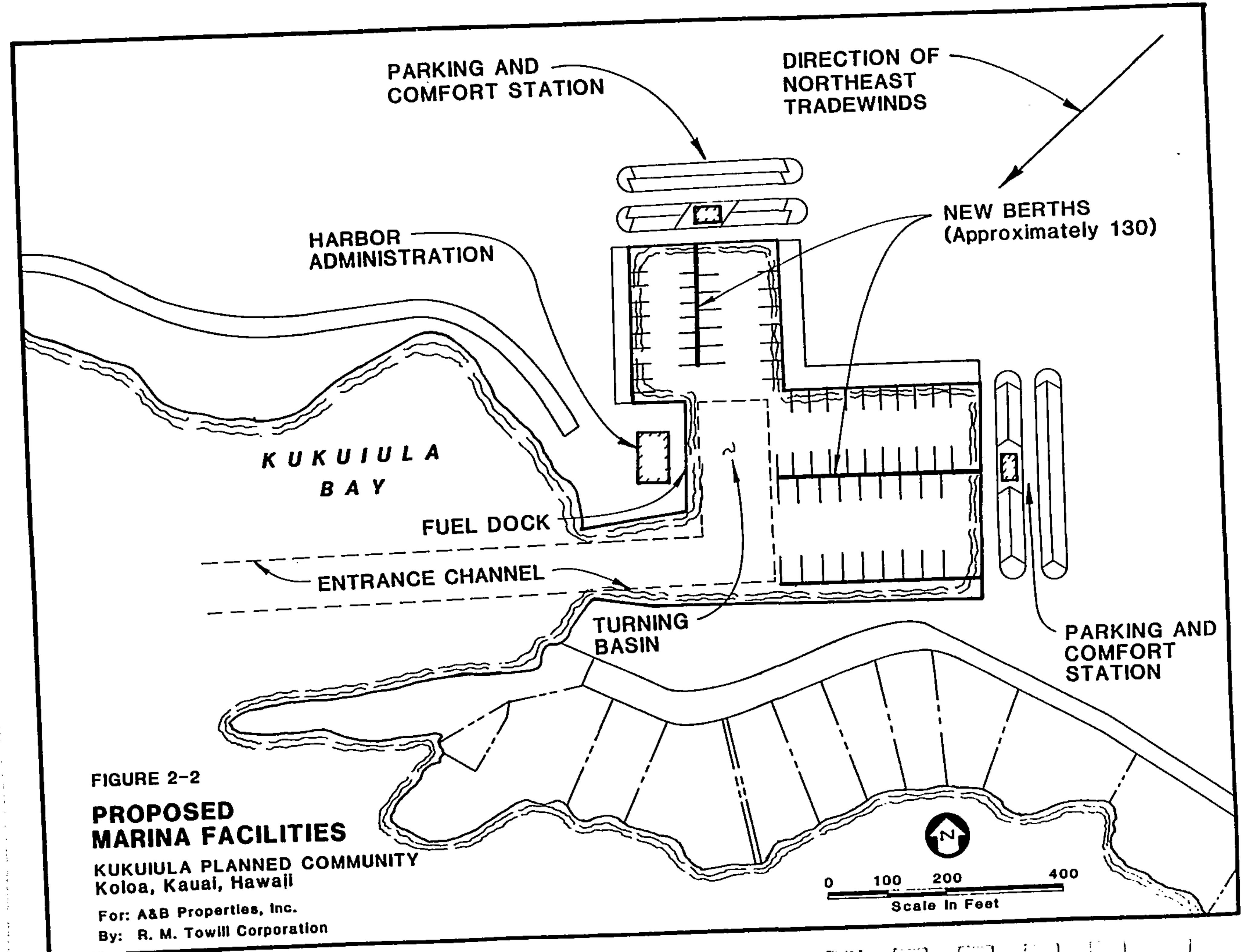

FIGURE 2-2

PROPOSED MARINA FACILITIES

KUKUIULA PLANNED COMMUNITY
Koloa, Kauai, Hawaii

For: A&B Properties, Inc.
By: R. M. Towill Corporation

The marina is expected to house a mix of commercial fishing, tour boats and private boats. These slips may either be rented or sold. Drydock repair facilities are not planned to be developed at this proposed marina. Nawiliwili Harbor, located 12 miles to the east, has drydock and repair facilities. Boats may be taken to Nawiliwili Harbor for repairs.

A&B will reserve land near the existing boat launching ramp for future expansion of these facilities. The existing boat ramp and parking facilities will not be affected by the marina development. Expansion of these facilities will create additional oceanfront property for use by the public.

2.2.4 Resort

The resort facilities are presently planned for about 20 acres adjacent to the marina. This resort facility is expected to be developed to include approximately 500 hotel rooms, related restaurants and shops, parking facilities, tennis courts and a swimming pool. The resort's proximity to the marina, commercial area and golf course provides additional activities for guests of this resort complex.

2.2.5 18-Hole Golf Course and Related Facilities

A privately operated 18-hole golf course is planned to extend almost the entire length of the project site (east to west). This golf course and related facilities will be open to the public at reasonable rates. The clubhouse is located just west of Aepo Stream and may include tennis facilities and a swimming pool. The first nine holes will start to the east of the clubhouse and follow a linear pattern along both sides of the existing cane haul road. The second nine holes will start to the west of the clubhouse and meander through the residential area to maximize golf course frontage lots.

In addition to providing a recreational facility, this golf course will serve two other purposes. The fairways will serve as a series of major retention basins and drainage swale to capture most of the mauka storm water runoff and route these flows to a major outlet at Kukuiula Bay. Secondly, it will serve as a buffer to the cane haul road to assist in controlling dust and noise impacts on nearby residential development.

2.2.6 School Site

Earlier master planning studies located a new 10-acre elementary school site within the project boundaries. After discussions with the County of Kauai, it was agreed that A&B will reserve land adjacent to the nearby Koloa Elementary School for expansion of their facilities. The acreage that will be reserved for school expansion is within the project boundaries.

2.2.7 Parks and Open Space

Presently, there are three neighborhood park sites planned within the project limits. The largest is located adjacent to and mauka of the existing Prince Kuhio Park. A&B plans to donate some of this land to Prince Kuhio Park for expansion of their facilities. The remaining land will be deeded to the County for eventual development into a neighborhood recreational park. This park will also contain several archaeological sites that are to be preserved.

A 4-acre park site is located just below the Manuhonuhonu Reservoir. This site can be developed by the County into a neighborhood recreational park with landscaping, court areas, a comfort station and parking facilities.

The third park is sited near the secondary collector road in the northeast sector of the project. This 6-acre site may also be developed by the County into an active neighborhood park, which could include ballfields.

A 100-foot buffer zone along the Phase I area has been established on the mauka side of Lawai Road. This buffer strip can be developed to include parking and a pedestrian/bike path. The pedestrian/bike path can also be extended to the end of Lawai Road.

Open space buffer areas between housing developments will be incorporated. These buffer areas create a more private and open atmosphere between developed areas. Some of these open space buffer areas are created because of steep unbuildable slopes or by natural drainageways.

2.3 INFRASTRUCTURE

2.3.1 Flooding and Drainage

A drainage system will be developed to include road gutters, catch basins, drain lines, box drains, box culverts, bridge culverts, drainage channels, retention basins, siltation basins and drainage swales. As previously mentioned the golf course will also serve as a major drainage swale and a series of retention basins to capture most of the storm water runoff from areas mauka of the golf course. During storms the golf course fairways will hold most of the water then route these flows to major drainage channels and retention basins in the vicinity of the marina resort complex and then into the ocean at Kukuiula Bay. Daily drainage will be routed via an open grass channel maintained on the golf course to the outlet at Kukuiula Bay.

Drainage in areas makai of the golf course will be accommodated by an underground drainage system to retention and siltation basins on site then discharge into the ocean through an existing box culvert fronting the Lawai Beach Resort.

Receiving waters at the two existing points of discharge (Kukuiula Bay and the outlet at Lawai Beach Resort) are classified Class A by the State Department of Health.

2.3.2 Potable Water

Because the existing water system is adequate only for the current needs in the area, water source and storage facilities need to be developed to service the proposed project. A new well is proposed at Mahaulepu where two wells already exist. This well is expected to produce approximately

1.75 mgd which will satisfy most of the 1.89 mgd ultimately required for this development. The additional 0.14 mgd will not be required until the last increments of the development. Testing of this new well will be required to determine its actual capacity. Two 1-mg storage tanks are needed to meet the storage requirements. The first tank is planned to be constructed during the initial phases of the project near an existing storage tank just above Koloa Elementary School. The second tank is planned for construction north of the cane haul road and west of the mauka residential area.

The water distribution system will consist of 8-inch and 12-inch water lines forming a complete loop and will connect Lawai Road to the new water system, the storage tank and possibly a pumping station. The existing water distribution system may also require some upgrading.

2.3.3 Circulation System

There are two major points of entry to the project site off Poipu Road. The major entrance to the project site will be at the intersection of Poipu and Lawai Roads. This intersection is planned to be reconfigured into a cross intersection: Poipu Road onto Lawai Road and the New Poipu Beach Road onto the new project road. This reconfigured intersection will improve existing conditions by providing a safer movement of traffic. From this intersection, a major four-lane divided roadway winds through the south side of the project and eventually connects back to Lawai Road near the Spouting Horn Park. Because of the proposed marina, portions of the existing Lawai Road are planned to be removed, resulting in Lawai Road having to dead-end on both sides of the marina. A collector street will connect the new divided roadway to the existing Lawai Road, providing easy access to coastal amenities. Alternatively, Lawai Road could be relocated around the marina, providing a scenic oceanfront roadway for the public. The pedestrian/bike path may also follow along this route.

The second entrance off Poipu Road is located farther north to serve the northern portions of the project. This collector road travels through the northern section of the project site and connects back to the four-lane divided roadway near the proposed resort complex.

A two-lane roadway is planned through the eastern section of the project site. This road will begin at the new four-lane divided roadway and travel north to intersect with the northern collector road. This road may be extended to Koloa Road to serve as a second major north/south roadway. Because the land between Koloa Road and the project is not owned by A&B, the intersection with Koloa Road cannot be determined at this time.

An existing cane haul road traverses the central area of the project site and will remain in operation for the foreseeable future. A portion of this cane road (from Aepo Stream going east approximately 2,200 feet) is planned to be realigned to the north providing additional space to accommodate the proposed facilities in the makai area.

2.3.4 Solid Waste

Solid waste will be collected by the Kauai County Department of Public Works and disposed of at the Kekaha Landfill. Refuse collection for the commercial and resort facilities will be handled by private collection services. During the 25-year development time frame, there will be an annual increase of 1.5 tons of solid waste per day. When the project is fully occupied (year 2015), approximately 38 tons of solid waste per day will be generated.

2.3.5 Wastewater Treatment and Disposal

The existing wastewater treatment and disposal facilities in the Koloa-Poipu area consist of private sewage treatment plants and cesspools. Presently, there is no public sewer system in the Koloa-Poipu area.

The recently completed Facility Plan (1988) for the Koloa-Poipu area indicated a need for a regional wastewater treatment plant. The County's regional plans will be taken into consideration in the design and development of the wastewater treatment and disposal facility planned for this project.

A new wastewater treatment plant is planned in the northern section of the project. The treatment plant is proposed to provide secondary treatment through the use of aerated lagoons. The proposed development will require two lagoons to treat approximately 1 mg of sewage per day. The treatment plant will also include a control building with headworks, an odor control system and a chlorination system. Because of the County's plans for a regional wastewater treatment plant, an 18-acre site has been reserved for expansion of this facility to include two additional lagoons for development of a regional wastewater treatment plant. The addition of the two lagoons will increase the capacity of the plant by an additional 1.5 mg of sewage per day as projected in the County's Facility Plan. A mechanical plant could alternatively be designed and constructed to accommodate the sewage generated by the development. If a mechanically operated plant is developed, only 5 acres of land will be required. Should an ocean outfall pipeline be needed, an easement will be provided through the site. Ultimately, the regional wastewater treatment plant will be able to treat 2.5 mg of sewage per day.

Sewage generated by this project will be conveyed via gravity sewer mains, primarily within the roadways, to the wastewater treatment plant or to underground package sewage pumping stations in the low areas of the project. The raw sewage will then be pumped up to the wastewater treatment plant through force mains, then gravity flow into the plant headworks.

Approximately 1 mgd of effluent is expected to be generated by this development. The treated effluent is planned to be chlorinated and used to irrigate the golf course. Injection wells are also proposed to provide an emergency effluent disposal system.

The proposed wastewater treatment plant and disposal system will be designed in accordance with County of Kauai standards. Sizing of improvements and schedule of construction will be coordinated with the Kauai County Department of Public Works.

2.3.6 Power and Communications

Electrical power will be provided by Kauai Electric and telephone service by the Hawaiian Telephone Company. A 57 KV transmission line from Kauai Electric's Hanapepe power plant follows along the major cane haul road traversing the site to a substation near Koloa Town. Existing residents are serviced by a 3 phase, 12 KV distribution line along Lawai and Poipu Roads. The Hawaiian Telephone switching station is also located in Koloa.

Both the existing electric substation and the telephone switching station may not be able to accommodate the proposed development. A new electric substation and a telephone switching station may need to be provided on site in accordance with the Kauai Electric and Hawaiian Telephone requirements. A new substation and switching station would improve the existing electrical and telephone service to the Koloa-Poipu area. A system of underground ducts is proposed to accommodate electric, telephone and cable services.

2.3.7 Landscaping

Landscaping is proposed along the three major roadways within the project site. These roadways include the four-lane divided roadway in the south, the two-lane collector road through the northern section and the roadway in the east, connecting these two roads.

The four-lane divided roadway in the south is planned to have a landscaped median strip approximately 18 feet wide. This median strip will be narrowed at intersections to provide turn lanes. A 20-foot wide landscaped area is planned on the mauka side of the roadway with an 8-foot wide meandering pedestrian/bike path. The makai side of this roadway is planned for an 8-foot wide landscaped area (see Figure 2-3).

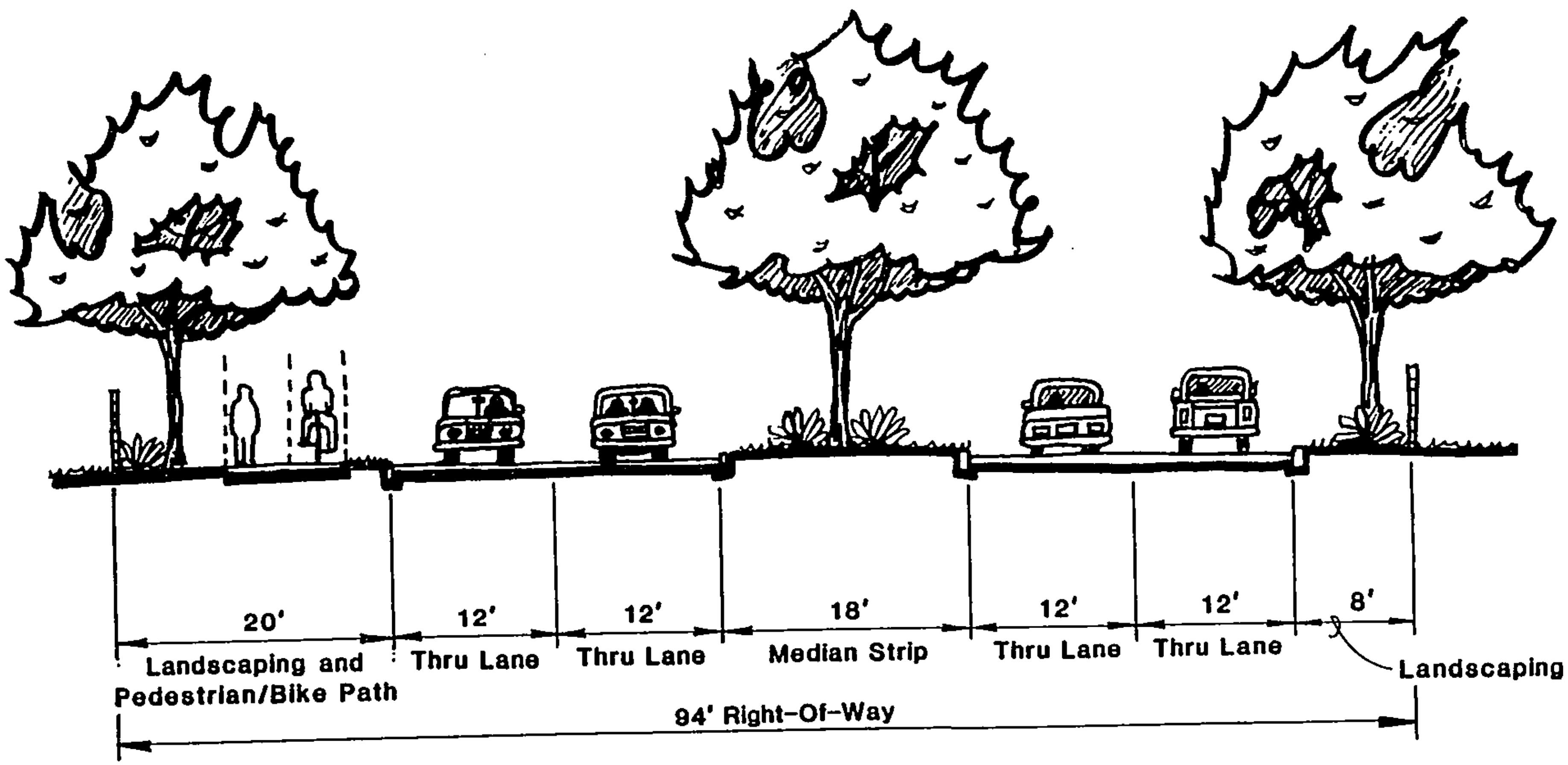

FIGURE 2-3

LANDSCAPE SECTION OF FOUR-LANE DIVIDED ROADWAY

KUKUIULA PLANNED COMMUNITY
Koloa, Kauai, Hawaii

For: A&B Properties, Inc.
By: R. M. Towill Corporation

The northern collector road provides an 8-foot wide landscaped area along both sides of the roadway. A 4-foot wide sidewalk can be provided on the mauka side of the road.

Landscaping along the road connecting the two major roadways will include landscaping and sidewalks on both sides.

Another major landscape feature includes a landscaped buffer strip along both sides of the major cane haul road. Landscaping along this major cane road is intended to help control dust and noise generated by its use. Landscaping along this road will be limited to areas adjacent to the proposed development. A berm planted with shrubs and grass could also be developed in lieu of trees and shrubs planted on a flat surface along the cane haul road.

Landscaping around the perimeter of the wastewater treatment and disposal facility will help to screen this facility from the surrounding residential developments.

A 100-foot wide setback along Lawai Road, from the edge of Metropolitan Mortgage Company's development to the marina, has been established and can be landscaped to buffer the development from existing residences. Beach parking or pedestrian/bike paths could also be included within this 100-foot strip to provide close access to coastal amenities.

2.4 PROJECT PHASING AND COSTS

2.4.1 Phasing

This project is currently divided into two major phases. The first phase, for which A&B recently received zoning approval, encompasses approximately 219 acres. Phase II consists of approximately 800 acres of which approximately 200 acres will be developed into a golf course. Table 2-1 summarizes the land use allocations by phases.

TABLE 2-1

LAND USE ALLOCATIONS
PHASES I AND II

Land Use	PHASE I Acreage	PHASE I Units	PHASE II Acreage	PHASE II Units
Single Family	123	738	320	1,900
Low-Density Multi-Family	44	440	40	400
High-Density Multi-Family	28	560	0	0
Commercial	*12	--	0	--
School	0	--	7	--
Resort	0	--	20	**500
Park	6	--	10	--
Marina	0	--	10	--
Major Roadways	***	--	30	--
Cane Haul Road	0	--	10	--
Sewage Treatment Plant	0	--	18	--
Golf Course	0	--	200	--
Open Space/Buffer	6	--	135	--
TOTAL	219	1,738	800	**2,800

* Six acres are designated "agriculture" according to County zoning.

** 500 hotel rooms are planned for the resort development at Kukuiula Bay.

***Acreage for the major roadway through the Phase I area is included in acreage for single and multi-family residential uses.

Phase I is expected to begin construction by 1990, provided all necessary approvals and permits are expeditiously processed. Development areas will be divided into approximately 10-acre parcels for incremental development by A&B or for sale to other developers. Phase I is expected to near completion by the year 2005.

Phase II is expected to begin construction by 1996 and near completion by 2015. Similar to Phase I, increments of approximately 10 acres will be developed by A&B or sold to prospective developers. The actual demand for the planned housing units will determine the development's completion date.

2.4.2 Costs

An "order of magnitude" cost estimate was developed for off-site, on-site and backbone infrastructure costs. This estimate includes construction costs, contingency and non-construction costs, such as surveying, designing, marketing and master planning. The cost of the land is not included in this estimate.

The ultimate cost of site improvements for this development, not including the land and buildings, is approximately $170 million. Off-site costs totaled $60 million and included new water facilities, a 1 mgd wastewater treatment facility, major drainage outlets to the ocean and improvements to the intersection of Poipu, Lawai and the four-lane divided project roadway.

Backbone costs included the two major project roads with related major utilities and is estimated to be $30 million. On-site costs for internal roadways with related utilities and lot preparation totaled $80 million.

Based on the "order of magnitude" cost estimate, the total site improvements cost per unit is approximately $35,000. This cost per unit does not include the construction of the golf course which will be an additional $12.5 million and the marina, which will cost as much as $8.8 million.

SECTION 3

The Existing Physical Environment and Related Impacts

SECTION 3
THE EXISTING PHYSICAL ENVIRONMENT AND RELATED IMPACTS

3.1 GEOGRAPHY AND CLIMATE

The proposed project is situated on the Island of Kauai, commonly referred to as the Garden Island because of its lush vegetation and beautiful mountains. Kauai is the northernmost and oldest of the State's major islands. It is the fourth largest island with a land area of 555 square miles. Kauai County includes the Island of Niihau, approximately 70 square miles, which is privately owned by the Robinson Estate.

Kauai, like the other Hawaiian Islands, consists of a huge shield volcano. Kauai's shield volcano is classified as the Waimea Canyon volcanic series and dates back to the late tertiary period, possibly the Pliocene epoch. After the emergence of this shield volcano, the island experienced a long period of erosion with no volcanic activity. Steep cliffs were formed around the island from wave activity. Deep canyons were cut by streams and rocks were weathered into soil material.

Volcanism was renewed by the Koloa volcanic series in the Quaternary period, possibly Pleistocene epoch, but was not continuous over the entire island. These Koloa flows covered much of the weathered Waimea Canyon flows and filled canyons and gulches, smoothing the topography. The most recent volcanic activity is near Koloa, on the southern side of the Island of Kauai, which is the vicinity of the proposed project.

Kauai lies just south of the Tropic of Cancer and has a mild semitropical climate, dominated by the northeast tradewinds which blow approximately 80 percent of the time. The tradewinds are sometimes interrupted by cyclonic disturbances, usually during the winter months, commonly known as Kona storms.

At elevations below 300 feet, the mean monthly temperatures range from 69°F in February and March to about 77°F during August through

October. The temperature drops about 3 degrees for each 1,000-foot increase in elevation. The temperature in the Koloa-Poipu area ranges from 72 to 79°F at approximately 50-foot elevation.

Mount Waialeale, located in the central area of the island, is considered the wettest place in the world with a median annual rainfall of 465 inches. Waimea, just 14 miles to the southwest, has a median annual rainfall of only 22 inches. The Koloa area has a median annual rainfall of approximately 70 inches. Much of the rainfall in the leeward areas of the island is attributable to the cyclonic disturbances.

3.2 LAND USES AND OWNERSHIP

3.2.1 Ownership

The Kukuiula Planned Community Project is situated on land owned by Alexander and Baldwin, Incorporated, or McBryde Sugar Company, a subsidiary of A&B (Figure 3-1). McBryde Sugar Company utilizes some of this land for sugarcane cultivation. Other areas of the project site are periodically used for pasture.

The project will encompass approximately 1,000 acres in the Koloa District. The tax map keys consist of 2-6-03:por. 1, 4, 23, por. 31, por. 32 and 2-6-04:10, 11, 16, 18, 38, 39, 40, 44, 45.

The coastal road, Lawai Road, extends approximately 2.5 miles from Poipu Road to Lawai Valley. Most of the oceanfront properties along Lawai Road were sold years ago by A&B to private individuals. Oceanfront properties that remain in A&B ownership are portions along Kukuiula Bay (800 feet) and steep cliffs immediately west of the Spouting Horn Park (1,200 feet). Other major landowners adjacent to the project consist of Knudsen Trust on the mauka side, and John W. G. Allerton Estate and the Pacific Tropical Botanical Gardens to the west in Lawai Valley. Lands owned by Knudsen Trust are generally used for sugarcane cultivation, under lease to McBryde Sugar Company. The Allerton Estate is a tropical garden started by Queen Emma in the 1890's, adjacent to the Pacific Tropical Botanical Gardens.

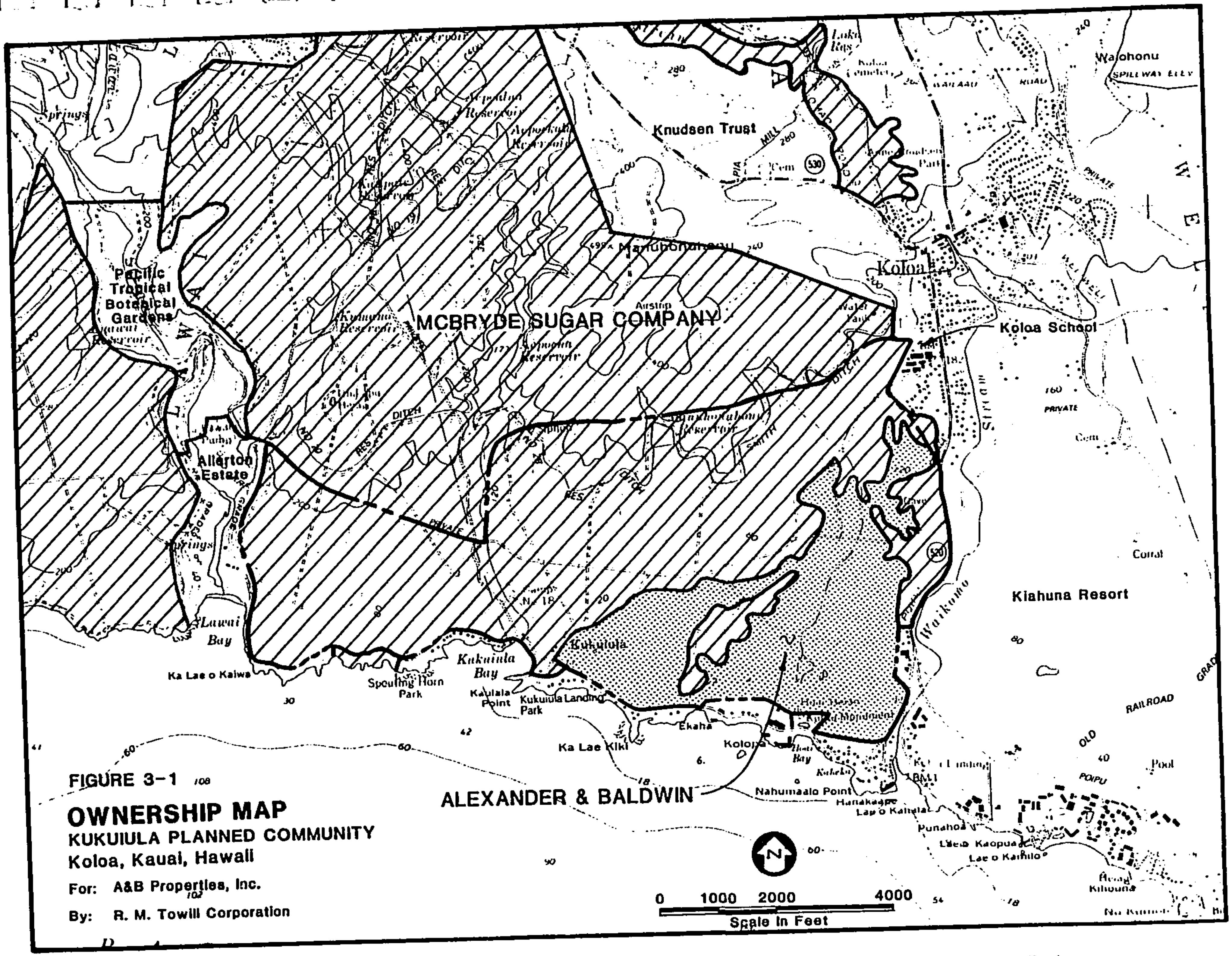

FIGURE 3-1

OWNERSHIP MAP

KUKUIULA PLANNED COMMUNITY

Koloa, Kauai, Hawaii

For: A&B Properties, Inc.

By: R. M. Towill Corporation

3.2.2 Existing Land Use

Land uses on the project site consist of pasturelands and sugarcane cultivation (Figure 3-2). The pasturelands are not actively being used for grazing because of limited and poor quality vegetation. The shallow soils here do not provide a good medium for the growth of vegetation.

The cane fields utilize "prime" and "other" agricultural lands, according to the State ALISH system (Agricultural Lands of Importance to the State of Hawaii). Approximately 24 acres of sugarcane (Field No. 529) are planted on "other" agricultural lands. This field is located in the middle of the pasturelands in the southeastern section of the site. McBryde Sugar Company plans to cease operation of this field in 1989 because of its isolated location and low productivity. The development will utilize approximately 300 acres of "prime" agricultural lands and 300 acres of "other" agricultural lands (see "Agriculture" in this section).

Adjacent land uses along the coastline include private residences, the Prince Kuhio Park, Kukuiula Small Boat Harbor, Spouting Horn Park and the Metropolitan Mortgage Company's resort-oriented multi-family development. Along the eastern boundaries of the project, along Poipu Road, there are private homes, a small commercial area, the Kiahuna Resort (across the street) and the Koloa Elementary School near the northeast side of the site. The areas north of the site are used for pasture and sugarcane, and are owned by McBryde Sugar Company, which then abuts the Knudsen Trust lands. The Allerton Estate and the Pacific Tropical Botanical Gardens in Lawai Valley border the western edge of the site.

A. Impacts

The loss of pasturelands will not have a significant impact on the supply of grazing lands in the area. The poor soils and limited vegetation available do not provide enough cattle fodder to make active grazing worthwhile.

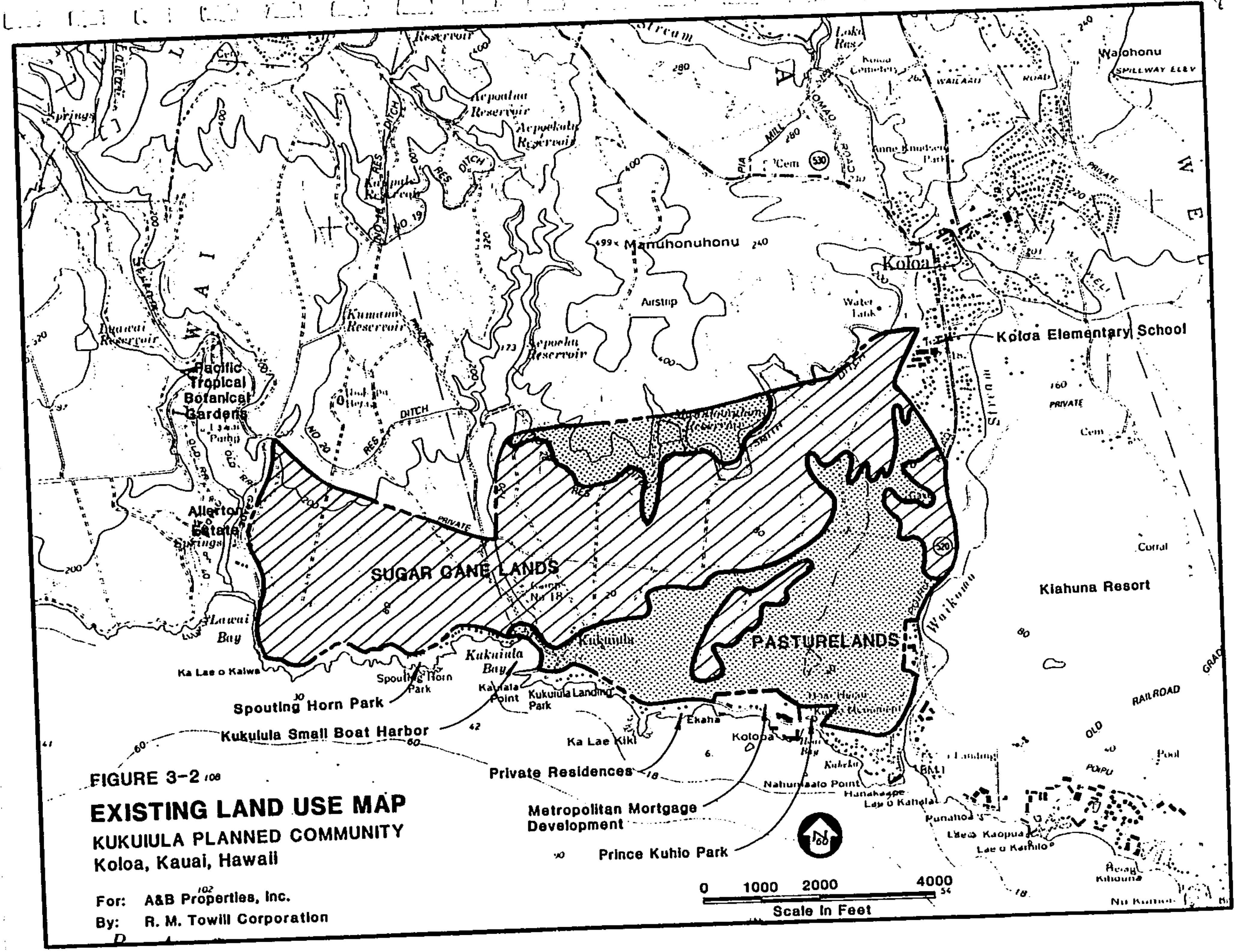

FIGURE 3-2

EXISTING LAND USE MAP

KUKUIULA PLANNED COMMUNITY
Koloa, Kauai, Hawaii

For: A&B Properties, Inc.
By: R. M. Towill Corporation

Approximately 600 acres of agricultural lands will be withdrawn from the agricultural inventory and be developed into the various uses as indicated on the development plan. More detailed information regarding impacts on agriculture is provided in the section entitled "Agriculture."

Significant impacts on adjacent land uses will be caused by the increase in traffic. Impacts from increased traffic are addressed in Section 5, paragraph "Circulation System."

B. Mitigation Measures

To minimize impacts on the adjacent land uses, especially to the coastal residential properties, a 100-foot setback along the mauka side of Lawai Road beginning at the west end of Metropolitan Mortgage Company's development to the proposed commercial area near Kukuiula Bay, will be reserved for landscaping, pedestrian/bike paths and/or beach parking. The western edge of the project, which borders the Allerton Estate and the Pacific Tropical Botanical Gardens, will be primarily developed into golf course fairways to minimize adverse visual impacts.

3.2.3 State and County Land Use Classifications

3.2.3.1 State Land Use

In 1985, the State Land Use Commission reclassified approximately 219 acres of land within the 1,000-acre site from "Agriculture" to "Urban." The remaining 800+ acres are situated on land classified "Agriculture" under the State Land Use System. A&B will petition for a District Boundary Amendment to change the land classification of the 800+ acres to "Urban" after approval is received on the County General Plan Amendment.

3.2.3.2 County Land Use and Zoning

The County General Plan designates approximately 219 acres of the 1,000-acre site "Urban Residential." The 800+ acres are designated "Agriculture" and "Open" (Figure 3-3). A&B filed a County General Plan Amendment Petition to change the 800+ acres to "Urban Residential" and "Resort" (Figure 3-4). This EIS has been developed to fulfill the requirements of the General Plan amendment process.

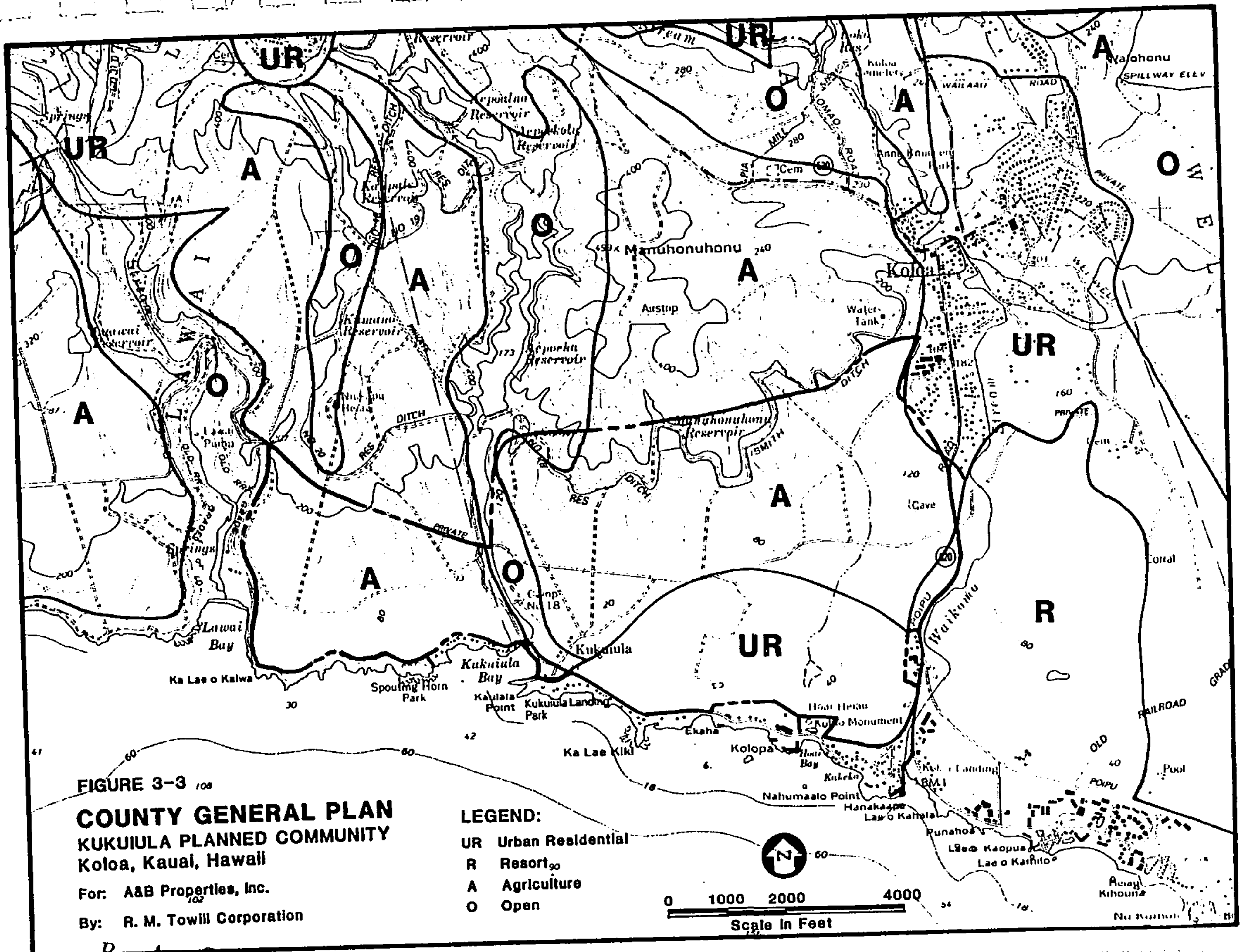

FIGURE 3-3

COUNTY GENERAL PLAN
KUKUIULA PLANNED COMMUNITY
Koloa, Kauai, Hawaii

For: A&B Properties, Inc.

By: R. M. Towill Corporation

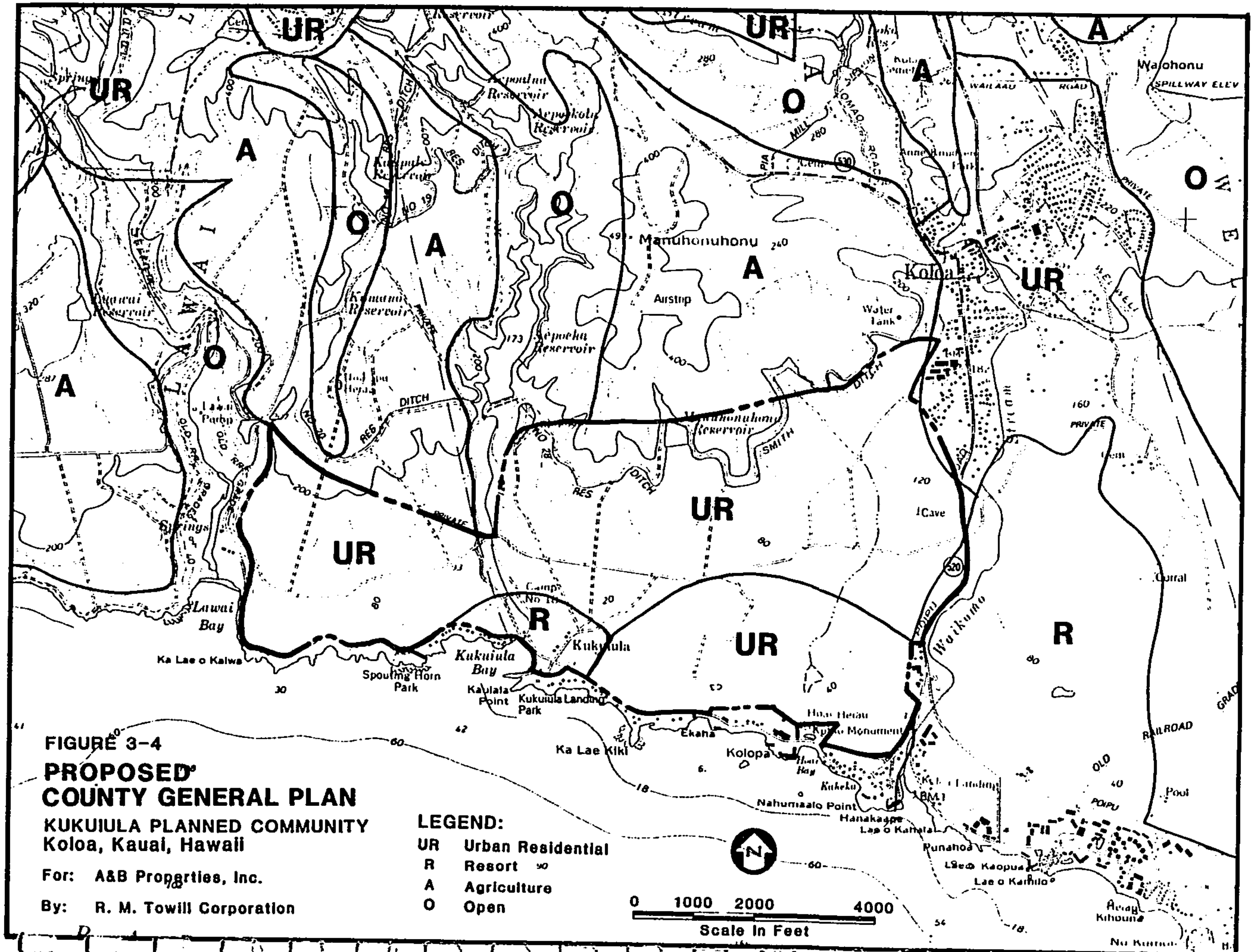

FIGURE 3-4

PROPOSED COUNTY GENERAL PLAN

KUKUIULA PLANNED COMMUNITY
Koloa, Kauai, Hawaii

For: A&B Properties, Inc.

By: R. M. Towill Corporation

LEGEND:
UR Urban Residential
R Resort
A Agriculture
O Open

0 1000 2000 4000
Scale In Feet

County zoning designation for the project area is currently "Agriculture" and "Open," exclusive of the 213 acres which has recently been changed to residential, commercial, open space and park. An application to rezone the remaining 800+ acres will be filed by A&B or other prospective developers wishing to take part in this development. This process will be pursued after approval is received on the General Plan amendment and district boundary amendment.

A. Impacts

The development will change the State and County designations of approximately 800 acres from "Agriculture" to "Urban." No significant adverse environmental impacts are anticipated due to the State and County land use reclassifications.

3.3 SOILS

Information on and maps of the soil types were obtained from the "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii," as prepared by the U.S. Department of Agriculture, Soil Conservation Service, August 1972.

The soils generally consist of silty clay, silty clay loam and stony silty clay. A few patches of Nonopahu clay soils (NnC) and Hanamaulu silty clay (HsB) occur just below the Manuhonuhonu Reservoir. The Nonopahu soils have a high shrink swell potential and workability is poor. In contrast, although closely associated, Hanamaulu soils have a low shrink swell potential and are favorable foundation material. Most of the soils, however, are the better Waikomo and Lihue soil series (Figure 3-5).

A large patch of Makaweli silty clay loam soils (MgB and MgC) occurs in the extreme west of the project site above Lawai Valley. The Makaweli soils are generally favorable for foundations, however, they are stony in places. Steep cliffs sloping down into Lawai Valley, along the western coastline and around the Manuhonuhonu Reservoir, are Rough Broken Land (rRR) or Rock Outcrop (rRO) soils. These unbuildable areas will be left as open space.

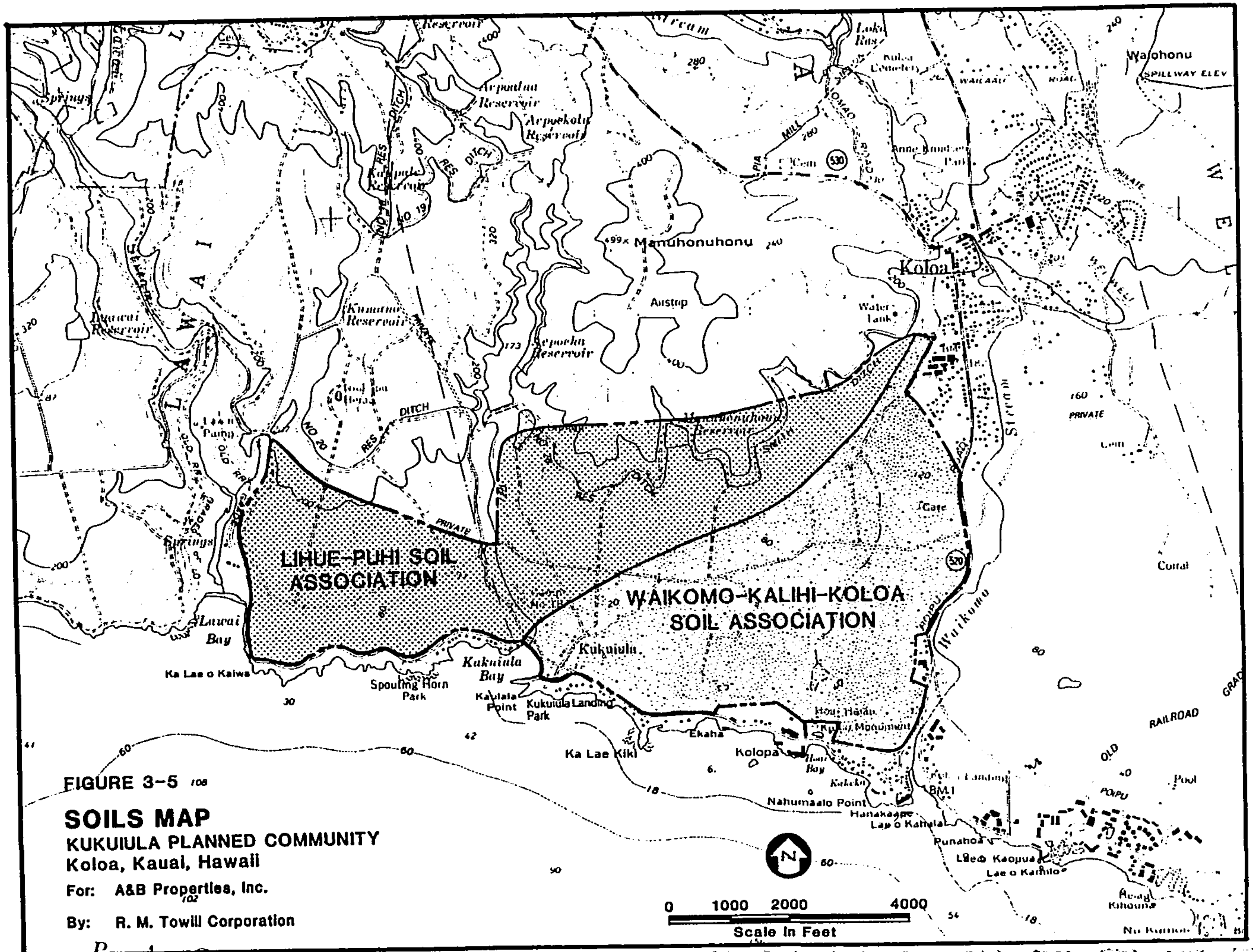

FIGURE 3-5

SOILS MAP

KUKUIULA PLANNED COMMUNITY

Koloa, Kauai, Hawaii

For: A&B Properties, Inc.

By: R. M. Towill Corporation

The Waikomo series (Ws, Wt, Wu) are poorly drained, stony and rocky silty clay soils. This soil series is geographically associated with Koloa soils (KvB, KvC, KvD) found in a few areas of the site. Waikomo soils are typically shallow, with less than 20 inches of soil material overlying bedrock. These soils are gently sloping from 2 to 6 percent. Permeability is moderate, runoff is slow and the erosion hazard is slight. Pasture, sugarcane, wildlife habitat and homesites are the primary uses on Waikomo soils. Presently, the Waikomo very rocky silty clay soils (Wt) are used as pasture.

Unlike the Waikomo soils, the Lihue silty clay soils (LhB, LhC LhD, LhE2) are deep and well drained. This soil type is geographically associated with Ioleau (IoC, IoD2, IoE2) and Puhi (PnC, PnD, PnE) soils which are also scattered throughout the site. Waikomo soils reach depths greater than 5 feet over bedrock. Slopes are gently rolling to steep, therefore runoff and erosion hazards vary significantly. Slopes from 0-15 percent have slow runoff and the erosion hazard is slight. Runoff is moderate to rapid and erosion hazard is moderate to severe at slopes of 15 percent and greater. These soils are used for sugarcane, pineapple, pasture, truck crops, orchards, wildlife habitat, woodland and homesites. Sugarcane cultivation is the current use on these soils.

A. Impacts

It is anticipated that the Waikomo soils will require expensive excavation because of the underlying bedrock. Fill material may be required on these soils to reduce excavation during construction. The Lihue soils will be relatively easy to grade for homesites, roads and utilities.

Erosion is evident along the northern section of the project site. Removal of vegetation during construction will cause erosion to occur at a much faster pace. Soil erosion during construction will increase the amount of silt entering the coastal waters, impacting the water quality.

The development will create impervious surface conditions, resulting in increased storm water runoff. Changes in the topography will also eliminate the ponding areas presently holding storm water runoff.

B. Mitigation

A borrow site for fill material and a stockpile area for the boulders will be designated on site. Boulders extracted from this area may be used as revetment material for construction of the marina.

To minimize soil erosion during construction, erosion control measures will be implemented according to the County regulations and as prescribed by an Erosion Control Plan. An Erosion Control Plan will be required for approval by the County of Kauai prior to construction. The plan will describe the measures required to minimize adverse impacts to the receiving coastal waters. The increase in storm water runoff will be mitigated as discussed in Section 5, paragraph "Drainage." Slopes above or adjacent to the development will be grassed to minimize erosion.

3.4 NOISE

Measurements of noise levels were performed at the project site in March 1988. Measurements were taken from existing traffic noise and sugarcane operations. Projections were made for increased traffic, golf course maintenance, stationary equipment, other noise associated with resort and commercial uses, and noise generated during construction.

Noise measurements taken along Lawai and Poipu Roads included background noise levels and a mix of vehicles (automobiles, trucks, heavy equipment, buses). Background noise levels along Lawai Road were 48 to 53 dBA under normal tradewind conditions. The dominant sounds were the wind in the foliage, distant traffic, the surf and birds. Periodically, helicopters flew over the ocean, paralleling the shoreline causing noise levels of up to 55 dBA. Maximum noise levels from traffic moving at 25 to 35 miles per hour (mph) along Lawai Road were 58 to 67 dBA at a distance of 45 to 50 feet from the center of the road.

On the southern end of Poipu Road, the average hourly noise level (Leq [60 min]) is 67 dBA for a setback distance of 60 feet from the center of the road. At a 50-foot setback distance, tour buses caused maximum noise levels of 75 dBA if not accelerating and 85 dBA when accelerating.

The volume of traffic on Lawai Road is too low to obtain meaningful correlations with the Federal Highway Administration's (FHWA) Noise Prediction Model criteria. Therefore, two locations along Poipu Road (one in Koloa Town and the other near the cane road) were taken to compare short term equivalent noise levels with predicted hourly noise levels. Measurements indicated a difference of only two dBA which is considered acceptable.

There are no quantitative noise regulations for Kauai County which apply to sugarcane operations. However, the State Department of Health (DOH) noise regulations, enforced in the City and County of Honolulu, have been used as a guide in this study. These regulations allow sugar operations to generate 70 dBA at the property line for 10 percent of each 20 minutes. Conditional Use Permits are also available for agricultural field preparation and harvesting, as long as they do not exceed 95 dBA at the property line.

When cane fields are harvested, cane harvesters will operate 24 hours a day, causing noise disturbances for several days. Fortunately, each cane field is only harvested every two years.

Land preparation for new planting or ratooning occurs every six years. This process covers 13 acres a day on two shifts and will last for several days.

Unlike the infrequent noise generated during harvesting and land preparation for new planting near the project site, the cane haul road which traverses the site will be used on a 24-hour basis when fields west of the site are being harvested. A person located 80 feet from the edge of the cane haul road would experience maximum noise levels of 78 dBA for each cane haul truck passing. There are approximately 46 fields containing 4,500 acres that will be utilizing this cane haul road.

A. Short Term Impacts

Short term noise impacts are primarily related to construction. Construction related noise will be generated by the use of heavy equipment and drilling which will exceed allowable noise levels. Noise generated by construction traffic will not be significant because most of the operations will be contained on site and vehicles using public roads will satisfy the noise level requirements of the DOH regulations. Access to the site will be via Poipu Road onto the new project road. The most significant noise generated during construction will be the excavation of the marina. It is anticipated that blasting may be necessary because of the underlying bedrock. Ground vibrations or air blasts from explosions may cause structural damage, annoyance to nearby residences, injury to endangered marine species or damage to existing seawalls, breakwaters or structures at the Kukuiula Boat Harbor.

B. Short Term Mitigation Measures

Short term construction noise impacts will be mitigated by the use of mufflers on construction equipment and vehicles. Specific start and curfew times will be established for construction activities. A permit obtained from DOH will contain the necessary construction noise conditions.

Impacts from blasting operations for the construction of the marina will be mitigated by requiring strict adherence to the Technical Specifications of the contract which will conform to the requirements of the various concerned governmental agencies. The special conditions could include a blasting program to include mailing notices to potential impacted residences or owners stating blasting schedules or monitoring procedures to determine ground vibrations and air blast levels.

The entrance to the marina will not be opened to the ocean until the latter stages of excavation. Therefore, the bulk of blasting activities will not endanger marine species, because of the continuous dike above sea level between blasting areas and the open sea.

Sediment loads from construction of the marina are not expected to be significant except when the dike has been opened to the sea. The excavation of the marina will generally occur on land. The walls of the marina will either be cut slopes or bulkheads. If a slope wall is designed, the walls may be protected by some form of riprap armor underlain with a filter fabric or layer to minimize the loss of fine grain soils. The marina site is expected to contain hard basalt which will be desirable in terms of reduced erosion and siltation; however, blasting may be required depending on the extent of the basalt layer. If blasting is necessary, technical specifications will be prepared for construction operations. The technical specifications can include monitoring ground vibrations, size of explosive charge, type of explosives, etc. Precautionary measures to assure that endangered species are not affected can also be part of the special conditions for construction. Surveillance of endangered marine life via a helicopter is a possible condition in the specifications for blasting operations.

C. <u>Long Term Impacts</u>

A major cane haul road traversing the central area of the site will remain in operation indefinitely. During times of harvesting this road will be used on a 24-hour basis. At a setback of 80 feet from the edge of the road, noise levels of 78 dBA will be generated for each truck pass. Other noise generated by sugarcane operations will be caused by harvesting and land preparation for new planting in fields located adjacent to the project site.

Noise generated by golf course maintenance will also adversely impact nearby residents. However, noise from maintenance equipment is also incompatible with and disruptive of golf play. All equipment powered with internal combustion engines will have exhaust mufflers and noisier equipment will not be used near residences before 7:00 a.m. Normal ground maintenance operations will not cause unreasonable or excessive noise.

Other noise generated by the resort and commercial operations and stationary equipment will not exceed the allowable noise levels based on State Department of Health criteria.

Comparison of existing volumes of traffic with predicted traffic volumes indicated an increase of less than 2 dBA which is an acceptable increase. Measurements were taken using a worst case condition with no attenuation from plantings, walls, etc.

D. Long Term Mitigation Measures

Cane haul trucks will use the cane haul road an average of 56 days per year. A landscape buffer strip along both sides of the cane haul road will be planted to mitigate the noise and dust generated by the trucks. This buffer strip will create a setback distance from a dwelling of more than 56 feet from the center of the road, therefore, the 65 Ldn noise contour will not be exceeded in the planned dwelling units. A berm could be incorporated into the landscaping to attenuate noise generated by its use. Additionally, the golf course abuts most of the cane road, increasing the setback to residents. Night operations during harvesting will result in noise levels greater than ambient noise levels. This impact is unavoidable.

Unlike the Kauai residents who are accustomed to the cane operations, new residents may be annoyed and complain about cane operations which may interfere with sleep, conversation, etc. New residents will be informed through a disclosure statement in the deed of the expected noise exposure from cane operations. Because harvesting occurs every two years and land preparation occurs every six years the annual average Ldn will not exceed 65 Ldn, which is considered a maximum acceptable exterior noise exposure by the U.S. Department of Housing and Urban Development (HUD).

3.5 AIR QUALITY

An air quality study was prepared and is attached as Appendix B. The report focuses mainly on three sources of air pollution: industrial, agricultural and vehicular.

The present use of the land for sugarcane results in a significiant amount of air quality emissions. Burning of sugarcane prior to harvest results in the emission of particulates, carbon monoxide and other organics. High levels of particulate concentration can be reached within a one-mile radius of a cane fire. Fortunately harvesting of each sugarcane field is performed every 2 years and each cane fire lasts only 20-30 minutes.

The only significant fixed-point stack emissions are from sugar mills and electrical power generating facilities. Sugar mills produce over 50 percent of the particulates with cane field burning producing most of the rest. Sulfur dioxide is emitted mainly by the steam electric power plant near Port Allen.

There are approximately 25 sugarcane fields within a mile radius of the development. About 8 of these fields are located to the west of the project. The usual prevailing northeast tradewinds will move most of the smoke from these 8 fields away from the development. There are about three fields totaling approximately 330 acres just north of and adjacent to the project. These fields will have the greatest impact on the development to the west. These three fields are harvested one or two months apart. The next harvest will occur in July, September and October of 1989. Seven of the 25 fields will be replaced by this development. The remaining seven fields are located to the north of the development. A high ridge shields the project site from these fields.

Another source of air pollution related to the cane operations is the presence of a major cane haul road. This cane road is used for approximately 50 fields from Poipu Road to Hanapepe. An average of approximately 56 days of the year are used by cane haul trucks for harvesting. A significant amount of dust is generated along this dirt road from the cane trucks traveling to and from the Koloa Sugar Mill. Dust from this cane road will be carried into the new development by the prevailing wind.

As with all the Counties, transportation, specifically motor vehicles, is the primary source of air pollutant emissions (SDB). The State average of pollutant emissions caused by transportation was 43 percent in 1980. Kauai was the second highest with 40.6 percent next to Oahu at 47.4 percent. Hawaii and Maui measured 38.1 and 35.8 percent, respectively. The second largest contributor of emissions in the State is fuel combustion by stationary sources (i.e., electric power generating plants, and agricultural fuel). Agricultural burning ranked third for Kauai, Hawaii and Maui.

A. <u>Impacts</u>

According to the Federal Clean Air Act, a residential development is not considered a direct source of air pollution. However, a residential development is considered an indirect source of air pollution because it will generate motor vehicle traffic. The quality of the air focuses mainly on the long term impacts from vehicular traffic and adjacent land uses.

Short term air quality impacts from the project are related to construction. Construction activities will increase concentrations of air pollutants in the vicinity of the project.

The development will utilize approximately seven cane fields. Existing residents downwind of the project will have significantly less smoke from cane burning operations. This development will create considerable distance between existing coastal residents and cane fields. New residents adjacent to the cane fields and the cane haul road will experience air pollution from the cane burning operations and dust generated from the use of the cane haul road.

A more significant long term contributor to air pollutants will be the increase in vehicular traffic. Carbon monoxide will be increased, especially during peak hours. The EPA air quality standards are not expected to be exceeded, however, the State Standards may be exceeded during the later phases of the project. Vehicles that idle at intersections or move at very low speeds will increase the carbon monoxide emissions. Roads that operate at service levels E or F will add to the increase of emissions. The major cane haul road traversing the length of the project will remain in operation indefinitely. Residents living near the cane road will be exposed to dust generated by its use.

Another potential long term, indirect air quality impact will be the increase in the use of electrical power, causing an increase in air pollution emissions.

Solid waste is expected to be landfilled, therefore, air pollution emissions will be minimal. Emissions from the boating operations are also expected to be minimal. Improper application of pesticides on the golf course may cause drift to downwind areas.

B. Mitigation

During construction, dust control measures will be implemented in accordance with Department of Health regulations. Frequent watering of the soil will reduce the amount of fugitive dust emissions generated during construction. EPA estimates that watering twice daily will reduce the amount of fugitive dust by 50 percent.

Until such time that urbanization replaces the sugarcane operations in the Koloa District, residents will continue to be exposed to the smoke from cane harvesting operations. Prospective residents will be advised of the potential air pollution from burning cane. A disclosure statement will be provided in the deed to inform buyers of this potential air pollution.

Early landscaping of the buffer strip along both sides of the cane haul road will be implemented to minimize dust passing through the site. A landscaped berm could be an alternative method of reducing dust, noise and visual impacts generated by the use of the cane haul road. The location of the golf course generally along both sides of the cane haul road will increase the distance to nearby residents thereby minimizing dust pollution. The cane road can be oiled or paved to control the dust. The present practice of watering this road to keep the ground moist near residences appears to be an effective measure. McBryde Sugar Company will enforce a speed limit regulation when trucks are passing through residential areas.

Increases in carbon monoxide emissions from motor vehicle traffic can be reduced in a variety of ways. Increased capacity at intersections will allow vehicles to idle for a shorter period of time thereby reducing carbon monoxide emissions. Improvements are planned at the intersection of Poipu Road, Lawai Road and the new project road to include signalization, storage lanes and reconfiguration of this intersection. The proposed Koloa bypass road planned by the County will improve traffic circulation in the Koloa area. Improvements to existing roadways and new roads proposed by the project and the County will reduce air quality impacts. For more details on traffic see Section 5, paragraph "Circulation System". Carpooling or bus service will reduce the amount of traffic on the roads. The proposed pedestrian walkways and the bike path will provide residents an alternate means of access to nearby employment opportunities thereby reducing traffic congestion and carbon monoxide emissions.

The amount of carbon monoxide emissions from motor vehicles in the future is expected to decrease. The Federal motor vehicle emissions control program mandates tighter emission standards for new vehicles. Fuel and fuel additives are also regulated to reduce the amount of lead thereby reducing lead emissions from motor vehicles. Newly manufactured gasoline powered vehicles are designed and required to burn only unleaded gasoline.

Technological advancements in motor vehicle engines and emission control equipment may be developed to burn cleaner fuels before the project is fully occupied. Additionally, the State may adopt a more stringent motor vehicle inspection and maintenance program to ensure that emission control devices are properly maintained. Car pooling and bus service may also help to mitigate traffic related air pollution.

Solid waste will be landfilled at Kekaha Landfill, however, conservation and recycling programs could help to reduce solid waste, thereby reducing emissions.

Emissions from the boat operations at the marina will be minimal and could be considered to offset the reduction of the cane burning activities.

Compliance with safety guidelines for the spraying of chemicals for golf course maintenance should mitigate potential air quality impacts.

Indirect emissions from electrical demand may be reduced by the use of solar energy. Installation of solar water heaters, designing homes to maximize indoor light without increasing indoor heat and the use of landscaping to provide shade may lessen the electrical power demand.

3.6 FLORA

A botanical survey was conducted in March 1988 to inventory and assess the botanical resources on the project site. A report of that survey is attached as Appendix C.

Because approximately 60 percent of the area is planted with sugarcane, the flora survey was conducted mainly on the eastern section of the project where the land is not planted with sugarcane. Areas along the edge of the cane fields and pockets of rock piles within the cane fields were surveyed. Open hillside pasturelands in the northern section of the project, formerly used to grow pineapple, were also surveyed.

A total of 202 plant species were found on the property. Ninety percent or 182 of the plant species were found to be introduced species. Native species numbered 14 and Polynesian introduced species numbered 6.

The rapidly growing sugarcane shades out much of the weedy species normally associated with cultivated land. Weedy species include finger grass, nutgrass, Bermuda grass and sleeping grass. These weedy species were found on the margins of the cane fields. Irrigation ditches and drainageways contained dense California grass with various weedy species and clumps of amaryllis.

Boulder and rock piles scattered throughout the cane fields and pasturelands typically supported growths of koa-haole scrub. In the middle of the cane fields to the west, a large cluster of Chinese banyan and Java plum trees was found growing on a large stone platform. This platform is part of a heiau which, to date, is unnamed and unrecorded (see "Archaeology" in this section).

Along the top of the ridgeline of Lawai Valley, ornamental species have spread into the weedy scrub bordering the cane fields. These ornamental species include the golden pothos, philodendron and montbretia. The rocky coastal cliffs from the Spouting Horn Park to Lawai Valley supported common ironwood trees with dense koa-haole shrub along Lawai Beach Road. Seaward facing slopes contained koa-haole, 'ilima, 'aki'aki, pa'u-o-Hi'i'aka, Guinea grass and finger grass.

The sand pockets and coralline rubble among boulders at Kukuiula Bay supported the pohuehue, Australian saltbush, tree heliotrope, naupaka kahakai and 'akulikuli.

The scrub pasture in the southeast portion of the site consisted mainly of four types of vegetation cover. The four cover types are koa-haole thicket, lantana scrub, open mixed scrub and California grass pond association. The denser scrub occurred mostly along the edges of the pastureland. Open areas had scattered clumps of shrub species. The hillside pasturelands, formerly used for growing pineapple, contained mixed grass pasture.

A. <u>Impacts</u>

None of the 202 species found on the project are considered rare, threatened or endangered according to the Federal and/or State standards. Ninety percent of the species were introduced and were mainly weedy, scrub and mixed grass species. The native endemic and indigenous species numbered 2 and 12, respectively, and Polynesian introduced species numbered 6.

B. <u>Mitigations</u>

After clearing of the vegetation in the northern section of the site, revegetation and/or protective measures will be taken to prevent additional loss of soil. Erosion control measures will be performed according to the County of Kauai regulations and as prescribed by the Erosion Control Plan.

3.7 FAUNA

A fauna survey was conducted on the project site and on lands adjacent to the site in March 1988. Survey of the area included (1) amphibians and reptiles, (2) birds and (3) mammals.

The Hawaiian Islands do not have any native or endemic amphibians or land reptiles. All of these species have been introduced by man and are not considered endangered or threatened. The survey did not focus on the presence of these species.

Amphibians consist of toads, frogs and salamanders. Toads and frogs were introduced to the Hawaiian Islands as either a food source or a means to control insects. Salamanders are not known to be introduced to Kauai. There were no amphibians observed on the site.

Reptiles include geckos and skinks, snakes and turtles. The geckos and skinks would adapt well to both urban and rural habitats and are not endangered species. No snakes or turtles were seen on the site.

Nineteen species of introduced birds were observed on site and on adjacent lands. Introduced bird species included (1) cattle egret, (2) ring-neck pheasant, (3) red jungle fowl, (4) rock dove or feral pigeon, (5) spotted or lace-necked dove, (6) barred dove or zebra dove, (7) barn owl, (8) melodious laughing-thrush, (9) mockingbird, (10) shama thrush, (11) Japanese white-eye, (12) common Indian myna, (13) western meadowlark, (14) ricebird or nutmeg mannikin, (15) black-headed munia, (16) house sparrow, (17) red-crested cardinal, (18) cardinal, and (19) house finch.

Birds were sometimes introduced to Hawaii to control insects, such as the cattle egret and the common Indian myna. Cattle egrets were imported to control a variety of flies which damages hides and causes lower weight gains in cattle. The army worms, which destroyed pasturelands, were controlled by the introduction of the myna.

The feral pigeon is rare to Kauai. A number of flying pigeons that were observed near the site may have been those of a pigeon fancier. The barn owl was not observed on the site by the biologist. However, a letter received by the State Division of Forestry, March 1988, indicated that these owls do occur in the area. Barn owls have been reported to kill seabirds and their chicks.

Game birds include the pheasant, spotted or lace-necked dove and the barred dove or zebra dove. The pheasant had the highest 10-year average kill of 327 birds from 1977 to 1986. The spotted or lace-necked dove and the barred or zebra dove, numbered 61 and 53, respectively, for the 10-year average kill.

Among the song birds are the melodious laughing-thrush, shama, Japanese white-eye (also known as Mejiro) and the cardinal.

There were two indigenous or native species on the site. A black-crowned night heron was seen in a pond mauka of the cane haul road. Herons eat fish, frogs, snakes, mice, insects, crayfish and a variety of aquatic life. In Kahuku, the black-crowned night heron caused much loss at Oahu's Kahuku prawn farm as well as other aquaculture farms Statewide. A 120-day permit to destroy these birds was issued to producers in 1985. The second native species observed was a migratory bird, the golden plover. The plovers were found feeding along the cane haul road and the Kiahuna golf course.

The letter from the State Division of Forestry stated that the wandering tattler or 'Ulili, a migratory bird, has been seen in tidepools along the shore. This letter also stated that an endemic bird species, the Hawaiian owl or pueo, passes through this region. During the survey, neither one of these birds was seen.

The Hawaiian hoary bat is the only endemic land mammal classified as endangered. Bats feed at night over cane fields, pasture, golf courses and residential areas. Bats were not observed during the survey.

Introduced mammals are serious pests to man and their surroundings. Feral cattle, goats, sheep and pigs have destroyed forests since the 1800's. None of these were found on the site.

The smaller mammals, such as rats, feral cat and feral dog prey on endangered forest birds, waterbirds and domestic poultry and birds. These small mammals are believed to be present on the site, although none was observed.

A. Impacts

None of the terrestrial vertebrate fauna found on or around the project site are considered threatened or endangered. Most of the animals will continue to thrive on or near the site, regardless of changes in land use.

The endangered Hawaiian hoary bat, known to breed on Kauai, was not observed. However, the bats will continue to feed at night over the cane fields, golf courses and residential areas. Similarly, the rare, non-endangered Hawaiian owl, having a diurnal habit, will not be affected by the proposed project.

The development will provide new habitat for birds and other animals.

B. Mitigation

The terrestrial vertebrate fauna found on or around the site are generally considered pests to humans and their surroundings, except for some of the bird species which people sometimes find pleasure in watching. Development of this project will help to control the increase of these pests in Hawaii, as most people who will reside here will try to exterminate them.

3.8 MARINE RESOURCES AND WATER QUALITY

A marine environmental survey was conducted at Kukuiula Bay in May 1988 (Appendix E). This survey consisted of water quality, limited water current, and biological surveys to define baseline environmental conditions prior to the proposed construction of the marina and channel at Kukuiula Bay.

Kukuiula Bay and small craft harbor consist of approximately 7 acres. A manmade jetty extends 400 feet from east to west with a parking/boat loading area bordering the southern side of the jetty. A 100-foot wide draglined channel on the northern side of the jetty extends from the toe of the jetty to the boat launching ramp on the east. Shoreline facilities include a boat launching ramp, vehicle and boat trailer parking and a washdown area.

One perennial and two intermittent storm water channels discharge directly into the harbor on the northern side of the bay. Waters in this northern section, approximately one-third of the bay, were discolored during this survey, a possibly chronic condition.

Water quality analyses included temperature, salinity and dissolved oxygen measurements in the harbor waters. The mean temperature of the harbor waters was 25.3°C. Harbor waters in the northern section of the harbor had a cooler mean temperature of 23.8°C, as a result of surface water discharge from the largest drainage channel.

Salinity of the harbor waters ranged from 18.4 to 27.4 parts per thousand (ppt). The normal oceanic salinity is approximately 34.0 ppt. The low salinity is characteristic of nearshore marine waters that are subject to storm water discharge and sugarcane irrigation tailwaters and the prevailing tradewinds causing water mixing. The highest salinity reading was taken on the ocean side of the jetty (31.2 ppt), indicating freshwater discharge even along the wave-exposed coastline.

Dissolved oxygen values ranged from 6.25 to 8.25 parts per million (ppm). The highest reading (98 percent saturation) was taken on the north side of the bay in an area exposed to moderate wave action just below the largest drainage discharge channel. The average dissolved oxygen value in the harbor was approximately 80 percent of saturation.

Although noticeable plumes of turbid waters were present beneath the discharge channels, significant amounts of silt or sedimentary materials were not observed on live coral in this vicinity. Much of the silt and sedimentary material is deposited in natural ponding areas, streambeds and dispersed over a wide area away from shore by water current and wave action. The preponderance of live, healthy coral in this region suggests that silt and sediments are not a limiting factor for certain coral recruitment and growth.

The water current analysis indicated that wind effects predominated regardless of the tidal period. The average surface currents were 14.6 centimeters per second (cm/sec) and the average midwater currents were 5.0 cm/sec. Both surface and mid-water current demonstrated a seaward flow during all tidal periods (see Figure 3-6).

In the south end of the bay, surface currents in the morning rising tide flowed at a velocity of about 4 centimeters per second (cm/sec) in a westerly direction. Midwater currents averaged less than 0.3 cm/sec with plume dispersion in a north and south direction. Surface currents in the northern section of the harbor, however, moved in a southwesterly direction at about 13 cm/sec (centimeters per second), much faster than the southern section of the harbor where the current is impeded by the jetty. Plume dispersion was less apparent in this northern section because of limited wind fetch. Midwater currents in this area averaged 4.0 cm/sec in a southwesterly direction. Surface currents in the afternoon receding tide increased, generally due to the increase in wind velocity. Midwater velocities were essentially identical to the morning rising tide.

The survey of marine resources included coral, algae, fishes and macroinvertebrates. Five species of coral, 23 species of algae, 20 fish species and a diverse number of macroinvertebrates were found in the bay.

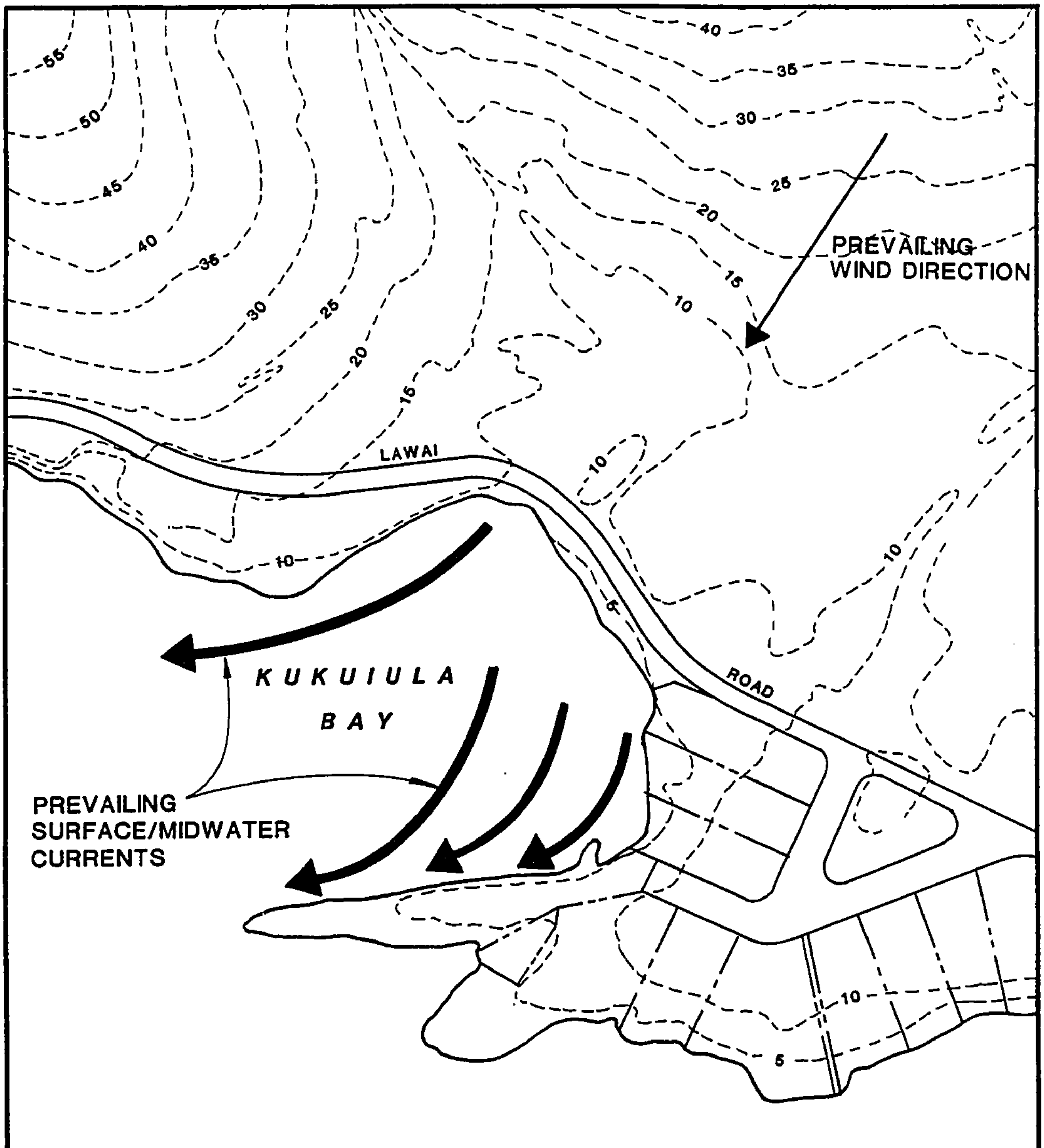

FIGURE 3-6

SURFACE AND MIDWATER CURRENTS

KUKUIULA PLANNED COMMUNITY
Koloa, Kauai, Hawaii

For: A&B Properties, Inc.

By: R. M. Towill Corporation

0 100 200 400
Scale in Feet

The five coral species included Pocillopora damicornis, Pocillopora meandrina, Porites lobata, Porites compressa, and Montipora. Pocillopora damicornis were found in the shallow perimeter waters and dominated in terms of number of colonies. Percent coverage of this coral averaged less than 0.1 percent.

Pocillopora meandrina frequented in the shallow waters and was less common in the main harbor basin. This species was generally found on the seaward side of the inshore Pocillopora damicornis zone.

Porites lobata dominated the deeper waters of the harbor and was generally found in depths below 2 meters. This species covered about 5 percent of the substratum along the perimeter of the harbor to 10 percent in the main harbor basin. Large dead colonies were often found overgrown with living coral. As much as 30 to 60 percent of the Porites lobata were dead at any given spot within the harbor basin. There did not appear to be any correlation between patches of dead coral and proximity to drainage water discharge.

Porites compressa (finger coral) was found in the deeper waters and covered approximately 2 percent of the harbor basin. Montipora was limited to only 7 colonies all of which were found in the main harbor basin.

Twenty-three algae species were identified in the harbor. Fish grazing and wave disturbances made identification of some of the algae impossible. However, the overall density and abundance of algae was low compared to other similar locations in Hawaii. Acanthophora spicifera dominated the flora of the jetty, often forming dense, nearly monotypic mats. The north and east sides of the harbor had a flora consisting of occasional standards of uloa, dictyota and various calcareous algae.

Only 20 species of fish were recorded within the harbor and population densities were low. Blemmies, wrasses, surgeon fishes, and damsel fishes dominated all areas surveyed. The turbid water discharge in the northern section appears to be a popular feeding ground for certain fish species.

Schools of juvenile mullet (Nugil cephalus) were frequently observed grazing on particulate matter discharge from the drainage outlet. The presence of only eight families of fish and the number of individual species observed in the harbor is exceptionally low. There was ample coral, rock and sand habitats available for various fishes throughout the inshore harbor basin waters, however, these habitats were largely unoccupied.

Macroinvertebrates were found mostly in the intertidal zone along the northern section of the harbor. The harbor basin and jetty area contained a very sparse invertebrate population. Represented species included grapsid crab and an assortment of common nerites and littorines. Large populations of the rock-boring urchins Echinometra oblonga and echinometra mathaei dominated rock outcrops along the north side of the harbor. The most abundant and widespread invertebrate throughout the subtidal reaches of the harbor basin was the octocoral, anthellia edmonsoni. This species often formed a bluish-purple carpet across larger boulders.

The temperature, salinity and dissolved oxygen values observed in Kukuiula Harbor were in the range normally associated with nearshore marine waters subject to surface or subsurface fresh or brackish water discharges. The presence of the turbid plume in the northern section of the harbor (originating from the drainage discharge) does not appear to adversely affect the marine biological resources. On the contrary this area provided good feeding grounds for certain fish, a diverse invertebrate community, and supported intensive algae and coral growth.

A supplemental survey of the baseline conditions in Kukuiula Bay was conducted in April 1989 to determine whether water quality measurements and biological observations made during the May 1988 surveys were the result of other environmental factors (see Appendix F). The water quality of the bay was comparable to the conditions of the 1988 survey, as described previously. The recent Kona storm of March 1989 apparently had a significant impact in the bay area. Mud-stained rocks in the northwest side of Kukuiula Bay and damaged algae in areas exposed to wave action were found. The diversity of marine flora and fauna observed was less than those of the 1988 survey, much of which was attributed to the low visibility in the water. The macro-invertebrate octocoral (Anthelia edmonsoni) was the most abundant and widespread in the 1988 survey, but was not observed in the 1989 survey. However, three new species of macroalgae and two new invertebrates were identified during this survey, suggesting that the conditions are not totally unfavorable to all species. These new macroalgae species included green algae (d. versluysii) and the brown algae (d. friabilis, R. pangoensis and S. echinocarpum). The two new invertebrate species include juvenile ghost crab (Ocupode ceratopthalmus) and a tube building snail (Serpulorbis variabilis).

In addition to the marine environmental survey, a nearshore circulation study was performed in March and April of 1989 (Appendix G). The study was conducted in order to describe the circulation patterns in the vicinity of the two drainage outlets. These outlets are (1) the intermittent Aepo Stream at Kukuiula Bay, and (2) the existing box culvert fronting Lawai Beach Resort.

Results of the nearshore circulation study indicated that the predominant factor influencing the nearshore waters is the wind, with little influence from the tide and waves. Once the nearshore waters move offshore, the semi-diurnal tide transports the water to the east during ebb tide flow or to the west during flood tide flow. The diurnal tide influences the overall flow and may be responsible for much of the flow speed and directional variability in long term records. The offshore current is influenced by the Pacific North Equatorial Current which moves westward, thus, the direction of the offshore flow is generally to the west. Current measurements were taken using drogues to measure the current speed and direction of flow during "Kona" storm conditions, tradewind and northwind conditions in Kukuiula Bay and from Ekaha to Hoai Bay (see Figures 3-7 and 3-8a,b).

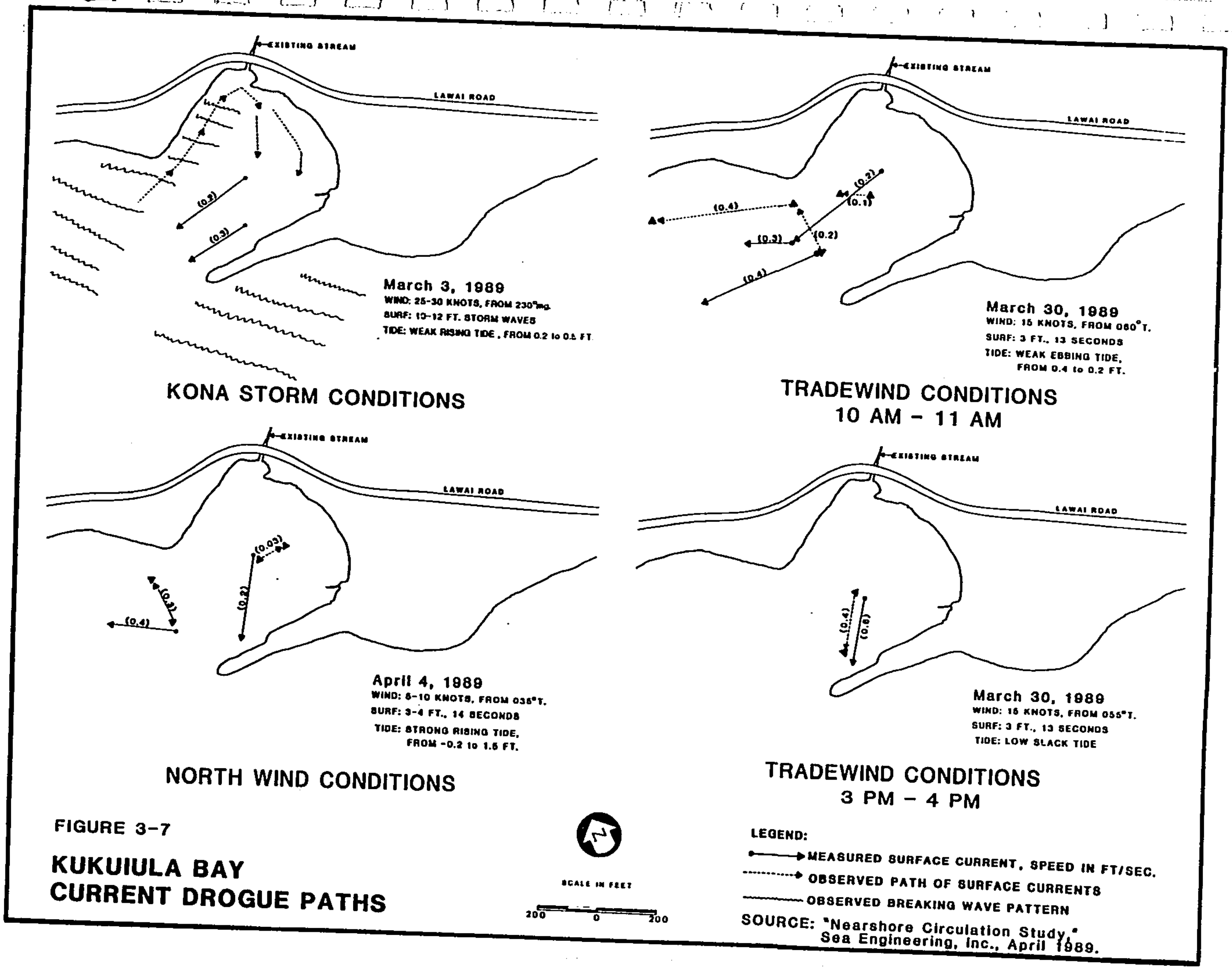

FIGURE 3-7

KUKUIULA BAY CURRENT DROGUE PATHS

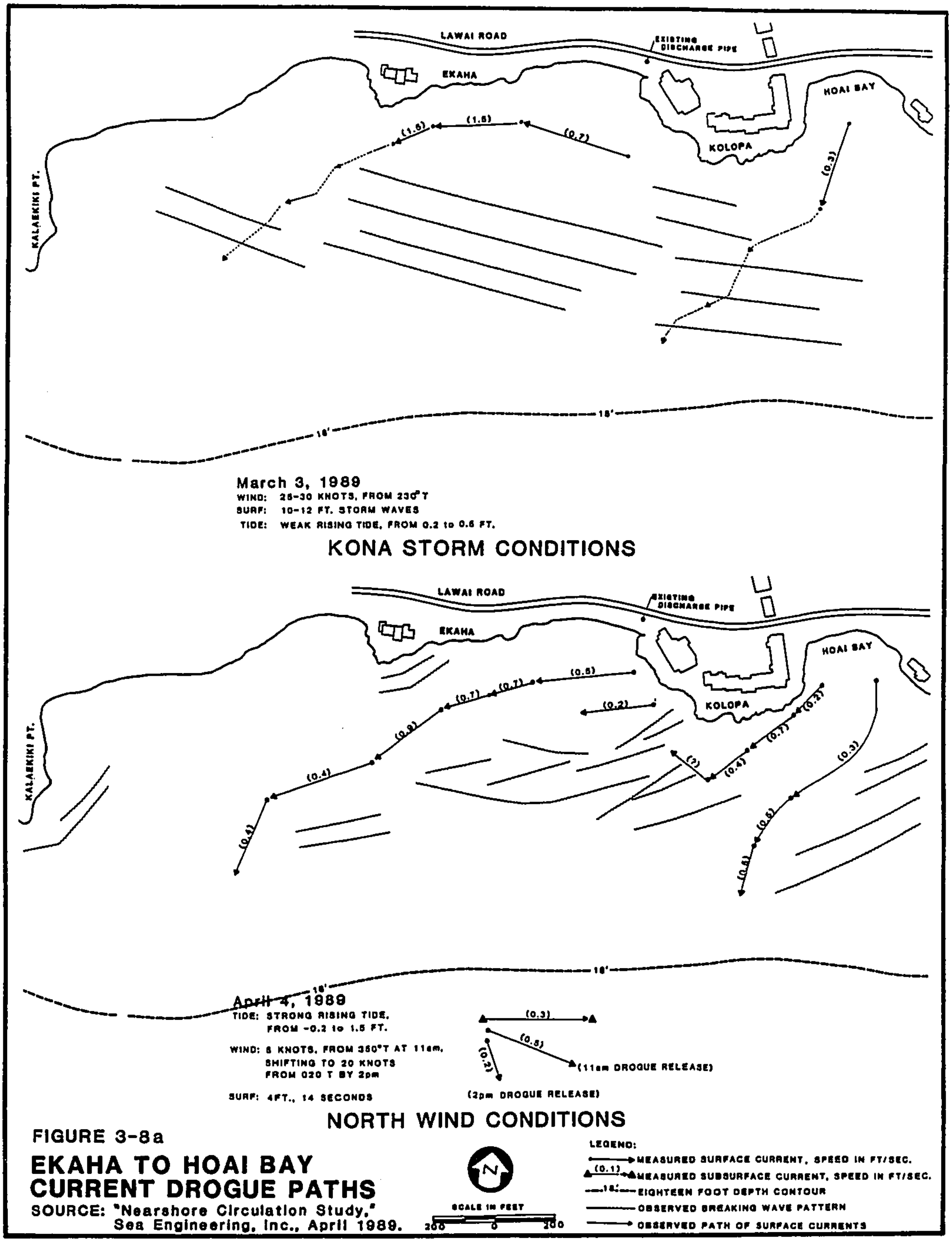

FIGURE 3-8a

EKAHA TO HOAI BAY CURRENT DROGUE PATHS

SOURCE: "Nearshore Circulation Study," Sea Engineering, Inc., April 1989.

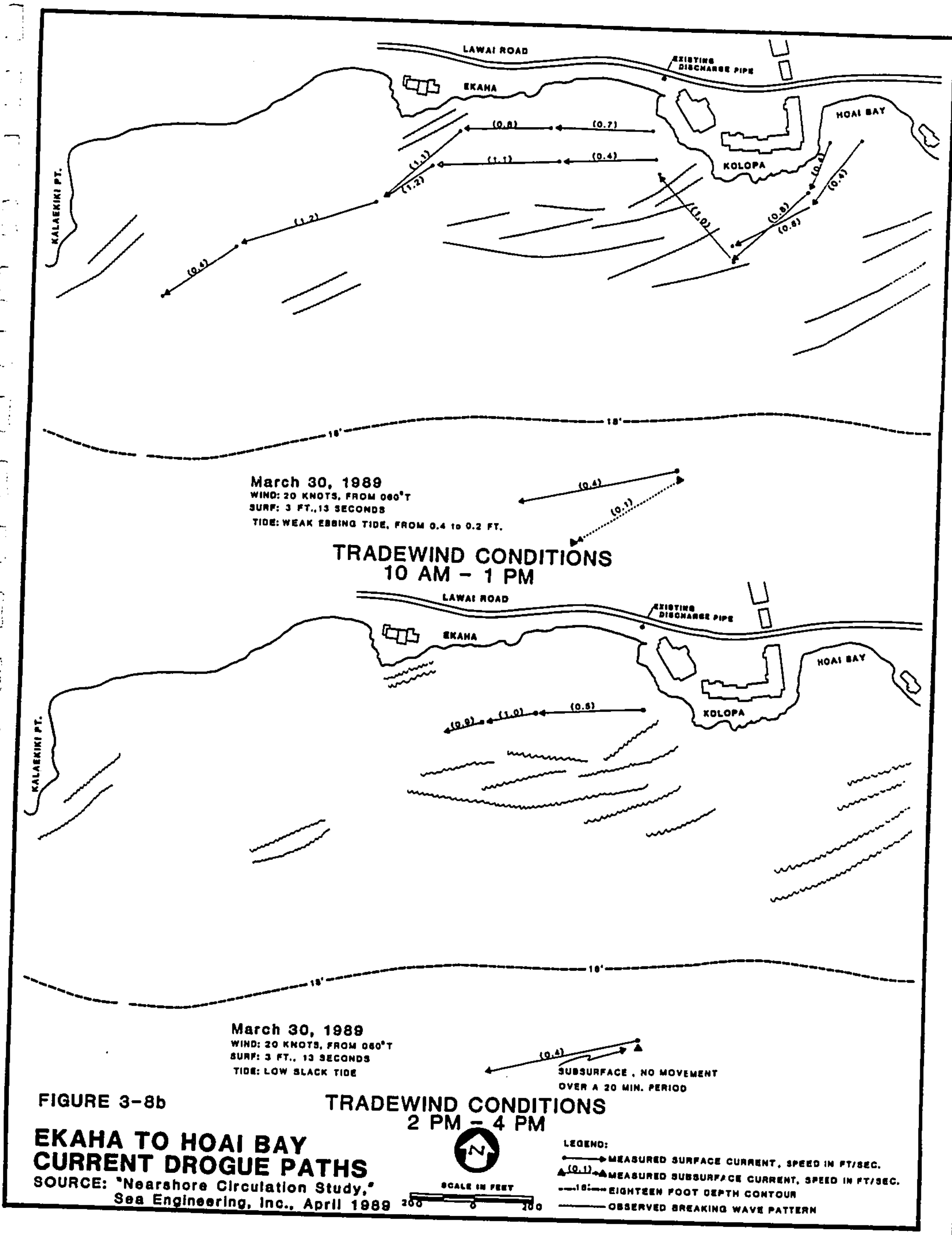

FIGURE 3-8b

EKAHA TO HOAI BAY
CURRENT DROGUE PATHS

SOURCE: "Nearshore Circulation Study," Sea Engineering, Inc., April 1989

During the Kona storm conditions in Kukuiula Bay, the breaking waves extended all along the north side of the bay into the shore. A counter current was observed in the center and south side of the bay moving the water seaward. This seaward flow was generated by the buildup of water surface elevation in the nearshore areas, or head, from the breaking waves and the volume of water discharged by the stream, in spite of the 25 to 30 knot onshore wind. This was the only time that the surface currents moved counter to the wind. Uniform mixing occurred in the nearshore zone inside and outside of the bay from the storm wave action. Aepo Stream discharged highly turbid water and the bay and nearshore waters were chocolate brown out to about the 18-foot contour. East of Koloa Landing to Hoai Bay, the nearshore waters were noticeably less turbid and the amount of water discharging through the existing box culvert near the Lawai Beach Resort was small. The movement of the offshore water was to the west.

Drogues were also released near Kolopa Point and in Hoai Bay. The waves break almost all the way to the shore at Kolopa because of the bottom conditions. The head generated by the waves at Kolopa Point forced the flow to the west. Because the flow channel narrows off Ekaha, the current speed increases through this area. Once past the point, the flow velocity then decreases and moves seaward. Similarly, in Hoai Bay, despite the onshore waves and wind, the buildup of head created a counter flow and consistently moved the flow seaward. Because the bad weather prevented any boat work, drogues used during the Kona storm conditions were lost.

On March 30, 1989, current measurements were taken during moderate tradewind conditions. In Kukuiula Bay, both the surface and subsurface currents moved in a seaward direction, then in a westerly direction along the shore. At Hoai Bay, the currents moved seaward, however, because of wave action off Kolopa Point, the current flows around Kolopa Point and moves west, past Ekaha then gradually travels seaward near Kalaekiki Point.

During moderate to strong northerly winds, an incoming south swell and a strong rising tide, the surface drogues moved almost directly downwind, while the subsurface drogue moved very slowly shoreward. The subsurface drogue moved toward the shore in response to the mass transport of seaward surface flows (see Figure 3-9). The direction of flow between Ekaha and Hoai Bay was similar to the tradewind conditions, except that one drogue released in Hoai Bay moved seaward through a deeper channel.

As indicated in the current study, water circulation within the nearshore waters moved seaward rather quickly during almost all tide, wind and wave conditions. Once seaward of nearshore waters the turbid water mass, even during times of storms, was quickly dispersed and transported offshore in an east or west direction, depending upon the tide stage.

The observation of the chocolate brown discharge at Kukuiula Bay during storm conditions suggests that soil erosion is a significant factor. The change in the surface conditions from agricultural fields to grass cover, buildings, and pavement, and the inclusion of retention and siltation basins to hold storm water runoff and deposit silt and sediments will reduce the amount of eroded soil currently discharging into the bay. The less turbid waters and the small amount of discharge at the existing box culvert fronting Lawai Beach Resort, suggests that much of the water is retained on site and silt and sediment are being deposited in natural ponding areas. Again, the retention and siltation basins proposed will minimize discharge in nearshore waters.

Another study was completed in April 1989 to identify adverse environmental impacts associated with marina operations on the environment in general (see Appendix H). This study was completed in conjunction with the aforementioned current study. In general, the effect of the marina and marina operations on the environment will have minimal adverse impacts.

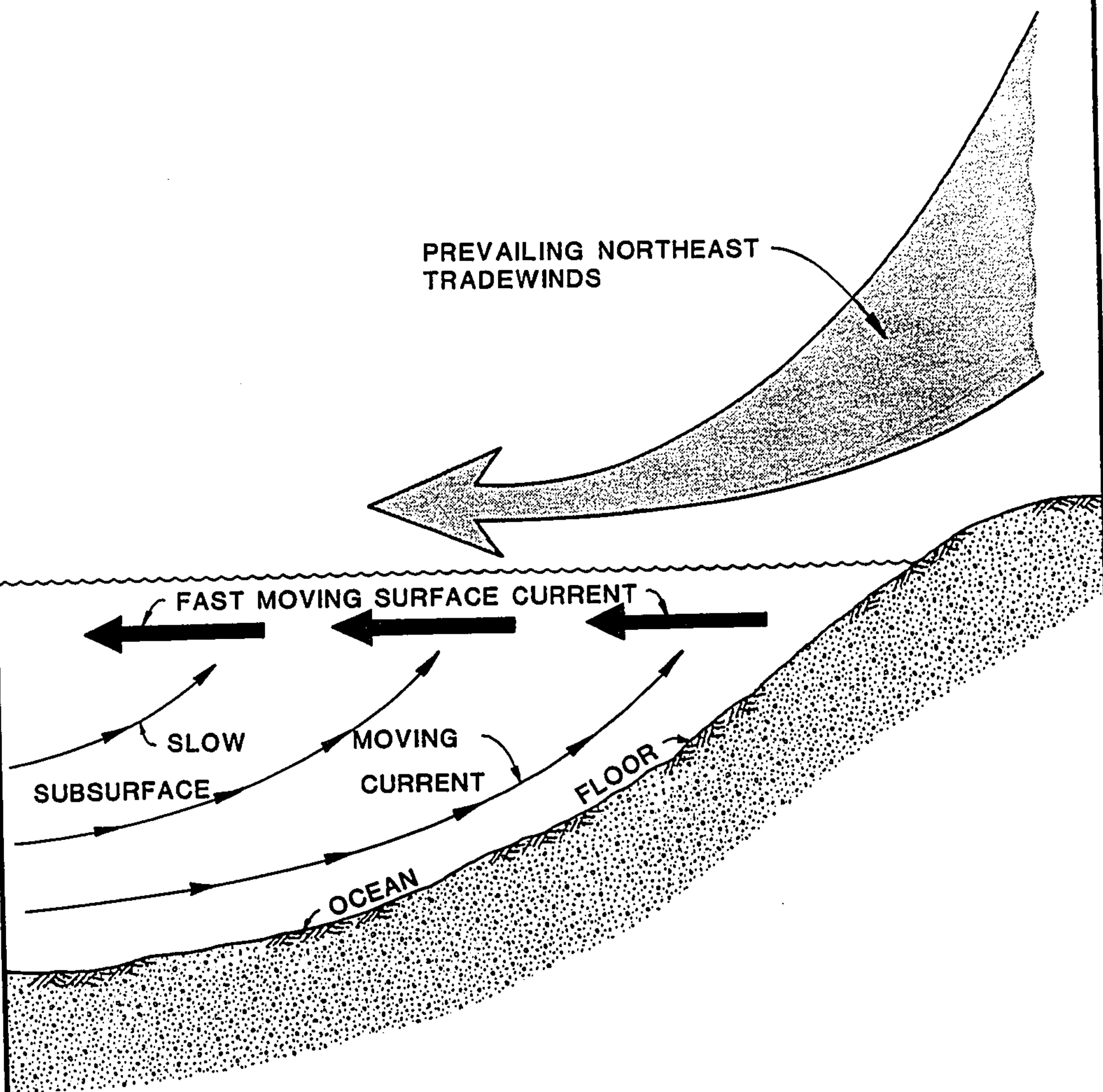

FIGURE 3-9

CROSS SECTION OF NEARSHORE OCEAN CURRENTS

KUKUIULA PLANNED COMMUNITY
Koloa, Kauai, Hawaii

For: A&B Properties, Inc.
By: R. M. Towill Corporation

Because there is no point source of groundwater runoff into the marina, only a small amount of thermal stratification will occur in the surface waters. Low salinity is expected because of groundwater infiltration. Dissolved oxygen levels in the marina will vary according to the weather conditions. During times of calm weather, low dissolved oxygen levels would be expected and during the high wind conditions, the marina waters will flush quite rapidly, maintaining a high level of dissolved oxygen. Total nitrogen and phosphorus is expected to increase, especially after heavy rainfall, however, studies of the Hawaii Kai Marina, which is the location for a large point source drainage outlet, indicated no adverse impacts. Since there is no point source of groundwater discharge in the proposed marina, nutrient levels are not expected to be a problem.

Coliform bacteria levels for the Hawaii Kai Marina were measured by the Water Resources Research Center, 1973. Results of that study indicated that the bay and ocean was in compliance with the applicable water quality standards. Coliform organisms were calculated to disappear within 10-35 minutes, suggesting that these organisms do not survive long in a marina environment.

Pesticides are also known to be related with marinas associated with housing developments in relation to termite treatment and preservatives in home construction. Because the marina will receive only surface flows and retention basins are planned to filter out much of the sediment, impacts from pesticides in the marina will be minimal. The amount of pesticides which do enter marina waters will become impotent with dilution and degradation over a period of time.

The absence of industrial sources of heavy metals around the marina should mean relatively low levels of heavy metals. Heavy metals which will occur in the marina will be by leaching of soils, reflecting natural conditions.

Nutrient loads from incoming surface and groundwater infiltration are expected to support phytoplankton growth which in turn will be harvested by zooplankton communities and juvenile fish. The marina will serve as a nursery for juvenile fish as well as a shelter from predators. Adult fishes are generally not associated with marina environments. Adult forms tend to search for more diverse habitat and food outside the marina, in the open waters.

Boat docks and other structures within the marina will provide a foundation for colonizing of intertidal organisms, however, will reduce light availability below, restricting development of photosynthesizing organisms. Juvenile and marine life will utilize these structures for shelter and as a source of food.

The boats and related docking facilities will interfere with the wind, which is the primary source of water circulation. However, the orientation of the proposed marina is such that the prevailing northeast tradewinds will blow directly into the main turning basin and out toward the entrance channel (see Figure 2-2).

Pollutants will occur from fuel and oil leaks, sewage and trash, however, these impacts are expected to be relatively minor. Other studies of marina waters have indicated that coral and reef communities can exist in areas subjected to chronic, long term oil pollution. Marina users who derive their livelihood from the marine resources will have an economic incentive to prevent pollution problems. A pumpout station for sanitary waste and convenient comfort stations will be developed in the vicinity of the marina. Trash receptacles to reduce litter will also be provided and maintained. Careful management of the marina complex will control potential pollution problems.

Water mixing from vessel maneuvers and propeller action have been shown to be beneficial to the water quality in Pearl Harbor. Vessel stirring will reduce the bottom water residence time which will improve dissolved oxygen levels. Large amounts of benthic sediments will be raised near the surface which will separate heavy metals from the water column. Heavy metals and oil will then attach to the sediments and be carried down to the bottom. The upper levels of the marina waters, where fishes generally reside, will be enhanced.

Marine algae, coral and other invertebrates may be adversely impacted by the changes in water movement, water quality and during construction. Algae and coral in the immediate vicinity of construction activities will be affected. Some of the algae species may recover on the marina revetment, walls, docks and slips. Other species may also develop as a result of the change in the low wave action and water quality. The creation of the marina will increase the diversity and density of marine algae growth. Coral, although not compatible with marina waters, have been found in marina environments.

Green sea turtles, which occur in the vicinity of Kukuiula Bay, are not expected to be adversely affected. Available information on the Hawaii Kai Marina and the Mala Wharf, Maui, suggests that the green sea turtles forage nearby reefs, wharfs and moored vessels, sharing the area.

Maintenance dredging will be necessary to maintain a safe navigational depth. This maintenance effort is performed every 10 years or so. During maintenance dredging resuspension of sediment will occur and possibly a decrease of dissolved oxygen content. However, the organic content of marina sediments is usually low and the dissolved oxygen will not be depressed by resuspended sediment. The relatively high flushing rate of the marina will minimize the impacts associated with maintenance dredging.

A. Impacts

Excavation of the marina will not adversely impact the existing marine resources, since the excavation of the marina will take place on land mauka of the existing harbor. However, when the entrance to the marina is opened, harbor waters will enter the excavated marina. This action will cause a short term impact as a result of silt and sediment loading which will increase the turbidity within the harbor and offshore water in the immediate vicinity. Because of the relatively fast flushing rates, a few days will be required to flush the excavated marina and stabilize bottom sediments. Nearshore conditions will be similar to post storm conditions.

A channel extending inland from the bay into the marina facilities will be subject to dredging operations to provide safe navigation. Dredging operations will destroy the organisms inhabiting this dredged area. The existing channel demonstrated evidence of past disturbance and represented species populations were very low. Surveys suggested that this area was previously subjected to dragline dredging to remove navigation hazards. Impacts resulting from dredging are, therefore, expected to be inconsequential.

It is unlikely that silt and sediment generated during marina and channel dredging operations would adversely affect the existing limited marine biota. Given the existing meager assemblage of marine biota occurring in the harbor, it is unlikely that the proposed marina and channel construction activities would result in any significant or long term impacts. Any such future impacts or short term disturbances are unlikely to exceed those conditions experienced within the harbor in its predeveloped state during heavy runoff conditions.

There were no rare, endangered or threatened plant or animal species found in the harbor or adjacent offshore waters during the survey period. The threatened monk seal and green sea turtle occurs in the area and may occasionally forage within the harbor. Although Kukuiula Bay is not known to represent a monk seal turtle nesting habitat, nesting for the green sea turtle has been documented at Lawai Bay and at Barking Sands. The monk seal habitat generally occur on islands northwest of Kauai.

A major green sea turtle resting site occurs along the seaward reef front within 150 meters of the busy entrance channel of the Hawaii Kai Marina on Oahu. Turtles forage the nearby reefs sharing the area with the many users of Maunalua Bay reef. The operation of private vessels and commercial ventures for many years in the area apparently has not caused a decline in the resident turtle population. At Mala Wharf, Maui, a number of green sea turtles rests offshore of the wharf around an old sunken vessel that serves as a mooring for a commercial boat. The turtles forage around the wharf and amongst the moored vessels, suggesting that turtles coexist with moored and moving boats. In addition, the nearest resting and nesting site at Lawai Bay is nearly 5,000 feet away.

Noise associated with construction and dredging operations, and silt generated by channel dredging and marina flushing could result in the green sea turtle having to seek alternative feeding and loafing areas. No long term impacts on sea turtle populations are anticipated.

The endangered humpback whale is known to transit the area with the December-March period representing the primary period of calving and breeding. Low-level sounds generated by heavy equipment operations could be detected by transiting whales. There is no evidence, however, that such sounds would adversely affect whale migration routes or result in any type of abnormal behavior.

The proposed marina facilities may increase the total number of recreational, commercial, and charter fishing vessels on Kauai. This could result in an increase in fishing effort and increased competition between fishers for fishery resources. An increase in the number of boats and boating related facilities could result in an increase in pollutants (oil, fuel, anti-fouling point) within the bay.

Nutrient-rich golf course runoff and the proposed emergency effluent disposal system have the potential under certain climatic conditions, to cause localized nutrient enrichment. Preliminary water current measurements suggest, however, that the residence time of any such nutrients would be insufficient to cause any eutrophication of nearshore waters.

B. Mitigation

Development of the proposed drainage system (see Section 5, paragraph "Drainage") and the use of the golf course as a major drainage swale and siltation basin will reduce the amount of silt and sedimentary material entering the harbor. This will potentially improve the water quality within the bay as well as the adjacent shoreline and offshore areas to the west.

Sediment loads from construction of the marina are not expected to be significant except when the dike has been opened to the sea. The excavation of the marina will generally occur on land. The walls of the marina will either be cut slopes or bulkheads. If a slope wall is designed, the walls may be protected by some form of riprap armor underlain with a filter fabric or layer to minimize the loss of fine grain soils. To mitigate adverse impacts to coastal waters, particulate matter will be allowed to settle out before the dike is opened to the sea. When the dike is completely opened, a large silt screen will be placed across the opening. Silt screens have been proven to be effective in controlling sediment impacts caused by similar types of coastal excavation projects. Once the screen is removed, a few days will be needed to flush the marina. The marina site is expected to contain hard basalt which will be desirable in terms of reduced erosion and siltation; however, blasting may be required depending on the extent of the basalt layer. If blasting is necessary, technical specifications will be prepared for construction operations. The technical specifications can include monitoring ground vibrations, size of explosive charge, type of explosives, etc. Precautionary measures to assure that endangered species are not affected can also be part of the special conditions for construction. Surveillance of endangered marine life via a helicopter is a possible condition in the specifications for blasting operations. In addition, excavation of the marina could be limited to the months of April through October when the humpback whales are absent from Hawaiian waters.

If additional dredging of the 100-foot draglined channel is needed, coral transplantation may represent an effective mitigation measure. Small colonies of coral may well lend themselves to relocation.

To mitigate impacts to nearby structures, a plan will be developed to document existing conditions by use of elevation details and photographs. The plan will also include periodic inspection and evaluations to assure that settlement, displacement of rocks and structural damage have not occurred. The technical specifications prepared for the construction of the marina may also include a program to monitor ground vibrations.

3.9 ARCHAEOLOGY

An archaeological survey was performed on the site in March 1988 and the report of the findings and recommendations are attached as Appendix I.

There were a total of 58 sites found on the 1,000 acres planned for development (Figure 3-10). Many of these sites contained multiple features, which totaled 150 in all. The majority of the sites were located on non-cultivated land, some of which has been disturbed by bulldozing. Four of the sites were located in cultivated land. Sites found included heiau's, agricultural sites, habitation sites, burials, lava tube caves, and historic sites.

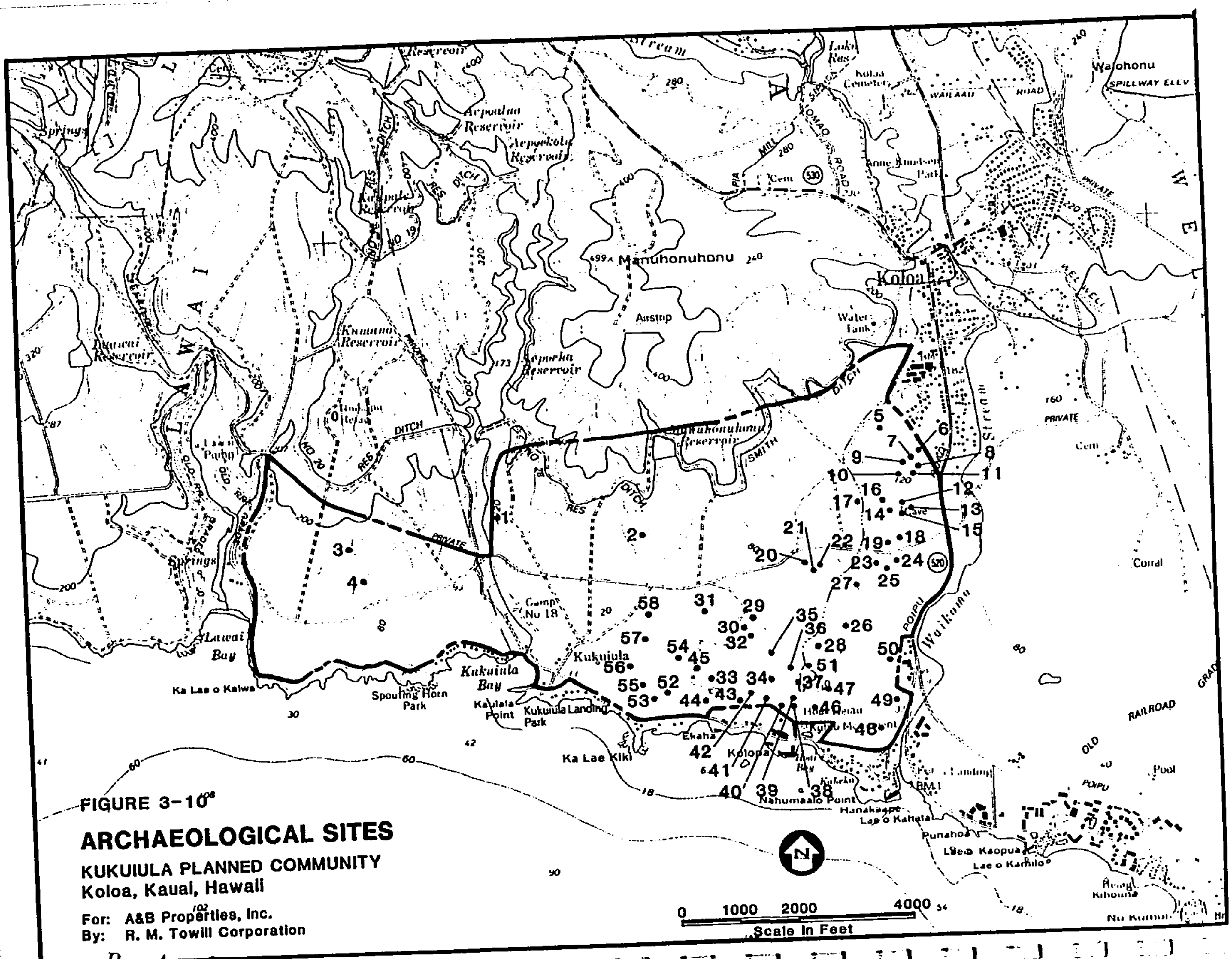

FIGURE 3-10

ARCHAEOLOGICAL SITES

KUKUIULA PLANNED COMMUNITY
Koloa, Kauai, Hawaii

For: A&B Properties, Inc.
By: R. M. Towill Corporation

Of the 58 significant sites found, seven of the sites have been recorded and are no longer significant. The remaining 51 sites are still significant, 30 only for their information content and 21 for multiple criteria, according to the Hawaii and National Registers of Historic Places (see Table 1 of Appendix I).

The 21 multiple criteria sites are significant because they are excellent examples of a site type, are likely to yield important information, and/or have cultural significance (religious structures or burials). Fourteen of these sites are excellent examples of site types.

Two heiau's were located. A known heiau, Kamaloula, was located on the north side of an impoundment just north of the Prince Kuhio Park. An unnamed heiau, which was discovered during this survey, is located in the middle of the cane fields in the western portion of the site. This site is partly covered with field boulders, however, the exposed portion is about 300 feet long by 20 to 60 feet wide. A third possible small heiau site consisted of a large platform just mauka of Prince Kuhio Park.

There were numerous agricultural and habitation sites, some of which were combined agricultural/habitation sites. A significant agricultural feature found was a uniquely designed raised auwai, located in back of the Prince Kuhio Park. The auwai is raised 2 to 4 feet above ground with the water aqueducted on the top of the built-up bank.

Two of the sites found are almost certain to have burials. These sites are generally difficult to recognize based on surface evidence. Even habitation sites could contain burials in and around them.

Seven lava tubes were recorded during the survey. The largest lava tube is located in the northeastern section of the project site and extends for approximately 400 feet. This lava tube was used as a Civil Defense bomb shelter in the 1960's by the County of Kauai. These lava tube sites contained evidence of Hawaiian occupation, particularly near the entrances. There is a possibility that these lava tubes may also contain burials.

A number of sites showed evidence of historic era construction and/or occupation. Two of the significant sites include a house foundation with a stone bread oven and a railroad berm constructed by McBryde Sugar Company between 1890-1910. Portions of this railroad embankment are as much as 30 feet above the existing ground.

A. Impacts

The archaeological sites found on the project site will be affected by the development of this project. Sites not recommended for preservation will be subject to a data recovery effort, then demolished during construction and replaced by the various uses proposed. Significant sites not recommended for preservation may also be incorporated into open space within the development wherever possible.

B. Mitigation

A preservation plan and archaeological data recovery plan for the 51 significant sites will be prepared and submitted to the State Historic Sites Section and the County Planning Department for approval before construction commences.

Seven of the 58 sites have been recorded and are no longer significant. Thirty sites are significant only for their information content. These sites will undergo data recovery to extract important historical information. The remaining 21 sites containing multiple criteria will also be subject to archaeological data recovery. Fourteen of the multiple criteria sites are excellent examples of site types however, better examples are already preserved at Kiahuna.

A field trip to inspect archaeological sites at Kiahuna and Kukuiula was held on October 24, 1988. Participants included the consulting archaeologist, representatives from the Kauai Historic Sites Commission, State Historic Sites Section, County of

Kauai Planning Department, Dr. William Kikuchi, Kiahuna Corporation and A&B Properties. This field trip was conducted to verify that Kiahuna has indeed preserved better and larger site types than those found on the Kukuiula site. The sites at Kiahuna were not affected greatly by modern disturbances, like the Kukuiula sites, therefore sites at Kiahuna contained larger and better examples of site types. This field trip confirmed that the sites at Kiahuna still remain and the examples of site types were far better than those found at Kukuiula.

Three of the sites (Sites 3, 38A and 51) are recommended for preservation. These sites include 2 heiaus and portion of a raised auwai. The heiaus have been recommended for preservation based on three of the seven broad criteria established for the National and State Registers. These two sites are excellent examples of heiau sites, are likely to yield important information and have cultural significance. The auwai is being preserved because it is a unique and excellent example of a raised aqueduct and has important information of significance. This auwai and one of the heiaus also fall within the area designated for a park which is an ideal place for a historic site to be displayed to the public. This park land will be deeded to the County for development into a neighborhood recreational park.

Although only site feature 38A (the auwai) was recommended for preservation, nearly all of the features in Site 38 can be accommodated in the proposed park. Preserving Site 38 almost in its entirety will result in the preservation of a very large habitation and agricultural complex. Preservation of this site will also allow preservation of a large portion of the elevated railway berm. Site 40 will also fall within the boundaries of the park and will be preserved. In addition, the Portuguese oven and house site (Site 11) will also be preserved, as recommended by the Kauai Historic Sites Commission.

Because caves Sites 15, 19, 23 and 24 have recently been placed back on the State Register of Historic Places (Sept. 1988), entrances to these caves will be sealed to preserve their contents and to prevent possible liability problems. Sealing the entrances to the caves will provide future archaeologists the opportunity to explore our Hawaiian heritage. In addition, it is recommended that areas above the lava tubes be kept for open space or park use rather than roadways in the event stress from heavy vehicles causes the lava tubes to collapse. In the event the lava tubes pose a hazard or the lava tubes fall within or near roads and utilities, portions of the lava tube may require structural modification. If this situation should occur, proper permits and approvals will be sought before work is performed on the lava tubes.

Until a detailed preservation plan has been approved by the State Historic Sites Section and the County Historic Sites Commission, no action will occur on significant sites.

In the event burials are found, a site will be designated on or off site for reinterment of excavated burials. This process will be done in accordance with the Department of Health regulations with appropriate blessing ceremonies and as specified under Act 265, Chapter 6E of the Hawaii Revised Statutes.

The lava tubes pose a risk to life and property should they collapse during construction activity. It is recommended that testing and excavation be performed in these caves before they are demolished or filled. Lava tubes situated in areas set aside for open space may have the entrances sealed to preserve the deposits and prevent possible liability problems or vandalism. These lava tubes should be carefully mapped to prevent accidents during construction.

Although the majority of the sites are not recommended for preservation, developers of specific parcels may wish to include some of the archaeological features within landscaped gardens or as open space.

All phases of the archaeological data recovery process will be coordinated with the Kauai County Historic Sites Commission and the State Historic Sites Section. Preservation, testing and excavation will be done according to the preservation plan and data recovery plan prepared by the archaeologist and approved by these agencies. The Office of Hawaiian Affairs will also be consulted during the mitigation process.

3.10 AGRICULTURE

The project site is situated in Area 4 of the Land Studies Bureau (LSB), Detailed Land Classification for the Island of Kauai, 1967. This area is divided into four smaller sections (see Figure 3-11) because of the differences in physical characteristics. Area 4 spans from Mahaulepu going west to Waimea Canyon. The site is in portions of Areas 4a, 4b and 4c.

The overall Productivity Ratings for each land type are identified by "A" (the highest) to "E" (the lowest). Approximately one-third of the site is classified "A," another third classified "B" and the remaining third "D" or "E." Categories "A" and "B" have deep topsoil and are moderately to well-suited to machine tillage. Lands within the "D" and "E" categories are either too steep or too rocky for machine tillage and the agricultural potential is limited. These poor soils are generally located in the southeastern portions of the project, currently being used as pasture.

The ALISH (Agricultural Lands of Importance to the State of Hawaii) system classifies approximately one-third of the land "prime," one-third as "other important agricultural lands," and the remaining third "land of no agricultural importance" (Figure 3-12).

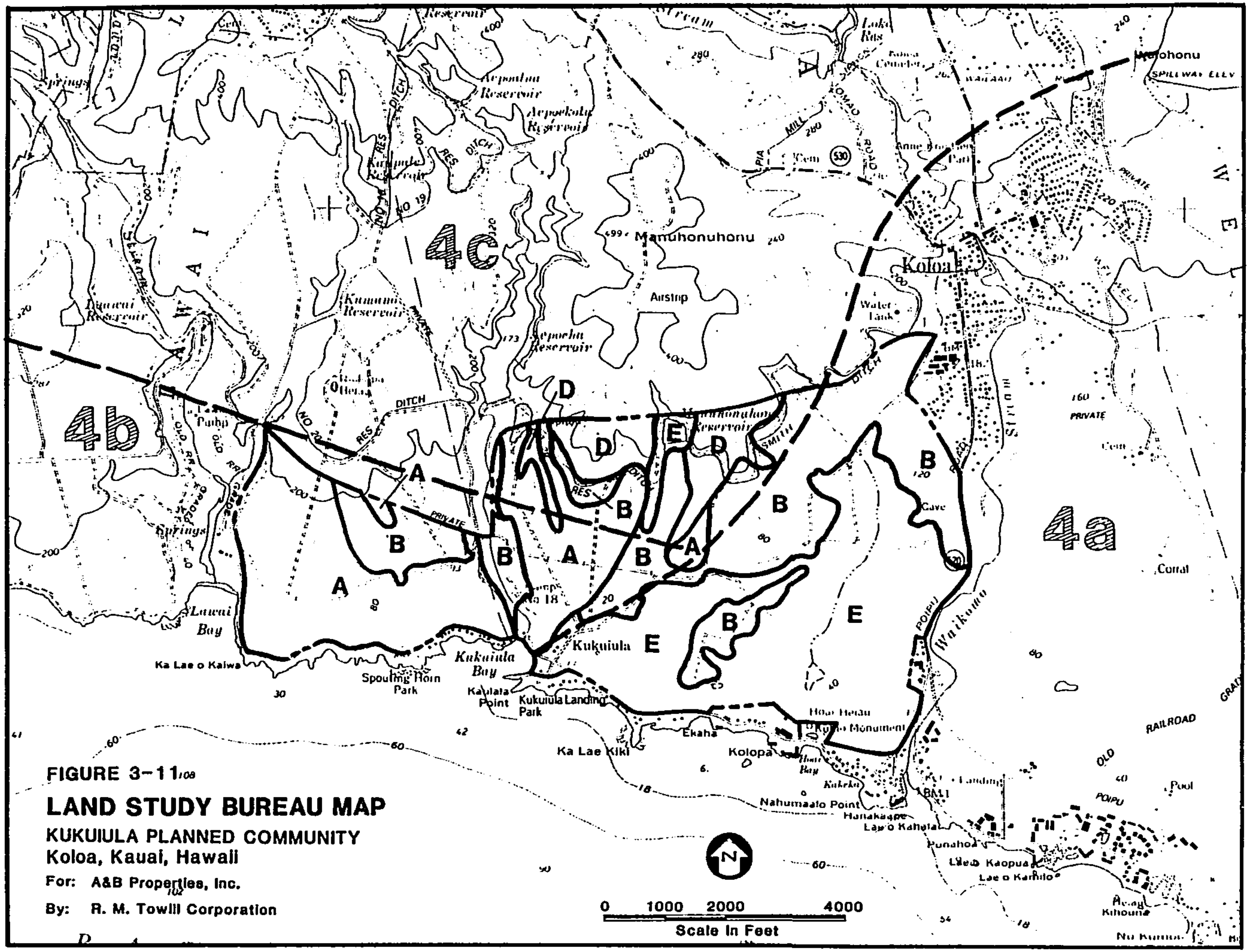

FIGURE 3-11

LAND STUDY BUREAU MAP
KUKUIULA PLANNED COMMUNITY
Koloa, Kauai, Hawaii

For: A&B Properties, Inc.

By: R. M. Towill Corporation

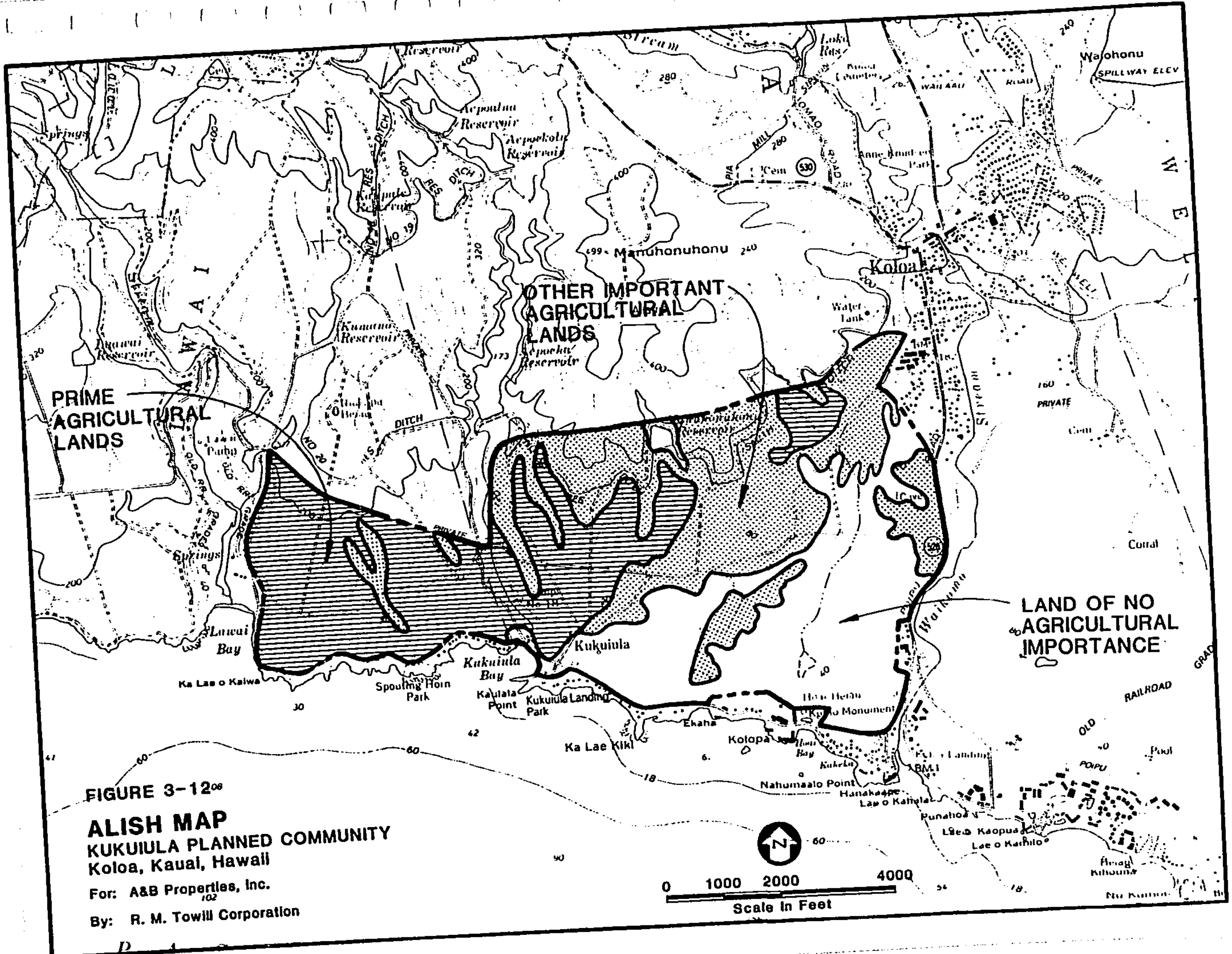

FIGURE 3-12

ALISH MAP
KUKUIULA PLANNED COMMUNITY
Koloa, Kauai, Hawaii

For: A&B Properties, Inc.

By: R. M. Towill Corporation

The State of Hawaii has a total of approximately 180,000 acres of land in sugarcane cultivation. The County of Kauai accounts for about 45,000 acres. The 600 acres of cane lands proposed for withdrawal is 1.4 percent of Kauai's cane lands and 0.3 percent of the State's inventory of cane lands.

According to the LSB system, Class A, B and C agricultural lands on Kauai total about 70,000 acres. Therefore, approximately 25,000 acres of available agricultural lands are not actively being used for agriculture. There appears to be little new demand for agricultural lands on Kauai at present. Except for ranching, very little diversified agriculture has taken place on Kauai historically. With the exception of the plans by large landowners, diversified agriculture would involve small acreage.

McBryde Sugar Company, founded in 1899, farms approximately 13,000 acres of sugarcane and 500 acres of macadamia nuts. In the past decade, McBryde showed a profit only two years from sugarcane operations. The average yield, however, has increased because of increased productivity. This increase in productivity, however, has resulted in a decrease in employment. Agricultural workers employed by McBryde dropped from 543 in 1983 to 433 in 1986.

The future of the sugar industry in Hawaii is uncertain because of low profitability and competition from foreign countries and other sugar sources (i.e., sugar beet and corn syrup). This is a major factor in A&B's attempt to diversify McBryde plantation away from sugarcane. McBryde has already diversified into about 500 acres of macadamia nut orchards on the southern side of Kauai. McBryde is also experimenting with coffee and tea, which have shown promising results. Final plans regarding diversified agriculture will be put in place within the next two years, because land leases from Grove Farm Properties (5,100 acres) and Knudsen Estate (2,200 acres) will expire in 1994.

If all of McBryde's cane lands cannot be used for alternative crops, the remaining lands in sugarcane can be consolidated with AMFAC's Lihue Plantation. Several million dollars will be needed to expand the mill to process 115,000 tons. Current capacity of this mill is 80,000 tons. Combined production of Lihue and McBryde plantations is presently about 130,000 to 140,000 tons.

Historically, sugar plantations and urban areas have been good neighbors on Kauai. There are very few complaints about blowing smoke. Each field is generally harvested once every two years and the cane burning before harvest lasts only 20 to 30 minutes.

A. Impacts

This development will result in the withdrawal of 600 acres of agricultural lands presently in sugarcane. The economic viability of the sugar industry will not be significantly impacted. The present low profitability from sugar, because of other sugar sources and competition, is more of a concern for the continuation of this industry. Further, there is ample agricultural land available which is unused and can replace more than 600 acres of land being withdrawn from agriculture.

A study done for Lihue Plantation on the removal of 270 acres of cane land predicted the loss of 10 jobs. Using this as a guideline, withdrawal of 600 acres from McBryde will result in the loss of about 21 jobs. Employment created from the development and diversified agricultural plans will far surpass the loss of employment from the sugar operations.

The financial impact on McBryde's operations will not be large enough to endanger the company's economic viability. McBryde will still be larger than two other Kauai plantations (Gay Robinson and Olokele). The size of sugar plantations vary tremendously to as low as 2,600 acres, which implies that the size of the plantation is not critical to the survival of a particular plantation.

The reduction of "prime" agricultural lands will not occur immediately. Agricultural lands will be converted to urban use on a phased basis. This area is anticipated to be one of the latter phases of the project because of McBryde's diversified agricultural pursuits and "prime" agriculture designation.

The proposed project is contiguous to urban and resort development in the Koloa District. This area also has a relatively high demand for new housing resources. The proposed development will help to meet the needs of this growing community. In addition to the variety of housing products proposed, recreational facilities, open space and commercial uses are proposed to complement the overall development.

3.11 VISUAL RESOURCES

The eastern section of the property does not have much in terms of scenic views of the ocean because of its low elevation. Views here consist mostly of the hillside and mountains with possible screened views of the ocean. The western portion provides unobstructed views of the ocean and mountains because of the gradual climb in elevation from the edge of the ocean cliffs to the uplands. More variety of views can be experienced along the upper limits of the site. Panoramic views of the ocean, mountains and adjacent lands are available.

Visual aspects within the development area consist of cane fields and sparsely vegetated pasturelands containing outcrops of large boulders. A few trees are scattered throughout the area.

A. <u>Impacts</u>

The development will impact the visual resources of a few existing residential properties along Lawai Road. Views of the mountains may be partially blocked.

The development will enhance the visual quality of the area by changing the existing appearance. A variety of landscape features, open spaces, parks, recreational facilities and the planned community will replace the cane fields, sparsely vegetated weedy pasture and rock outcrops.

B. <u>Mitigation</u>

To create a more pleasing visual environment, landscaping will be incorporated throughout the development. Landscaping will also be used to screen unattractive areas (i.e., sewage treatment plant). A 100-foot setback along the mauka side of Lawai Road will be reserved for landscaping, pedestrian/bike path and/or beach parking. The total distance from the existing homes may provide mountain views over the developed area. The more dramatic ocean views of the existing homeowners will not be affected by the development.

SECTION 4

The Socio-Economic Environment and Related Impacts

SECTION 4
THE SOCIO-ECONOMIC ENVIRONMENT AND RELATED IMPACTS

4.1 POPULATION CHARACTERISTICS

Of the four major Hawaiian Islands, Kauai has the smallest population: approximately 46,000 in 1986. De facto population for Kauai was 60,500. The 1987 Hawaii State Data Book (SDB) shows a significant increase in population growth for Kauai during the decade 1970 to 1980 of 31.3 percent. From 1980 to 1986 the population increased 18.5 percent. Specifically, the Koloa District experienced a 27.5 percent increase from 1970 to 1980. Hanalei had the highest increase in population from 1980 to 1986 with 73.4 percent, followed by Koloa with a 24.1 percent increase.

Recent social and economic trends indicate that Kauai and the other neighbor islands, excluding Oahu, will continue to experience fairly rapid population growth. By the year 2005, Kauai is expected to have a population of about 72,200 people, a 56 percent increase over the 1986 population figure. The "Revised Long-Range Economic and Population Projections to 2010, State of Hawaii," (Series M-K) January 1988, indicates an even higher increase in Kauai's population by 2005 to 76,800 people. Projected population by the year 2010 is estimated at 86,900.

Population projections for the Koloa District assume an increase of 2.5 percent per year compounded, according to the County Economic Development Office. By the year 2015 the population for the Koloa District will thus be approximately 22,300 (using the 1984 base year population of 10,381 people). The residential population for this development is estimated at 5,600 people based on percent distribution of the various housing products and prospective buyers.

Although the residential population for this project is 50 percent of the projected increase in population for the Koloa District, construction of all the units may not be completed by the year 2015. Construction of the units will be somewhat dependent on actual absorption rates (see "Market Assessment" in this section) and on the growth of the visitor industry.

Because Koloa District includes Poipu, one of Kauai's major tourist centers, the population of Koloa may increase at a much faster pace than actually anticipated. People will be attracted to Koloa because of housing, employment and activities available.

The dominant ethnic groups, in order of size, for Kauai are Filipinos (22.7 percent), Japanese (22.2 percent), Hawaiian mixture (22.2 percent), Caucasian (18.7 percent) and non-Hawaiian mixture (11.9 percent). Other ethnic groups consist of Hawaiian (0.7 percent), Chinese (0.6 percent), Puerto Rican (0.4 percent), Korean (0.2 percent), Black (.02 percent) and 0.4 percent people of other unmixed and unknown race. The State, as a whole, is dominated by Caucasian, Japanese, Part Hawaiian and Filipino (in order of size).

In recent years Koloa Town has inevitably been caught up in the visitor-oriented development at Poipu, however, the community wishes to maintain its existing rural character and residential community function. The Development Plan for the Koloa-Poipu-Kalaheo area indicated that this subregion is experiencing direct impact from changing uses and values by economic and social forces beyond the boundaries of the community and the County. In addition, the rapid change in the State of Hawaii's primary employment base of agriculture and military to visitor-oriented activities, increases the pressures in the area.

A. <u>Impacts</u>

The Kukuiula project will be developed fairly gradually and will not cause a major and sudden impact. The expected buildout of the project is about 25 years, which would result in approximately 150 units per year. The actual amount of units developed each year will be determined by market demand. Even without the project, the dynamics of social and economic change will impact the existing residential community of Koloa. It can be expected that, with or without the project, the Koloa-Poipu area will become increasingly developed and urbanized during the next several decades.

Population growth for the Koloa District is expected to increase with the development. The development of various types of housing, including affordable housing, may attract additional people to locate in the Koloa District. However, based on the projected increase in population and the expanding visitor industry, there will be a need for more housing and visitor accommodations. The sheer size of the development will complement the growth of Koloa by providing privately funded housing opportunities and visitor accommodations. Overall population impact on the island as a whole will be less than the impact on the Koloa region since some of the people that will locate here may already reside on Kauai.

New and improved infrastructure (i.e., roads, sewer, water) and additional recreational amenities resulting from this development will help to enhance the environment for the people of Koloa.

Additional employment opportunities may also attract people to locate in the Koloa District. The project's close proximity to Koloa's commercial center and the resort center at Poipu will draw people to relocate near their place of employment.

4.2 ECONOMIC CHARACTERISTICS

Kauai's economy is relatively small compared to Oahu's economy. Agriculture is still an important part of Kauai's economy. In recent years, however, tourism has grown considerably in economic importance. Current growth trends indicate that tourism will continue to grow and expand its role in the economy of Kauai. An economic and fiscal impact report was prepared and is attached as Appendix M.

4.2.1 Government Revenues and Expenditures

At project completion (year 2015), additional annual County revenues from this project could be as high as $8 million with new expenditures incurred by the County of $2 million. State revenues are expected to reach a high of $19 million per annum versus State expenditures of only $7 million. Total net revenues for the County and State are thus $6 million and $12 million, respectively for the entire project (See Table 4-1).

4.2.2 Business and Employment

The SDB indicates 20,900 jobs on Kauai. Approximately 84 percent of these jobs are nonagricultural. Per capita personal income for Kauai residents was $10,564 in 1984.

Kauai shows a job increase of more than 37 percent during the decade 1976 to 1986. By the year 2005 the job count for Kauai is expected to increase by approximately 88 percent, according to the State's Series M-K. Approximately 44,100 jobs are projected by the year 2010.

Kauai's steadily growing population and economy will require various kinds of expanded facilities, including housing, commercial and recreational facilities.

During the course of construction for this development, it is anticipated that an average of 270 to 370 person-years per year of direct construction jobs will be created through the year 2015. A higher number of direct jobs per year will occur during the initial phases and decrease in the latter phases. A total of more than 600 person-years per year of indirect construction related jobs will also be created. Table 4-2 summarizes the direct, indirect and induced construction employment through 2015 by phases. Personal income from these jobs will increase the economy of Kauai, as most of this income will be spent on the island. Employment will be generated by the construction of the infrastructure, single- and multi-family units, commercial areas, a resort complex, marina, parks and golf course.

The "order of magnitude" cost estimate for construction of the off-site and on-site infrastructure for this project is approximately $170 million. This does not include indirect or induced monies that will be generated during the course of construction.

TABLE 4-1

Government Revenue
and Expenditure Comparison

(1988 dollars; in millions)

	1995		2005		2015	
	Low	High	Low	High	Low	High
County of Kauai						
PHASE I						
New Revenues	$1.2	1.3	2.2	2.4	2.4	2.4
New Expenditures	0.5	0.6	0.7	0.8	0.7	0.8
Net Additional Revenues	0.7	0.7	1.5	1.6	1.7	1.6
Revenue/Expenditure Ratio	2.4	2.4	3.1	3.0	3.4	3.0
PHASE II						
New Revenues	$ -	-	1.0	2.3	2.6	5.5
New Expenditures	-	-	0.5	0.8	0.8	1.4
Net Additional Revenues	-	-	0.5	1.5	1.8	4.1
Revenue/Expenditure Ratio	-	-	1.9	2.9	3.3	3.9
TOTAL PROJECT, PHASES I AND II						
New Revenues	$1.2	1.3	3.2	4.7	5.0	7.8
New Expenditures	0.5	0.6	1.3	1.6	1.5	2.2
Net Additional Revenues	0.7	0.7	1.9	3.1	3.5	5.6
Revenue/Expenditure Ratio	2.4	2.2	2.5	2.9	3.3	3.5

TABLE 4-1 - Continued

Government Revenue
and Expenditure Comparison

(1988 dollars; in millions)

State of Hawaii	1995 Low	1995 High	2005 Low	2005 High	2015 Low	2015 High
PHASE I						
New Revenues	$1.9	2.2	3.9	5.1	4.9	7.4
New Expenditures	1.5	1.8	2.3	2.6	2.3	2.6
Net Additional Revenues	0.4	0.4	1.6	2.5	2.6	4.8
Revenue/Expenditure Ratio	1.3	1.3	1.7	2.0	2.1	2.9
PHASE II						
New Revenues	$ -	-	3.6	5.9	6.0	11.2
New Expenditures	-	-	1.2	2.0	2.5	4.5
Net Additional Revenues	-	-	2.4	3.9	3.5	6.7
Revenue/Expenditure Ratio	-	-	3.0	3.0	2.4	2.5
TOTAL PROJECT, PHASES I AND II						
New Revenues	$1.9	2.2	7.5	11.0	10.9	18.6
New Expenditures	1.5	1.8	3.6	4.5	4.8	7.0
Net Additional Revenues	0.4	0.4	3.9	6.5	6.1	11.6
Revenue/Expenditure Ratio	1.2	1.2	2.1	2.4	2.3	2.7

SOURCE: Peat Marwick Main & Co., Economic and Fiscal Impact Assessment for the Proposed Kukuiula Master Planned Community, Phases I and II, June 1988.

TABLE 4-2

Projected Direct, Indirect and Induced
Construction Employment

Average Annual Person-Years: 1990 to 2015

Type of Employment	1995 Low	1995 High	2005 Low	2005 High	2015 Low	2015 High
Direct:						
Phase I	280	320	135	155	10	30
Phase II	130	170	150	230	175	275
Subtotal	410	490	285	385	185	305
Indirect and Induced:						
Phase I						
On Island	55	65	30	30	-	10
Elsewhere in State	455	510	220	250	15	50
Phase II:						
On Island	25	35	30	45	35	55
Elsewhere in State	210	270	240	260	280	440
Subtotal	730	880	520	690	330	555
Total, rounded	1,140	1,370	800	1,070	520	860

SOURCE: Peat Marwick Main & Co., Economic and Fiscal Impact Assessment for the Proposed Kukuiula Master Planned Community, Phases I and II, June 1988.

Long-term employment opportunities will be created by the commercial areas, the marina, the multi-family units, the resort complex and the 18-hole golf course. Residents of this planned community will be well located in relation to nearby employment opportunities. Other existing employment centers within close proximity include the Koloa commercial center and the Poipu Resort area. By the year 2015 long-term direct employment generated by the project could be in the range of 900 to 1,300 jobs. Indirect and induced long-term employment can range from 1,700 to 2,400 jobs (See Table 4-3).

Wages and salaries paid to direct employees could be as much as $17 million by 1995, $27 million by 2005 and $25 million by 2015. This does not include potential wages and salaries paid through the project's indirect and induced economic effects. Table 4-4 shows a breakdown of job types by phases.

4.2.3 Tourism

Tourism is a rapidly growing industry for the neighbor islands, especially for Maui and Kauai. The annual visitor census for Maui and Kauai showed an enormous increase in visitors from 1981 to 1986. Maui County increased 118 percent and Kauai County increased 105 percent during the 5-year period (SDB). The majority of visitors are still on Oahu, however, the visitor count there has fluctuated during the past years, showing a decline in some years. By the year 2005 the number of visitors to the State of Hawaii is expected to nearly double the 1986 volume of 5.6 million.

The majority (82 percent) of visitors come to Hawaii for pleasure. Others arrive for business, conventions, visiting relatives and for a mix of business and pleasure. Of the 5.6 million visitors to Hawaii in 1986, about 56 percent stayed at hotels, 23 percent in condominiums and 10 percent at hotel-condos. The remaining visitors stayed with friends or relatives or in other accommodations.

The estimated visitor related expenditures (excluding Hawaii residents) in the State in 1986 was $5.5 billion. Kauai's share was approximately $520

TABLE 4-3

Projected Direct, Indirect and Induced
Long-Term Employment

Type of Employment	1995 Low	1995 High	2005 Low	2005 High	2015 Low	2015 High
Direct:						
Phase I	240	290	460	550	460	550
Phase II	-	-	440	660	510	770
Subtotal	240	290	900	1,210	970	1,320
Indirect and Induced:						
Phase I						
On Island	50	60	90	110	90	110
Elsewhere in State	140	170	280	330	280	330
Phase II:						
On Island	-	-	90	130	100	150
Elsewhere in State	-	-	260	400	310	460
Subtotal	190	230	720	970	780	1,050
Total	430	520	1,620	2,180	1,750	2,370

SOURCE: Peat Marwick Main & Co., Economic and Fiscal Impact Assessment for the Proposed Kukuiula Master Planned Community, Phases I and II, June 1988.

TABLE 4-4

Projected Annual Personal Income from Direct Employment

1990 to 2015

Thousands of 1988 Dollars

Type of Employment	1995 Low	1995 High	2005 Low	2005 High	2015 Low	2015 High
PHASE I						
Construction	$ 7,620	8,740	3,710	4,270	280	830
Operational	1,340	2,080	2,380	3,130	2,380	3,130
Commercial	1,510	1,510	3,020	3,420	3,020	3,420
Subtotal	$10,470	12,330	9,110	10,820	5,680	7,380
PHASE II						
Construction	3,580	4,680	4,120	6,220	4,790	7,500
Operational	-	-	6,550	9,830	6,550	9,830
Subtotal	3,580	4,680	10,670	16,050	11,340	17,330
Total	$ 14,050	17,010	19,780	26,870	17,020	24,710

SOURCE: Peat Marwick Main & Co., Economic and Fiscal Impact Assessment for the Proposed Kukuiula Master Planned Community, Phases I and II, June 1988.

million. Total State-wide sales including direct, indirect and induced expenditures was over $10 billion. Household income generated by visitor related activities for the State was about $4 billion. State and County tax revenues totaled approximately $660 million State-wide. A large percentage of the monies were spent at eating and drinking places, hotel services and real estate, and imports. Monies spent for these items accounted for over $4 billion of the State-wide visitor related expenditures.

Jobs (direct, indirect and induced) generated by the visitor industry accounted for 40 percent of the civilian labor force for the State in 1986. Visitor expenditures for this 1,000-acre Kukuiula project could result in about $50 million of direct annual expenditures by 2015, in 1988 dollars. Including the anticipated multiplier effects, this development could generate over $100 million in direct, indirect and induced visitor expenditure by 2015 (1988 dollars). Table 4-5, shows a breakdown of annual visitor expenditures for Phases I and II.

4.2.4 Agriculture

Agricultural lands consist of farms, crops, livestock, dairy products, poultry and aquaculture. In 1986, there were 4,600 farms in Hawaii totalling 1.95 million acres. Kauai County accounted for 203,448 acres. The County of Hawaii tops the State in agricultural lands with approximately 1.2 million acres. The total value of crop and livestock sales for the State in 1986 was about $565 million. Kauai County's share of livestock and crop sales for 1986 was $65.7 million. About $54 million of Kauai's agricultural sales was attributed to unprocessed cane.

Major crops for the State include sugar, pineapple, flowers and nursery stock, and macadamia nuts. These crops account for about $500 million of the total State sales. Major products from livestock farms include cattle, milk and eggs.

The State's two primary agricultural exports are raw sugar and pineapple. Increasing productivity has resulted in a decline of workers needed to

TABLE 4-5

Projected Direct Annual Visitor Expenditures
Millions of 1988 Dollars

Type of Employment	1995 Low	1995 High	2005 Low	2005 High	2015 Low	2015 High
Direct:						
PHASE I						
Multi-Family Units						
Medium Density	$ 3.7	3.7	11.5	11.5	11.5	11.5
Low Density	4.4	5.1	5.1	5.1	5.1	5.1
Single-Family Units	0.7	0.7	1.0	1.4	1.0	1.4
PHASE II						
Low Density Multi-Family Units	-	-	-	-	4.1	6.4
Single-Family Units						
Ocean- and Golf-Front Lots	-	-	0.7	1.4	1.0	2.7
Patio Homes	-	-	0.0	0.3	0.3	0.7
View and Other Lots or Units	-	-	0.7	0.7	1.0	1.7
Hotel Units	-	-	23.8	34.4	23.8	34.4
Subtotal	8.8	9.5	42.8	54.8	47.8	63.9
Indirect and Induced:						
PHASE I	6.0	6.5	12.0	12.2	12.0	12.2
PHASE II	-	-	17.1	25.0	20.6	31.2
Subtotal	6.0	6.5	29.1	37.2	32.6	43.4
Total, rounded	$14.8	16.0	72.0	92.0	80.5	107.3

harvest and process these exports. In the decade 1976 to 1986, the value of unprocessed sugar rose to a high of $385 million in 1980, then fluctuated for the remaining years and declined to $234 million in 1986. The annual output of raw sugar has stabilized at about 1 million tons.

Pineapple production has expanded in recent years due to the demand for fresh pineapples on the Mainland. Projections (Series M-K) indicate that export of fresh pineapple will gradually increase at an average of 1.2 percent every 5 years to the year 2010. The demand for processed pineapple is expected to stabilize by 2010.

The demand for Hawaii-produced raw sugar, on the other hand, is expected to decline by -1.3 percent from 1985-1990 to -1.8 percent from 2005-2010.

A rapidly growing field of agriculture is aquaculture. Aquaculture includes: freshwater prawns, marine shrimp, oysters, brine shrimp, carp and Chinese catfish, catfish, Koi, tilapia, tropical fish and aquarium plants, trout, abalone, ogo and microalgae. The value of aquaculture products rose from $1.66 million in 1980 to $3.55 million in 1986. In 1986, Kauai's 35 acres of aquafarms yielded 38,800 pounds of products with a value of $210,400. The City and County of Honolulu has 330 acres which yielded 892,600 pounds of products totaling $2.8 million.

Another growing field of diversified agriculture in Hawaii is the flower and nursery products industry. In 1981 $29 million sales were made in the State of Hawaii. In 1986, over $49 million was generated through the sale of flowers and nursery products. Within a short five-year period this industry has increased about 1.7 times. Kauai experienced the greatest boost during this period with an increase of 2.7 times ($420,000 in 1981 to $1.2 million in 1986). Products include: cut flowers, orchids, lei flowers, foliage, potted flowering plants, and ornamentals and trees.

A. Impacts

Development of this project will increase economic activity on Kauai. During the construction phase of the project, approximately $170 million of infrastructure construction contracts will be awarded. Indirect and induced monies from construction activities will also add to the island's economy, as most of the money will be spent on Kauai. Increased County and State tax revenues will also be generated, and these revenues are projected to exceed government operating expenditures for the project and its residents.

The addition of short-term and long-term employment will decrease unemployment in Kauai County. New employment opportunities created by the project will provide a variety of jobs for the unemployed. Of the four major counties, the County of Hawaii had the highest unemployment rate of 7.6 percent followed by the County of Kauai at 6.0 percent in 1986. The State's diversification into other areas of agriculture, such as high technology aquaculture or flower and nursery products, will help to alleviate unemployment resulting from the declining labor needs of the sugar and pineapple industries.

The tourist industry appears to be flourishing on Kauai. The addition of the proposed resort, multi-family units, the marina and recreational facilities will help to accommodate the rapidly growing visitor industry.

4.3 MARKET ASSESSMENT

Two market assessment reports were prepared by Peat Marwick Main & Company in November 1987 and May 1988 to assess the market support for Phase I (219-acre parcel) and Phase II (800+ acres), the summary of which is included as Appendices K and L. Results of these reports are as follows.

4.3.1 Phase I Market Assessment

The Phase I 219-acre development consists of approximately 740 single-family lots, 440 low density multi-family units, 560 medium density multi-family units and up to 80,000 square feet of commercial space.

* Single-Family Residential Lots

  Single-family residential construction authorizations on Kauai have totaled an average of 417 units per year since 1984. Development since 1982 has produced 370 single-family homes and 850 single-family lots. The Koloa and Lihue areas accounted for only 17 percent of the single-family development activity. The majority of purchasers (90 percent) of single-family homes in the Lihue and Koloa Districts were Kauai residents. Recent developments in the Koloa District included Bay View (40 lots), Waikomo Subdivision (30 lots) and Kono Hiki (20 lots), which had no finished home products. There are at this time no planned single-family developments for Koloa.

  Since 1982, the Koloa District accounted for 20 to 30 percent of County lot sales and 10 to 15 percent of single-family home sales. Recent trends indicate that the Koloa District could accommodate 20 to 30 percent of the County-wide demand in the future. The Kukuiula Phase I project could serve at least 50 percent of the Koloa District demand for single-family housing and up to 75 percent of the regional demand from 1990 to 2005 sales period. The 500 to 740 single-family houses within the Kukuiula Phase I project can be expected to be absorbed during the sales period 1990 to 2005. These units could be sold as either single-family lots or finished homes, depending on the prevalent market conditions.

* Multi-Family Units

  Multi-family construction authorizations on Kauai have averaged about 270 units per year since 1970. More than half of all authorizations were granted from 1978 to 1980. Development of multi-family units in the 1980's was relatively slow because of the weaker economic conditions on Kauai as well as in the State, and the recent Tax Reform Act of 1986.

A recent multi-family project completed in the Poipu area was Whaler's Cove in 1987. Other known plans for condominium development in the area include Lawai Beach Resort (60 units), Moana Golf Village (280 units) and Manualoa (46 units). These three projects are expected to be completed by 1990. The Kiahuna Master Plan, however, does include additional condominiums or hotel sites.

The Kukuiula project could provide housing units for resort-oriented and full-time/resident-oriented markets. About 570 to 830 units could cater to full-time Kauai residents. Areas located closer to the ocean could offer resort condominium products of 500 or more units to part-time residents, visitors and investors.

* Commercial Retail

Recent commercial development in the Koloa District has catered primarily to the visitor industry. There are three more commercial developments proposed in the Koloa District which will include visitor and resident oriented uses. The Kukuiula project plans to develop two 6-acre commercial sites. A neighborhood commercial shopping center is planned at the intersection of Poipu, Lawai and the new project roads. This commercial center will cater primarily to residents of the Koloa-Poipu area and will include a supermarket, drug store, and/or personal service shops. Based on the projected population of the Kukuiula development, approximately 12,000 square feet of resident oriented commercial space could be supported. In addition to the Kukuiula residents, significant market support could be anticipated from current and expected levels of visitor population both in Kukuiula and Poipu. This could result in an additional 13,300 square feet of commercial space from the Kukuiula visitor market and 24,800 square feet from the Poipu market. Therefore, this neighborhood commercial area can be developed into a 50,000 square feet commercial complex.

The second commercial site is planned near the proposed resort hotel and marina and will cater primarily to visitors and marina related shops. Some resident oriented shops could also be supported at this location. About 30,000 square feet of commercial space could be supported in this area.

4.3.2 <u>Phase II Market Assessment</u>

Phase II offers a variety of single- and multi-family residential housing products. Approximately 1,900 single-family lots and 400 multi-family units are planned. A resort hotel is also planned at Kukuiula Bay. Major recreational amenities planned include an 18-hole golf course and a 100 to 150 boat marina.

* <u>Single-Family Market Assessment</u>

  Approximately 1,900 lots or homes are proposed to be developed for single-family market units. Because of the topography and proximity of amenities and uses planned, single-family lots provide a wide variety of housing types. Housing products include golf course frontage lots, oceanfront lots, patio homes, view lots and other single-family lots.

  It is anticipated that golf course, oceanfront and view lots will attract 20 to 30 percent full-time resident owners, 50 to 55 percent part-time resident/second homeowners, and 15 to 20 percent investors (long or short-term rentals). Other single-family housing products would be supported by 60 to 65 percent full-time resident owners, 15 to 20 percent part-time resident/second homeowners and 20 to 25 percent investors.

By the year 2015, golf course, oceanfront and patio homes could absorb as many as 1,050 lots and/or homes and other view and non-view lots as many as 1,000 units.

* Multi-Family Market Assessment

  Multi-family units for Phase II of this development consist of about 400 "low density" units -- about 10 units per acre. Most of the multi-family units provided in Phase II have golf course frontage and/or excellent ocean views. These units are expected to attract similar buyers as the single-family lots/homes. About 10 to 20 percent is expected to be purchased by full-time resident owners, 35 to 40 percent part-time resident/vacation home buyer and 45 to 50 percent investor and/or vacation home buyers. Assuming a capture rate of only 45 to 50 percent for Kukuiula's market share, as many as 530 condominium units could be absorbed by 2015. This does not include units sold for the Phase I development. Overall new unit sales for the Poipu area, not including resales of existing condominiums can reach a high of 1,800 units by the year 2015.

* Resort Market Assessment

  Visitor accommodations on Kauai consist primarily of hotels and condominium units. In 1987, the Hawaii Visitor's Bureau (HVB) reported a total of about 6,000 visitor units on Kauai (3,300 hotel rooms and 2,700 condominium units). There are seven hotel projects planned for completion by 1995, totalling an additional 3,400 rooms.

  Growth in the average daily visitor population was based on projections made by the Department of Business and Economic Development (DBED). The average daily demand for hotel units is projected to be about 8,700 units by the year 2005, representing an annual average increase of approximately 5 percent over the projection period.

The average occupancy level is typically 70 to 80 percent, permitting visitors choice in accommodations and allowing hotels to efficiently maintain and operate their facilities profitably through busy and slower periods. Based on an occupancy level of 70 to 80 percent and projected average daily demand of 3,700 rooms in 1987 and 8,600 in 2005, the island is expected to require a minimum of 5,700 rooms in 1990 and 10,900 by 2005. These projections indicate that an additional 1,800 to 3,300 rooms over and above those presently planned hotels will be required by the year 2005.

The planned Kukuiula hotel is expected to be developed into about 500 rooms. This hotel will capture about 4 to 5 percent of the Kauai visitor room demand, as compared with capture rates at Kapalua (3 percent) and Wailea (9 percent).

* Affordable Housing

As stated previously, the County has required that A&B provide 10 percent of the total unit count of Phase I for affordable housing. A&B plans to provide affordable housing products on and off site for Phase II. The exact location of these sites and percentage of affordable housing units have not yet been determined. Affordable housing may be integrated among the market units rather than designating a specific site for this development. Employee housing will be made available for employees within the project and could also be integrated with the affordable housing requirements.

A. Impacts

This development will provide the residents of Kauai as well as prospective buyers from Oahu, the mainland and foreign countries, a wide variety of housing products. Affordable housing products will also be provided, although not entirely as a part of this development.

The proximity of this project to a major resort destination like Kauai's Poipu area encourages and complements the development of the proposed resort facilities. Development of the resort facilities will help to accommodate the needs of the rapidly growing visitor industry. Some of the other housing products proposed could also be used as visitor accommodations, offering a variety of choices. Should it be determined that transient housing products can be accommodated within this project, necessary approvals will be sought.

The two commercial areas proposed will provide residents as well as visitors close access to everyday shopping and personal services.

SECTION 5

Existing Public Facilities and Services and Related Impacts

SECTION 5

EXISTING PUBLIC FACILITIES AND SERVICES AND RELATED IMPACTS

The existing public facilities and services in the Koloa-Poipu area are presently being upgraded to meet the demands of a growing community. For this reason all new developments in the area must be sensitive to the impact upon public facilities and services of the Koloa-Poipu community. The land within the proposed development is predominantly being used for sugarcane cultivation. The rest of the land is sparingly used as pasture land although a small portion is presently used as a small boat harbor. Therefore, the construction of new electrical, telephone, potable water, sewer, drainage and roadway systems within the proposed development will be required along with the improvements to the existing public facilities and services.

5.1 FLOODING AND DRAINAGE

The primary drainageway of the Koloa-Poipu area is Waikomo Stream. The coastal areas of the Koloa-Poipu area and Waikomo Stream have been studied in detail by the Federal Emergency Management Agency (FEMA). Figure 5-1 shows flood zones as determined by FEMA. A portion of the Waikomo Stream flood boundary extends east on Poipu Road into the proposed development. Some isolated areas within the proposed development near the coastline are within the coastal high hazard area. The land within the proposed development is crossed by two drainageways (see Figure 5-1).

The smaller drainageway starts at the top of Manuhonuhonu and is bounded by Poipu Road on the eastern edge and Manuhonuhonu Reservoir to the west. The only outlet to the ocean for this drainageway is through a small box culvert fronting Lawai Beach Resort. The larger of the two drainageways starts in the forest reserve above Lawai and passes through a series of reservoirs to Aepoeha Reservoir above Kukuiula Bay. A defined channel has been cut by erosion down to a bridge culvert on Lawai Road. This bridge culvert is the primary drainage outlet to the ocean.

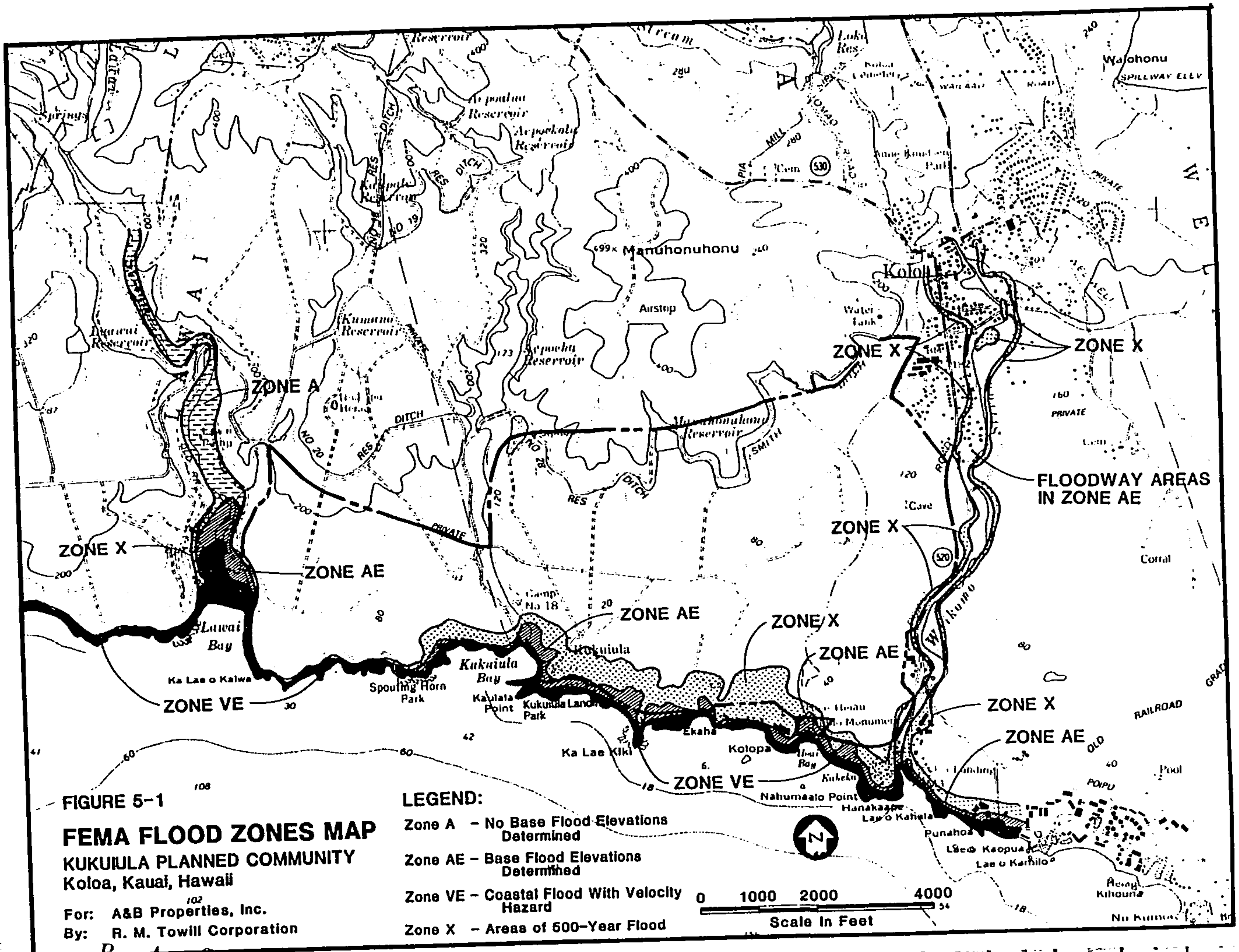

FIGURE 5-1

FEMA FLOOD ZONES MAP

KUKUIULA PLANNED COMMUNITY
Koloa, Kauai, Hawaii

For: A&B Properties, Inc.
By: R. M. Towill Corporation

LEGEND:

Zone A – No Base Flood Elevations Determined
Zone AE – Base Flood Elevations Determined
Zone VE – Coastal Flood With Velocity Hazard
Zone X – Areas of 500-Year Flood

0 1000 2000 4000
Scale In Feet

The proposed development area has only two major outlets to the ocean. While there are a few 30-inch and 18-inch reinforced concrete pipe culverts, the culverts are only capable of handling the surface runoff of Lawai Road and small areas mauka of the road. The homes in the coastal area below the development rely mainly upon ponding and infiltration in the upper vegetated areas to absorb the storm runoff. The storm runoff that cannot be held or cannot percolate into the ground will eventually enter the ocean through the two major outlets or sheetflow across Lawai Road. The two major outlets discharge into waters classified as Class A by the Department of Health. A 24-inch pipe which serves as an inlet/outlet for the pond at the Prince Kuhio Park enters into Class AA waters.

The proposed development will require the construction of drainage improvements which include road gutters, catch basins, drain lines, box drains, box culverts, bridge culverts, drainage channels, retention basins and drainage swales. All construction will conform to Kauai County Standards. Figure 5-2 shows the major drainage improvements for the proposed development. Runoff from drainage basin "C" (subareas C-1, C-2 and C-3) presently discharges into Kukuiula Bay and will continue to discharge into the bay. Stormwater runoff and daily flows from drainage basins "A" (subareas A-1, A-2, A-3 and A-4) and "B" (subareas B-1 and B-2) will be diverted by the swale to Kukuiula Bay. Drainage basin "D" will contain on-site retention and siltation basins then through existing outlet fronting Lawai Beach Resort. The principal features of the proposed drainage system are the drainage channels entering Kukuiula Bay and the golf course fairways which will also act as a drainageway and a series of retention basins during storms. The proposed system will hold and divert all the drainage above the golf course to the drainage channels and retention basins at Kukuiula Bay and then into the ocean. An intermediate system will be required during the initial phases of the development before the golf course and drainage channels are constructed. This temporary system will consist of a drainage swale above the first phase of the proposed development and a holding basin at Kukuiula Bay. This will divert the drainage from the area above the first phase of the proposed

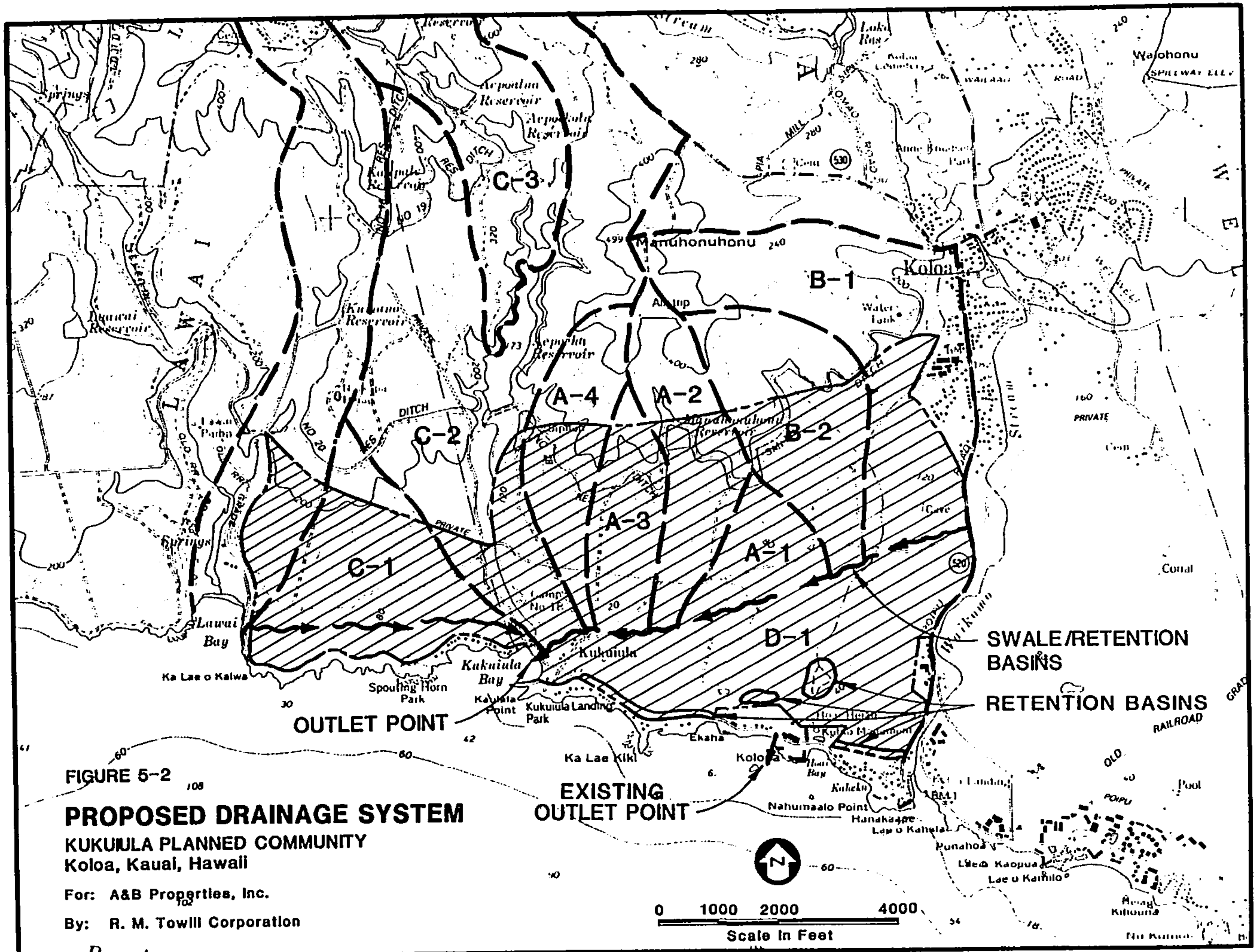

FIGURE 5-2

PROPOSED DRAINAGE SYSTEM

KUKUIULA PLANNED COMMUNITY
Koloa, Kauai, Hawaii

For: A&B Properties, Inc.

By: R. M. Towill Corporation

development to the existing bridge culvert at Kukuiula Bay. This swale will eventually be converted into the golf course fairways where it will serve as a series of major retention basins and drainage swale. The drainage system in the area below the major swale will consist of underground drain lines to retention and siltation basins on site then to an existing outlet fronting the Lawai Beach Resort. Retention basins and drainage swales will be sized to maximize sediment settlement, thus reducing potential adverse impacts to nearshore marine biota in Kukuiula Bay.

A. <u>Impacts</u>

The construction of the infrastructure for the proposed development will have a temporary impact upon the drainage facilities in the area. During construction, the land will be cleared and graded which will promote runoff of storm waters thereby increasing the storm flows into potentially two ocean outlets and increasing the flow of water over Lawai Road. Should a large storm such as the 50-year or 100-year storm occur during construction, this increase in runoff could result in flooding of homes, damage to Lawai Road and other developments in the coastal areas. The clearing and grading of the land will also result in increased soil erosion.

Soil erosion will be increased because there will be no vegetation to reduce the velocity of water and no vegetal root system to hold the soil in place. The soil erosion during construction, if uncontrolled, will eventually enter the ocean, increasing the amount of suspended solids within the coastal waters, affecting water quality. The construction of the proposed drainage facilities will also increase vehicular traffic to the construction site and increase traffic inconveniences where the construction will cross an existing road. The construction will increase vehicular emissions, dust and particulate matter in the air. Heavy equipment will be used which will also increase noise levels and vehicular emissions.

The proposed development will permanently change the drainage patterns of the land above Lawai Road which will have long term impacts upon the developments in the coastal areas as well as impacts to the water quality of the coastal zone. The construction of roadways, single-family and multi-family units, and parking areas will increase the amount of impervious area within the proposed development. Recontouring of the land to the grades required for the development will eliminate most of the existing ponding areas that presently hold storm runoff. These changes will increase the amount of storm runoff from the proposed development and increase the flooding potential to the coastal areas below Lawai Road. The construction of a complete drainage system will also create point source discharge of storm and normal surface runoff which will affect water quality.

As shown on Figure 5-2, the proposed development has two potential outlets to the ocean planned to discharge storm and normal surface runoff. These outlets constitute point sources of potential pollutant discharge of particulate matter and chemical pollutants. The chemical pollutants will include the active ingredients of pesticides, herbicides, fertilizers and laundry detergents.

B. Mitigation

The impacts due to the construction of the new drainage facilities will be mitigated by following the existing governmental regulations which control the noise, air and water quality impacts of the construction industry. Traffic inconveniences will be reduced by following the traffic control recommendations of the County and State and following their regulations for construction within a County or State right-of-way.

The drainage impacts due to construction of the total development will be mitigated by following the erosion control measures prescribed by an Erosion Control Plan required for approval by the County of Kauai prior to construction. The Erosion Control Plan is required before construction can commence and is intended to protect the receiving waters from adverse impact due to soil erosion. The Erosion Control Plan will delineate the sequence of construction and erosion control measures as required by the County of Kauai and the State of Hawaii. At no time will more than 15 acres of land be cleared for excavation. New land cannot be cleared until the previously cleared land is stabilized by grassing. The Erosion Control Plan will also include the construction of temporary silting basins which will reduce the amount of eroded soil and reduce the volume of water that will leave the construction site. The temporary silting basins will also reduce the increased flooding potential due to construction. Permanent basins will be required as part of the proposed development. As part of the initial design phases of the project, a Drainage Master Plan is presently being prepared which will determine the measures necessary to control the increased drainage due to the proposed development. Preliminary findings from the drainage master plan indicated that approximately 40 acre-feet will be needed to control the drainage from a 50-year storm generated below the golf course. The existing impoundment mauka of the Prince Kuhio Park, a new retention basin back of Lawai Beach Resort, and retention basins along Lawai Road will be sufficient to hold the increased storm water runoff caused by the development. A small swale system will be incorporated to move daily flows to the existing outlet.

To reduce the increased flooding potential of the proposed development in the mauka area, retention basins will be constructed along with drainage swales and channels to transport the storm runoff to Kukuiula Bay (see Figure 5-2). Initially, a drainage swale will be constructed directly above the boundary of the first phase to transport storm runoff away from the Prince

Kuhio and Kuhio Shores area to Kukuiula Bay (see Figure 5-2). The swale will integrate into the proposed golf course and will eventually become a part of the fairways. With proper grading, the golf course will be used to perform a secondary service as major drainageways and as a series of retention basins to minimize the impact of silt and the increased runoff of the proposed development. Daily flows will be routed via a small swale system to keep the flow moving, thereby elminating the potential breeding of mosquitos. The proposed drainage system will protect the areas makai of the proposed golf course from flooding due to the 50-year and 100-year storms. While storms of lesser magnitude may not affect the developments in the coastal areas, the 50-year and 100-year storms would definitely have a significant impact. Therefore, the proposed drainage system will have a significant beneficial impact by reducing the impact to the existing developments from flooding hazards due to the 50-year and 100-year storms. A meandering channel will be maintained on the golf course to transport the daily drainage to the outlet at Kukuiula Bay. The golf course and other proposed improvements will serve to reduce soil erosion but could increase the amount of chemical pollutants that enter the ocean. However, the basins proposed will also serve as siltation basins which will mitigate the adverse impact of increased soil erosion due to the development.

Infiltration wells may also be used in lieu of or in conjunction with retention basins. However, if infiltration wells are used, they should be designed such that the existing groundwater is not adversely impacted. However, considering the underlying basalt layer, infiltration wells may not afford adequate percolation.

The chemical pollutants will enter Class A waters at Kukuiula Bay and at the Lawai Beach Resort. Studies on urban areas of Oahu and in large golf course an resort complexes on the Island of Hawaii (Maunalani Resort and Punaluu's Resort) have found that the amount of pesticides, herbicides and nutrients in surface runoff and intertidal groundwater is minimal to non-existent. The primary constituent of the runoff are nitrogen and phosphorous. Nitrogen and phosphorous are nutrients used by phytoplankton, which is in the basic food chain of marine life. Due to the low levels of phosphorous and nitrogen expected, a great increase in marine phytoplankton is not likely. Due to the low levels of phosphorous and nitrogen and the diluting effect of the ocean, algal blooms resulting in eutrophication of harbor waters are not expected.

5.2 POTABLE WATER

The Koloa-Poipu area is presently served by two wells. Koloa Wells 16-A and 16-B at Waihonu and by two new wells on the ridge above Mahaulepu operated by the Department of Water of the County of Kauai. The two wells above Mahaulepu develop approximately 1,200 gpm each while the two Koloa wells are rated at 500 gpm per well. There are two water tanks close to the proposed development, one between Koloa Elementary School and Koloa Town, and one near the Puuhi Reservoir. Another storage tank is located on Omao Road further from the development. This system is adequate to serve the existing needs of the area but will not be able to accommodate the increased demand for water that the proposed development will generate.

To meet the water needs of the proposed development a new well near the two Mahaulepu wells is proposed as well as two new 1 million gallon (mg) storage tanks. The new well will produce 1.75 mg of water which will meet most of the 1.89 mg required by the total development. The additional 0.14 mg will not be required until the latter phases of the development. As the water supply situation in the Koloa-Poipu area is presently undergoing change, the actual means by which the additional demand will be met cannot be determined at this time. Storage requirements will be met by two water tanks, one above Koloa Elementary School and one above Kukuiula Bay. The distribution system of the Poipu area may also require upgrading in addition to the construction of the internal water system for the proposed development.

The water system for the proposed development will be designed to meet the standards of the Department of Water of the County of Kauai. The water distribution system will be composed of 8-inch and 12-inch pipes as shown on Figure 5-3. In the initial phases, the new distribution system will only loop with the distribution system on Lawai Road. A loop in the distribution system increases the capacity and reliability of the system. The new well and one storage tank are planned to be constructed with this phase. For the total development, a complete looped system is proposed, connecting all of Lawai Road to the new system, a new storage tank above Kukuiula Bay and possibly a pumping station. This should integrate into the existing water system and improve the overall water system in the area.

A. Impacts

The construction of the new facilities will have temporary impacts during construction. The construction of the new facilities will increase vehicular traffic to the site and cause traffic inconveniences where work is to be done on the existing roadways. There will be an increase in vehicular emissions, dust and particulate matter in the air. Heavy machinery will be used which will also increase noise levels and emissions.

The developed water sources in the Koloa-Poipu area do not have the capacity to meet the needs of the proposed development. The existing distribution system will also be stressed by the requirements of the proposed development. This is especially true for the area along Lawai Road. Any new water sources developed for the project will affect the groundwater supply of the area as all potable water for the Koloa-Poipu area is obtained from wells.

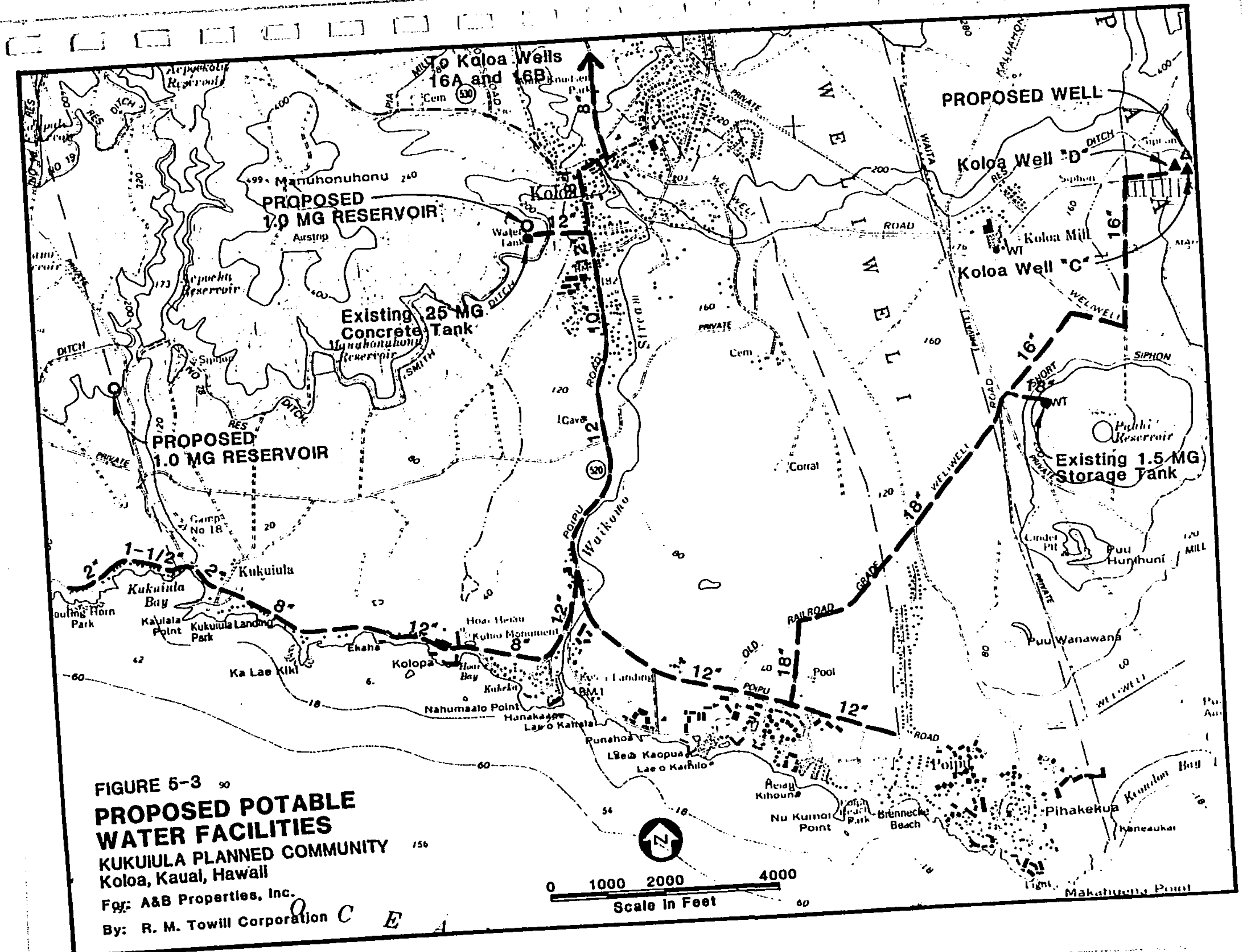

FIGURE 5-3
PROPOSED POTABLE WATER FACILITIES
KUKUIULA PLANNED COMMUNITY
Koloa, Kauai, Hawaii
For: A&B Properties, Inc.
By: R. M. Towill Corporation

B. <u>Mitigation</u>

The temporary impacts due to construction will be mitigated by following the existing governmental regulations which control the noise, air quality and water quality impacts of the construction industry. Traffic inconveniences will be reduced by following the recommendations of the County and State on traffic control and their requirements on construction within the State or County right-of-way.

The proposed development will ultimately require almost 1.9 mgd of water. In the initial phases of the development, a new well is proposed to be constructed in the Mahaulepu area which will provide over 1.7 mgd. The proposed well will be located where the Department of Water is confident that the quantity of water can be withdrawn without impacting the aquifer. Careful testing will be required to determine the actual capacity of the new well and to protect the aquifer. The development of this new source will adhere to the requirements of the Board of Water Supply and the State Water Code. Until the new well is tested, it cannot be determined if additional wells are required. The water demand for the proposed development is not expected to exceed 1.0 mgd for many years which means that a surplus of developed water will be available to the Koloa-Poipu community during that time. Thus, the proposed development will help to alleviate water supply problems during the initial phases. The 1.0 mg water storage tank planned for the initial phase of the development will also serve to improve the storage requirements of the Koloa-Poipu area.

A second 1.0 mg water tank is planned to meet the storage requirements of the subsequent phases and will also improve the storage system for the entire Koloa-Poipu area. The new reservoir will also locate a storage facility closer to the existing residents that live along Lawai Road near the Spouting Horn. The planned internal water system for the proposed development will also improve the water system for the residents along Lawai Road because their water system will no longer come to a deadend.

The new source of water will be developed in compliance with the State's Potable Water Systems Regulations, Chapter 20, Title 11, Administrative Rules. All new sources of potable water serving public water systems will require approval by the Director of Health prior to use.

5.3 CIRCULATION

Access to the Koloa District is provided by the two-lane Kaumualii Highway via Maluhia and Koloa Roads (also two lanes each). These two access roads intersect in the heart of Koloa Town. From this intersection, drivers travel west on Koloa Road to the intersection of Koloa Road with Poipu Road. Poipu Road presently serves as the major access to the project site.

Existing paved roads in the vicinity of the project include Poipu Road and Lawai Road. Poipu Road borders the eastern boundary of the project site. The right-of-way is 50 to 60 feet wide with a pavement width of approximately 24 feet. Lawai Road borders the southern limits of the project and has a 40-foot right-of-way with an 18-foot wide pavement. All existing roads within the project site consist of privately owned dirt cane roads. A major cane haul road running in an east/west alignment traverses the northern portion of the site. This cane haul road is expected to remain in operation for an indefinite period of time. Development of this project thus incorporates the cane haul road into the design as a fixed feature.

A proposed four-lane divided roadway will traverse through the lower areas of the site. This divided roadway will begin at the intersection of Lawai and Poipu Roads and ultimately connect back to Lawai Road just before the Spouting Horn Park. The existing Lawai Road will dead-end on both sides of the marina at Kukuiula Bay. Alternatively, Lawai Road could be rerouted around the marina, creating a scenic shoreline road. A collector street will connect this major collector road to Lawai Road. This connection will create easy access for future residents to coastal amenities along Lawai Road including the proposed marina. Alignment of this new collector road will route tour buses and sightseers by way of the new collector road instead of Lawai Road.

A secondary collector road, servicing the upper residential lots, will start at Poipu Road. It will connect to the four-lane divided roadway in the vicinity of the resort area.

A two-lane road, paralleling Poipu Road, is planned to connect the four-lane divided roadway to the upper collector road.

A. <u>Impacts</u>

The proposed project will increase the volume of vehicular traffic in Koloa. The increase in traffic will also increase noise and air pollutant emissions which will have an impact on the existing residents, which has been discussed in Section 3.

There will be no significant adverse impact to residents along Lawai Road. Access to new developed areas will be off the new collector roads planned on site. Traffic on Lawai Road may actually decrease, because tour buses and sightseers to the Spouting Horn Park can be routed by way of the new collector road. However, should Lawai Road continue around the marina, tour buses and sightseers will inevitably utilize this scenic shoreline road.

B. <u>Mitigation</u>

Impacts from the additional traffic generated by this project will be mitigated in several ways. The major access point onto the site at the Poipu Road and Lawai Road intersection will require extensive improvements. This intersection is currently a "Y" intersection and will be reconfigured to provide a cross intersection. Signalization and separate turn lanes will be incorporated (see Figure 5-4). Improvements at this intersection will provide a smooth transition from Poipu Road onto Lawai Road and from the Poipu Beach Road onto the new project road. Reconfiguration of this intersection will provide motorists a safer movement of traffic than what is currently being experienced.

A 100-foot setback along the mauka side of Lawai Road, from the Metropolitan Mortgage Company's development to the proposed commercial area, will be reserved for landscaping, pedestrian/bike path and/or beach parking. This setback will provide considerable distance between existing homeowners and the proposed development. Should access to developed areas in the west utilize Lawai Road, the roadway will be improved. Bike paths and pedestrian walkways are also proposed within the project site along the major roadways and along Lawai Road from the Lawai Beach Resort to the end of Lawai Road to the west. Landscaping is planned along the pedestrian/bike paths. These facilities will provide easy access within and around the development.

Carpooling and bus service may also help to mitigate traffic impacts.

To mitigate traffic impacts, signalization and multiple turn lanes are recommended at four intersections: (1) Koloa/Poipu Road intersection; (2) Koloa/Maluhia Road intersection, (3) Poipu Road and the new upper collector road; and (4) Poipu Road and the new 4-lane divided road.

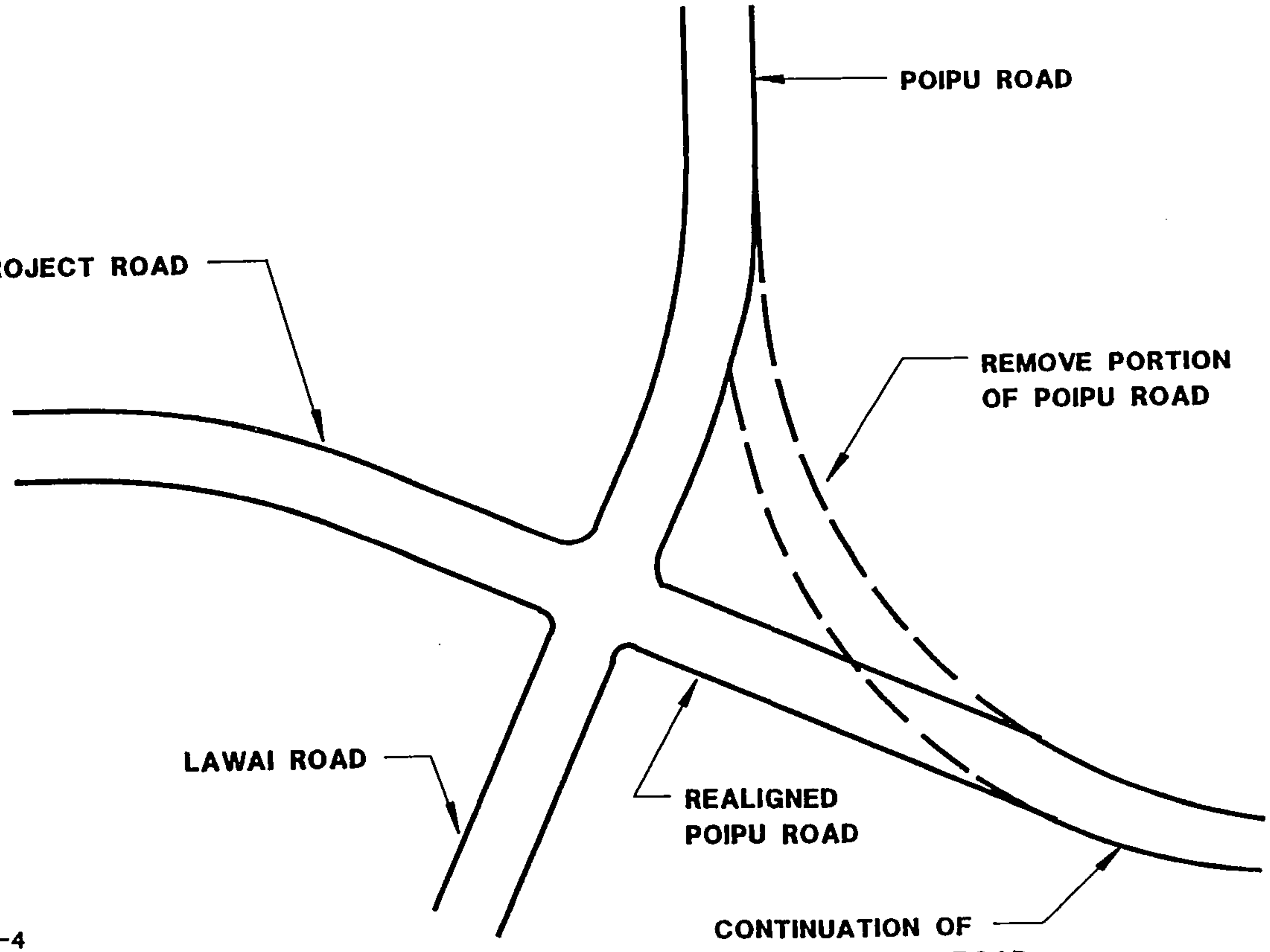

FIGURE 5-4

INTERSECTION OF LAWAI, POIPU AND PROJECT ROAD

KUKUIULA PLANNED COMMUNITY
Koloa, Kauai, Hawaii

For: A&B Properties, Inc.
By: R. M. Towill Corporation

In addition, Koloa Road, between Poipu Road and Maluhia Road, is recommended to be widened to four lanes. The right-of-way is sufficient to accommodate four 10-foot lanes with 2-foot shoulders. Poipu Road is also recommended to be widened to four lanes between Koloa Road and the upper collector road. Alternatively, a new road paralleling Poipu Road would reduce peak hour volumes and Poipu Road could remain two lanes with minor intersection improvements.

A Koloa bypass road is also being planned by the County of Kauai. It will start in Poipu, off Poipu Road, and travel north on the eastern side of Koloa Town, and connect to Wailaau Road, just north of Koloa Town. Future residents wishing to go to eastern destinations will be routed from the new major collector road onto the Koloa bypass road planned by the County of Kauai. Without the Koloa bypass road, a new north/south road or extension of the road paralleling Poipu Road is recommended to be constructed. This road could continue from the project's northern collector road and travel north from the project and eventually tie into Koloa Road. Connection of this road to Koloa Road must be coordinated with the landowner, Knudsen Trust. This road will be used by Kukuiula residents and residents in the Poipu area to route traffic off Poipu Road, which is projected to operate near capacity by the year 2000. An island-wide transportation study, currently being conducted for the entire Island of Kauai, could better identify the type and location of such a new roadway. A&B will participate in the planning of these facilities and integrate the recommendations from this study into the planning of the developments.

5.4 SOLID WASTE

Solid waste generated by the proposed development is planned to be disposed of by the Department of Public Works of the County of Kauai.

Some private collection services may be used for refuse collection of the commercial and resort activities. In 1983, the "Kauai Island-Wide Landfill Study" prepared for the County of Kauai, indicated that the Kekaha Landfill could be expanded to accommodate additional refuse volumes. This expansion would be accomplished by obtaining lands adjacent to the existing landfill. The report also determined that a system of transfer stations would be required due to the great distance of the Kekaha Landfill from the major centers of refuse generation.

A. Impacts

At full occupancy the proposed development could generate as much as 38 tons of refuse per day. This would amount to approximately 21 extra trips per day for refuse collection vehicles and an extra 2 trips for the tractor trailers that travel from the transfer stations to the landfill. The additional refuse volumes will also reduce the expected life of the existing landfill.

The 38 tons will be generated only when the project is fully occupied, approximately 25 years from now (2015). This is a conservative (high) estimate and assumes that all units, including transient, are occupied. This estimate was derived using a factor of 3.25 persons per unit. In actuality, the transient multi-family units are not expected to be fully occupied at any given time. Occupancy will probably begin by 1991, the estimated construction completion date for the first homes. Initially, the project will not generate a significant amount of solid waste. Thereafter, an average annual increase of 1.5 tons of solid waste per day starting year 1991 is expected.

An engineering report dated December 1983 entitled "Kauai Island-Wide Landfill," indicated that the underlying watertable at the Kekaha Landfill is brackish water and has no potential for drinking water. Leachate that will be generated in this region is expected to be very low because of the very low rainfall. The little leachate that will be generated will move with the groundwater and be filtered through the sand during its route toward the ocean. The leachate will also be diluted with the brackish groundwater before entering the ocean.

B. Mitigations

According to the 1983 engineering report, the life of the Kekaha Landfill is expected to go beyond the year 2005 because of its expansion capabilities. Projections to estimate the life of this landfill included population increase for Kauai at a growth rate of 2.4 percent per year. The 1983 report also indicated that the County is planning a system of transfer stations, one of which is planned in the Koloa District. By the year 2015, the expected buildout of this project, other facilities may need to be on line. A refuse transfer station is proposed to be developed by the County of Kauai on land owned by Knudsen Estate, midway between Koloa and Lawai Towns. This new transfer station will reduce the distance that the refuse collection vehicles must travel to the Kekaha Landfill and increase the efficiency of refuse collection in the Koloa-Poipu area. In this way, the impact to the existing refuse collection and disposal will be minimized. The closest transfer station to the Koloa-Poipu area at present is in Hanapepe. A&B will participate in the long range planning of this facility.

There are four other alternative disposal or processing methods which have been used for solid waste disposal. These methods include shredding, baling, resource recovery, and incineration. Resource recovery methods are processes by which energy and/or materials are recovered from refuse, and include composting, pyrolysis, and recycling. A brief description of each process is included below.

These alternative methods are volume reduction measures which produce residues that must be disposed of. Although these alternatives can extend the lifespan of a landfill by substantially reducing the volume of refuse to be handled, a landfill is still needed. A combined system of resource recovery and landfilling could possibly be a cost-effective alternative when considering long-term economics.

Shredding

A major advantage of the shredding process is that it reduces the volume of solid waste and converts it into a relatively *homogeneous* material which in many cases does not need daily cover (only final or cell covers). The machinery required for this process is commercially available in various types. The most commonly used is the hammermill. An important consideration in choosing the equipment is the size of the particles produced. This size consideration is important with regard to the process following shredding, i.e., energy recovery, disposal, or a combination of both.

Baling

Baling is another means of reducing the volume of solid waste that must be landfilled. When transfers and long hauls are necessary to dispose of solid waste, it can save on costs. It not only can extend the life of the landfill, but the handling and transport of wastes becomes easier.

Resource Recovery Methods

1. Composting - Composting is also an alternative process for volume reduction. The first step involves the separation of organic solid wastes from the inorganic fraction. The organic wastes are then decomposed at a rapid rate in open windrows or in a confined stand. The final product is a humus-like substance that is used primarily as a soil

conditioner. However, in the United States, this has proven to be an extremely costly process and is being phased out. The failure of composting as a viable alternate disposal method rests on four factors: (1) there has been no steady market found for the end product; (2) the initial investment and the operating costs have been found to be generally high when compared to other disposal systems; (3) a high quality product cannot be derived from refuse without excessive expense; and (4) the separation of organic from inorganic wastes requires a secondary disposal method, i.e., landfilling.

2. Pyrolysis - Pyrolysis involves the thermal decomposition of refuse in an anaerobic or near anaerobic condition. The high temperatures generated and the lack of oxygen breaks the materials down into three parts. The first is a gas which is primarily hydrogen, methane and carbon monoxide. The second product is a liquid fuel which includes organic chemicals (acetic acid, acetone and methanol). Lastly, a char is produced which is composed of almost pure carbon and includes any glass, metal or rocks that may have been included in the initial material. The end result is the conversion of solid wastes into a storable, transportable liquid or gas fuel.

3. Recycling - Recycling involves the recovery of materials from municipal refuse that can be marketed for reuse. There are basically two methods of recovery that are available. The first is recovery before refuse is placed within a collection vehicle, as is often done in Hawaii with aluminum cans. The second method is recovery from the mixed municipal refuse after its collection.

Types of materials that are recoverable include paper, glass and metal containers. These are generally separated at the source of generation and directly transported to a dealer of recycled materials or to a manufacturer. In Hawaii, the largest market is for aluminum cans which has been steadily increasing. Landscape trimmings for composting, and recycled steel and paper are not viable markets here.

Incineration

The possibility of energy generation by refuse incineration has been studied by other counties in the attempt to reduce dependence on petroleum oil importation. The process of incineration involves a controlled combustion that reduces solid, liquid or gaseous solid wastes into carbon dioxide, other gases and a relatively noncombustible residue. It can reduce the volume of solid wastes introduced into the system by as much as 80 to 90 percent, thereby considerably extending the life of a landfill.

This system is, however, one of the most costly alternatives due to the higher construction costs necessitated by the increasingly strict air pollution control requirements set forth by the Federal government.

Due to the uncertainty in the performance efficiency of such facilities, the high capital investment required, and the lack of experience and expertise locally in operating refuse incineration facilities, the construction of such a facility may not be feasible.

The possibility for energy recovery facilities have also subsided because of an unanticipated change in trends of fuel prices. The economic feasibility of the facility was based on the assumption that oil costs would continue to escalate rapidly. However, increases in oil prices have slowed down during the past several years. The cost savings in fuel would no longer be great enough to make the project economically feasible. In any event, a sanitary landfill will still be required to dispose of solid residue produced from incineration and refuse that cannot be incinerated.

5.5 WASTEWATER TREATMENT AND DISPOSAL

The Koloa-Poipu area presently has no public sewer system. Existing wastewater facilities consist of small private treatment plants for commercial, resort and multi-family housing developments and cesspools for single family homes. There have been complaints of plant and cesspool overflow as well as complaints of odor related to plant malfunction. The County of Kauai has planned for the construction of a regional wastewater treatment plant in their Facility Plan for Koloa-Poipu, Kauai, Hawaii completed in 1988. The sewage collection and treatment system for the proposed development will be integrated with the findings of the Facility Plan.

The sewage collection and treatment system for the proposed development will include a complete network of gravity sewer mains located primarily within the roadways. Sewage pumping stations with force mains will be required at the low points in the system where gravity flow is not possible. The sewage collection system will be designed to County Standards. The sewage pumping stations will be underground "package pumping stations" due to the ease of construction and for reduced visibility. In the early stages of the first phase, the collection system may transport the raw sewage to the existing Metropolitan Mortgage Company's wastewater treatment plant. This can only be done if the existing treatment facilities are upgraded to take full advantage of all the existing concrete tanks within the plant. In time, the collection system will transport the sewage to a new wastewater treatment plant located near the Manuhonuhonu Reservoir (see Figure 5-5).

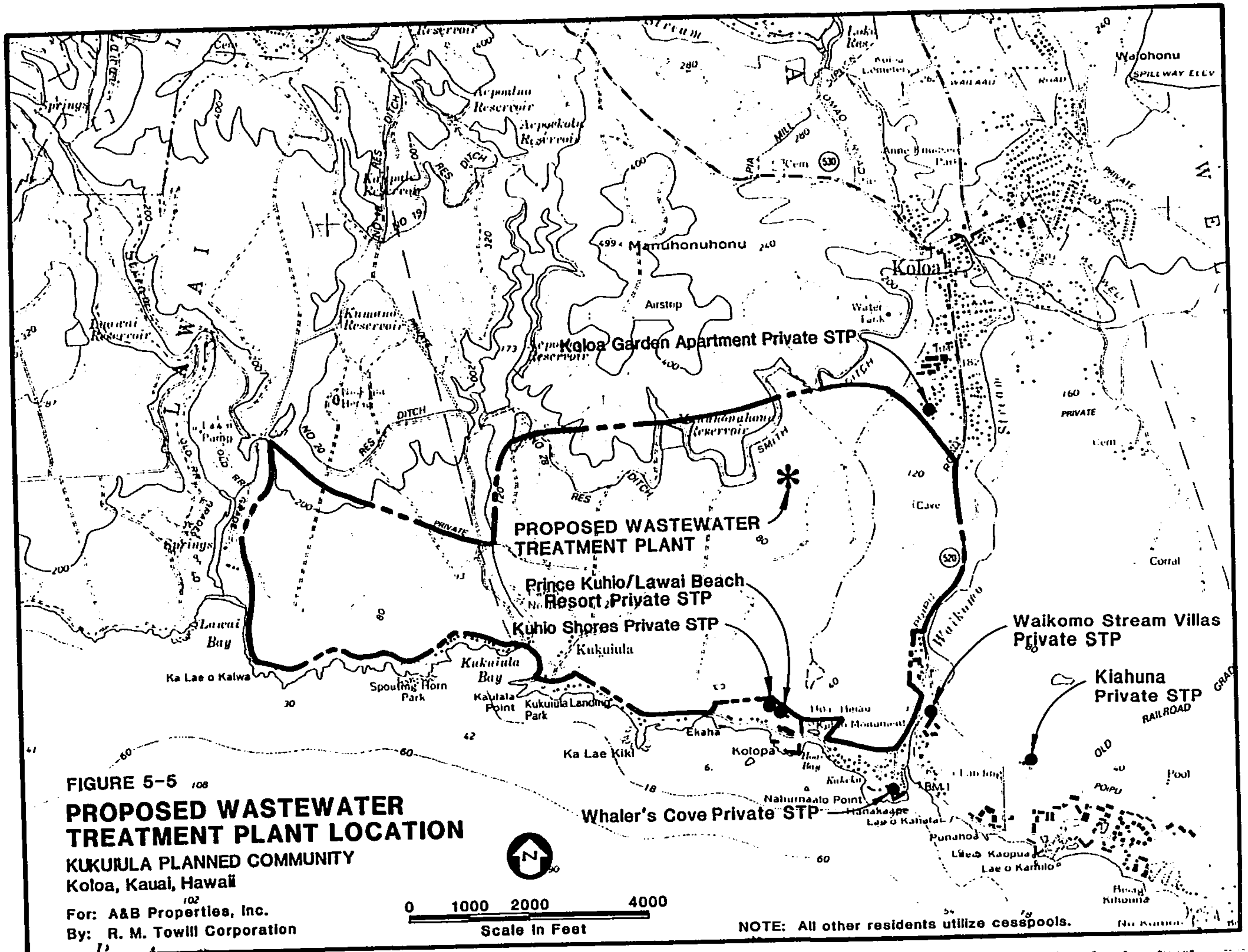

FIGURE 5-5

PROPOSED WASTEWATER TREATMENT PLANT LOCATION

KUKUIULA PLANNED COMMUNITY
Koloa, Kauai, Hawaii

For: A&B Properties, Inc.
By: R. M. Towill Corporation

The wastewater treatment plant is planned to provide secondary treatment by the use of aerated lagoons as the principal treatment process. This type of wastewater treatment plant will require two lagoons which will operate in series to treat 1.1 mgd of raw sewage. Each lagoon will be approximately 400 feet long and 250 feet wide and 18 feet deep (see Figure 5-6). The water level in the lagoons will be 15 feet deep. The lagoons will be lined to prevent the infiltration of the untreated sewage into the ground. Aeration will be provided by small diameter perforated PVC tubes laid on the lagoon bottom that will be connected to a blower system. To improve the performance of the aerated lagoons and decrease the amount of settleable solids from the raw sewage, pretreatment is necessary.

Pretreatment by screening and grit removal is also planned. The mechanical screens and aerated grit removal system will be housed in the headworks. In addition, air will be introduced into the raw sewage at the headworks to increase the dissolved oxygen in the sewage before it enters the lagoon. An odor control system utilizing an activated carbon system or chemical scrubbing is planned to control odors at the headworks. The treated effluent will be chlorinated before disposal. The effluent will be disposed of by using the effluent for golf course irrigation. A typical golf course can use the 1.1 mgd of effluent generated by the development. Injection wells will be provided as an emergency effluent disposal system. Figure 5-6 shows the basic layout of the proposed wastewater treatment plant.

A mechanical wastewater treatment plant such as an activated sludge plant is another alternative to aerated lagoons. The pretreatment system will be similar to the lagoon system. After pretreatment, primary clarification is usually provided followed by the primary treatment process. The sewage is treated by mechanically mixing the sewage with air and recycled sludge from the secondary clarifiers. After secondary clarification, the effluent is chlorinated and disposed of by conventional means. The sludge from the primary and secondary clarifiers must be rendered inert by aerobic or anaerobic digestion then dewatered and disposed of at a landfill. These

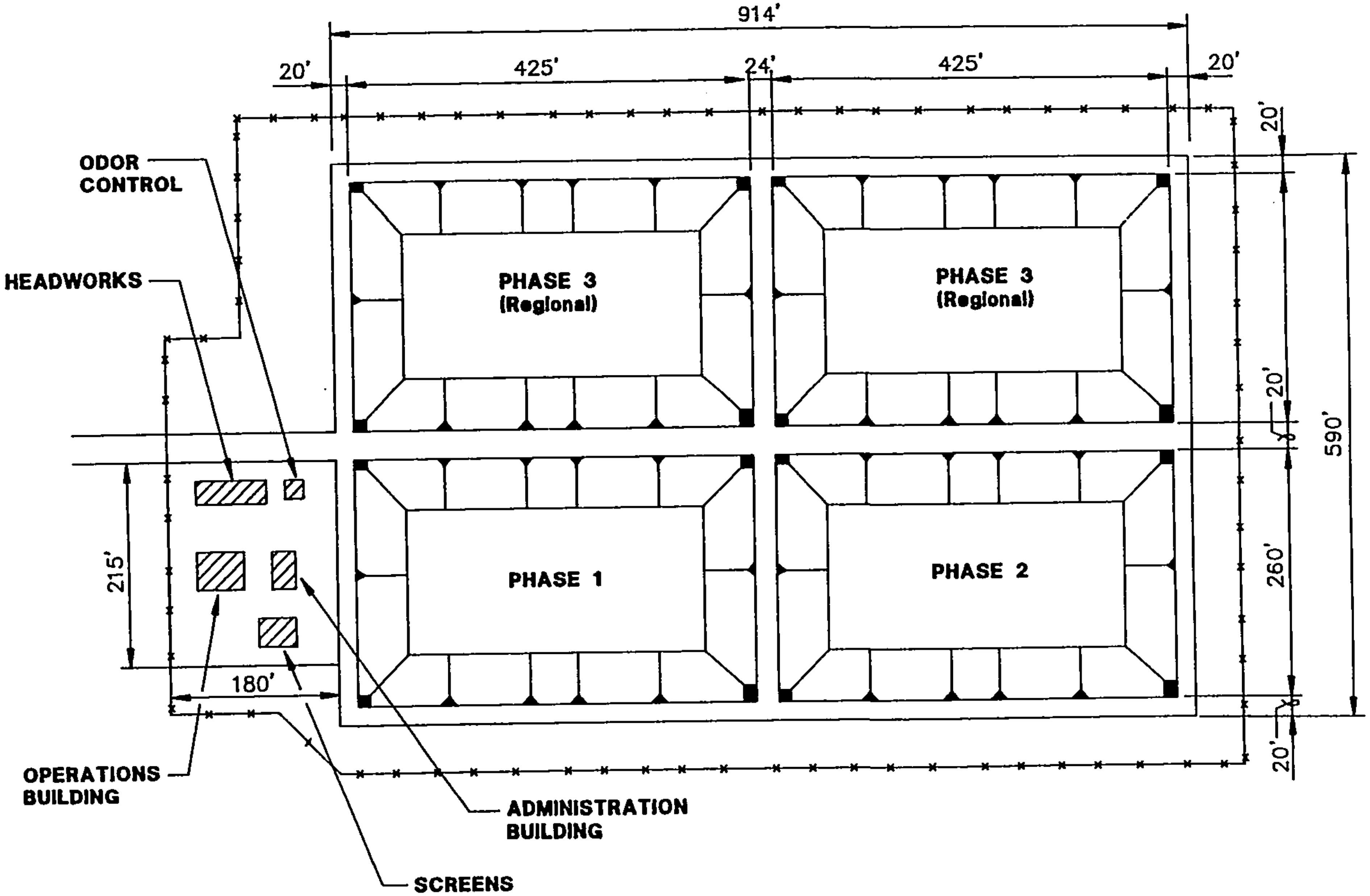

FIGURE 5-6

PROPOSED WASTEWATER TREATMENT PLANT

KUKUIULA PLANNED COMMUNITY
Koloa, Kauai, Hawaii

For: A&B Properties, Inc.
By: R. M. Towill Corporation

plants function well although they are more prone to upset which will result in improper treatment and odors. These plants are more difficult to operate then aerated lagoons.

A. Impacts

The proposed treatment plant will impact the regional plans of the County of Kauai due to the size of the plant. A treatment plant of this scale could be readily expanded to accommodate larger sewage flows if the expansion was designed for in the initial phases of the treatment plant design. For this reason, while the recently completed Facility Plan for Poipu-Koloa does not include the proposed development in the County's planning area, A&B does recognize the proposed wastewater treatment plant as the recommended Regional Treatment Plant site.

The construction of the collection system, pumping stations and wastewater treatment plant will have temporary impacts due to construction. The construction will increase the vehicular travel to the site and create traffic inconveniences where work is to be done on existing roads. The construction will also increase vehicular emissions, noise and particulate matter in the air. The use of heavy equipment will also increase vehicular emissions and noise levels.

The wastewater treatment plant will include one large control building as well as the headworks, odor control system, chlorination system and two large lagoons and is visible from portions of the development. The wastewater treatment plant will visually impact the surrounding area. Wastewater treatment plants can impact the environment by offensive odor generation, release of poisonous gases, groundwater pollution, noise and disease vector propogation. The use of sewage effluent for golf course irrigation could also have adverse impacts of groundwater pollution and the spreading of pathogens.

B. Mitigation

The construction related impacts will be mitigated by conforming to the existing governmental regulations which control noise, air quality and water quality impacts of the construction industry.

The treatment plant planning and design will take into consideration the regional plans of the County of Kauai. The plant will encompass approximately 18 acres which can accommodate an additional two lagoons. By operating the four lagoons in series the plant can effectively treat an additional 1.5 mgd of sewage projected by the County of Kauai in their Facility Plan. The appurtenant facilities can also be designed to accommodate the additional County regional requirements. By planning and designing the wastewater treatment plant to accommodate the sewage flows projected by the County, the impact to the County's regional sewage treatment plans for the Poipu-Koloa area will be minimized.

The visual impacts of the treatment plant will be minimized by siting the treatment plant in an area relatively hidden from the existing roads and designing the plant to blend into the natural surroundings. The plant has been located in a natural depression to minimize visual intrusion into the coastal zone landscape. The plant will be designed to optimize the excavation and fill material required. Buffer areas and landscaping should reduce the visual intrusion of the plant to the surrounding areas.

Odors associated with treatment plants usually occur when anaerobic conditions exist at the plant or in the collection system. Odors within the collection system will be minimized by utilizing gravity flow with adequate velocity whenever possible to keep the sewage aerobic. Pumping stations will be enclosed and force mains will be designed to reduce the length of time that raw sewage will remain in the force main. The collection system will be designed so that sewage will not be pumped directly into the plant headworks but gravity flow in. This will minimize the possibility that the sewage entering the plant will be septic.

In the plant odors can also occur at the sludge, screenings and grit handling areas and during plant upset. The high oxygen transfer efficiency of the air diffuser equipment will minimize the occurrence of anaerobic conditions within the lagoons. Aerated lagoons can also absorb heavy "shock loads," temporary peaks in sewage flow, due to long retention of the sewage within the lagoons. This type of treatment process is also less likely to be upset by unusual occurrences such as the discharge of a foreign substance into the sewage collection system or power failures. The lagoons will be lined with an impervious lining to prevent the leakage of untreated sewage into the ground and prevent groundwater pollution. Aerated lagoons are one of the easiest and odor free types of plants to operate. Odor should be controlled at the headworks.

At the headworks, an odor control system will remove the objectionable gases from the aerated grit chamber. While the generation of poisonous gases at levels considered dangerous is not likely, the odor control system will also eliminate the potential of the release of poisonous gases to the atmosphere. Proper operation of the grit and screenings disposal should keep the odors associated with these intermittent operations confined to the area around the headworks.

Proper headworks operation is necessary to insure that the area around the headworks does not become a breeding ground for disease vectors. Trained and certified wastewater treatment plant operators will operate the plant to minimize this possibility.

The treated effluent will be chlorinated before being used for golf course irrigation.

The disinfected secondary effluent is acceptable for use as irrigation water by the Department of Health. The general practice is to irrigate at night so golfers would not come into direct contact with the effluent and no health risks are anticipated. The effluent must pass through the root zone of the golf course fairway which will provide an additional layer of protection to the groundwater. The use of the effluent for golf course irrigation is not anticipated to threaten the groundwater.

The managers of the irrigation system using the reclaimed wastewater will be informed of the potential hazard. Procedures to assure the safety of the general public and personnel will be provided such as use of protective clothing and posting of signs to inform employees and the public that reclaimed wastewater is being used for irrigation.

Injection wells will be provided for emergency effluent disposal. The lagoons also have excess storage capacity if both options of effluent disposal are not available for 24 hours. Permits will be obtained from the Department of Health before the injection wells are constructed to insure that the wells will function adequately and that the wells will not adversely impact the groundwater or coastal waters.

An easement will be provided through the site should an ocean outfall pipe be needed.

All phases of the work will be coordinated with Kauai County Department of Public Works including sizing of improvements, schedule of construction, and land requirements (mechanical vs. lagoon).

5.6 POWER AND COMMUNICATIONS

Electrical power and telephone service will be provided by Kauai Electric and Hawaiian Telephone. The main 57 KV transmission line from Kauai Electric's Hanapepe Power Plant is along the existing McBryde cane haul road that runs through the project to the Koloa Mill. Existing residents are served by a 3 phase, 12 KV distribution line along Lawai and Poipu Roads. The existing substation for the Koloa-Poipu area is located near Koloa Town. The existing Hawaiian Telephone switching station is also in Koloa. Power and communication lines are proposed to be installed underground to include electric, cable and telephone services.

A. Impacts

The existing electric substation may not be able to provide the power needs of the proposed development without affecting service to the rest of the Koloa-Poipu area. The Hawaiian Telephone switching station may not be adequate the meet the communication needs of the proposed development as well. The electrical consumption for the project at full occupancy is estimated at eight megawatts, using a factor of two kilowatts per unit.

B. Mitigation

The proposed development may require a new electric substation to provide usable power. The requirements of Kauai Electric will be integrated into the planning and design of the proposed development. If a new substation is developed, it would improve electrical service to the Koloa-Poipu area. The requirements of Hawaiian Telephone will also be integrated into the planning and design of the proposed development. If needed, a new switching station within the development will be developed to optimize service to the development and to the Koloa-Poipu area.

Energy conservation devices or methods within the development can be used to conserve energy. The use of landscaping within developed areas can provide shade thereby reducing the use of air conditioners or fans. Wherever possible, structures may be situated such that the hotter southwest solar rays will not directly penetrate the interior. Proper ventilation will also aid air circulation within the units utilizing the natural breezes. In situations where this is not possible, the use of landscaping to provide shade or tinting of glass windows can be used. Because of the relatively sunny climate, solar water heaters may be used to reduce the amount of electrical consumption.

5.7 FIRE SERVICE

The Kauai Fire Department operates seven fire stations: Hanalei, Hanapepe, Kalaheo, Kapaa, Koloa, Lihue and Waimea fire stations. The busiest stations are Kapaa, Lihue and Koloa.

The Koloa Town station, which will serve this development, is equipped with two vehicles. One 1969 Crown Fire Truck with a 1,000-gallon tank and an International Rescue Truck equipped with a 200-gallon tank are used for fighting fires and providing rescue services. The fire truck can pump 1,215 gallons per minute. Other rescue equipment includes diving equipment, respirators and an inflatable boat.

A total of 15 firemen man the Koloa substation. Each of the three shifts contains five firemen. Aside from fighting fires, the firemen also assist in search and rescue operations on land and in the water. Response time to the project site from the Koloa substation has been estimated at 5 to 7 minutes. As a backup to the Koloa station, the Kalaheo substation would be used.

Response time from the Kalaheo station is estimated at 15 minutes.

Ambulance service is dispatched from three areas on Kauai. Waimea, Hanapepe and Lihue have ambulance facilities. The three clinics in Koloa do not have emergency facilities and often times call upon the fire department for assistance.

An emergency call will contact both the fire and police departments and both will respond to the emergency. An ambulance would be called if needed. Some of the fire department staff are trained in Emergency Medical Treatment (EMT). The ambulance staff is trained in Medical Intensive Care (MIC).

There are a total of 106 members of the Fire Department including clerical support. On-line firefighting staff totals 102.

The Koloa fire station responded to 29 fires and 233 emergencies in the fiscal year 1986-87 (Ref: County of Kauai Annual Report, 1987).

A. Impacts

Present operations at the Koloa fire station are sufficient to support the demands of the single-family residential homes proposed for the project. Significant impacts are anticipated from the multi-family, resort, and commercial areas, because of the greater density of people in these areas. Fuel storage facilities at the marina could also have adverse impacts in the event of leakage from a fuel storage tank.

B. Mitigation

It is recommended that the multi-family, resort and commercial buildings be equipped with sprinkler systems. Incorporation of sprinkler systems in these facilities may sometimes result in the extinguishing of a fire even before the fire department arrives on the scene.

The fuel storage tank at the marina is recommended to be an underground double-wall fiberglass tank. The fiberglass tank will minimize corrosion from salt. The double wall will allow for detection of fuel leaks in the inner tank before environmental pollution or hazards occur. In the event of a fire, the underground fuel storage tank will be protected.

5.8 POLICE SERVICE

The police force for Kauai consists of 132 sworn officers and 20 civilians. Currently there are three police stations located approximately 25 miles apart (Hanalei, Waimea and Lihue). Previously, there were 5 police stations. Response time to any given point between these three stations is approximately 15 to 20 minutes.

There are a total of 9 officers on each shift to respond to emergency calls with 2 officers on standby as backup. Each of the nine sectors is serviced by one police officer. The Koloa-Poipu area will be divided to include a new tenth sector to service the Poipu area. This process is expected to take approximately 8 to 10 months before it is implemented.

With the present population, it is estimated that one police officer serves 360 people. Request for additional police officers to service a growing population is usually submitted, as needed, before the budget for the County is established each year.

This project will be served by the Waimea substation of the Kauai Police Department. This substation is currently operating with 15 officers.

A. Impacts

The increased traffic from the development may cause response time to the project site to be delayed.

B. Mitigation

The new and improved roadway system as discussed in this section under "Circulation System," providing an efficient movement of traffic at the Poipu and Lawai Road intersection and the eventual addition of a new north/south roadway, will help to mitigate delayed response time to the project site.

The current policy of the Police Department is to request additional police officers before the County budget is established each year. Requests for additional police officers will be made as the population on Kauai as well as Koloa, increases.

5.9 MEDICAL FACILITIES

Existing medical facilities on Kauai consist of the Kauai Medical Group, the Wilcox Memorial Hospital and Health Center, Garden Island Medical Group, Kauai Veterans Memorial Hospital, Mahelona Samuel Memorial Hospital and a satellite facility of the St. Francis Hospital. The Wilcox Hospital is the largest facility on Kauai, located in Lihue, and is presently undergoing renovation and expansion. Construction completion is expected to be in the Fall of 1989. The Kauai Medical Group is also constructing a new 3-story building to expand this facility to a 48,000 square foot clinic. The existing building will be demolished. A new medical facility, Kuhio Medical Group, is being constructed in Lihue and is expected to open in August 1988.

Medical facilities for the Koloa area consist of a Koloa branch of the Garden Island Medical Group, Waimea Dispensary, and the Koloa office of the Kauai Medical Group. Ambulance service is dispatched from three areas on Kauai: Waimea, Hanapepe and Lihue. Approximate response time to the project area is 20-30 minutes. The fire department and coast guard also provide emergency service.

A. Impacts

No significant adverse impacts on the medical facilities will be caused by this development.

5.10 SCHOOLS

There was a total of 377 schools in the State of Hawaii in 1986 (1987 SDB). Public schools numbered 232 and private schools numbered 145. The County of Kauai accounted for 19 of the State's schools, 12 public and 7 private. There was a total of 24 new schools added since 1977 (5 public and 19 private), employing over 200 new teachers.

A total of about 200,000 students were enrolled for the school year 1986-87. Surprisingly, there was a decline of almost 10,000 students since the school year 1976-77 for the State. The schools on Oahu accounted for the decline in enrollment. All the neighbor islands have been experiencing increasing enrollment in the past few years. The amount of students enrolled in Kauai schools for the school year 1986-87 was 9,450 compared to 8,920 students for the school year 1983-84. The Koloa District consists of Koloa Elementary School (K-6) and Kauai Intermediate High School (7-12). According to the Department of Education, these two schools are currently operating at capacity. The average classroom size is 20 students for kindergarten to grade 3, 23 students for grades 4 to 6, and 25 students for grades 7 to 12.

Recent expansion to the Koloa Elementary School included a new community and school library, administrative building, cafeteria-auditorium and classrooms. The library also serves as a multi-purpose building. This educational facility is located just north of the project site on Poipu Road. Kauai Intermediate High School is located in Lihue. When the Kauai Community College was relocated to Puhi, off Kaumualii Highway, the Kauai Intermediate High School was expanded to utilize the former Kauai Community College facilities.

A. <u>Impacts</u>

The proposed project will have a significant impact on the elementary and intermediate/high schools. These two schools are currently operating at capacity. It is estimated that the project at complete "build-out" will increase the enrollment for the Koloa Elementary School by 300 to 500 students, and 200 to 300 for the Kauai Intermediate High School. A total of 16 additional classrooms will be required at the Koloa Elementary School and 10 classrooms for the Kauai Intermediate High School.

B. <u>Mitigation</u>

A&B will reserve land adjacent to the Koloa Elementary School for expansion of the school facilities.

The County Development Plan indicates a second elementary school located approximately 2,000 feet north of the intersection of Maluhia and Koloa Roads on Maluhia Road. The Development Plan also shows a high school on Koloa Road between Lawai and Koloa. This implies that future school facilities in Koloa are needed to meet the needs of the growing community.

The proposed development will take approximately 20 to 25 years before completion and/or full occupancy. This time frame will have an average annual impact on the elementary and intermediate high schools of 18 and 12 students, respectively.

5.11 RECREATIONAL FACILITIES

The County of Kauai has a total of approximately 137,000 acres of recreational area. The majority of this land is used for public hunting (102,000+ acres). Kauai ranks second in the State for the most acreage in beach resources (100+ acres) and for the most sport fields (51). The City and County of Honolulu has the highest beach acreage of over 300 acres with the highest count of sport fields (324). Kauai has approximately 200 miles of hiking/equestrian trails, again second in the State.

Coastal resources in the Koloa District include about 2 miles of sandy beaches, surfing sites and excellent body surfing conditions at Brennecke Beach. Coastal recreational activities include swimming, sunbathing, canoe paddling, boat launching, diving, fishing, surfing and body surfing.

Kauai leads the State with nearly 14,000 acres of State parks and historical sites. These facilities were visited by over 6 million people in 1987. Some of the more significant parks include the Wailua River State Park, Waimea Canyon State Park and the Kokee State Park. The Prince Kuhio historical park and the Spouting Horn Park are located adjacent to the proposed project.

Kauai has the smallest number of golf courses of any County (5 courses in 1984). An additional 9 holes are being planned to make the Princeville Golf Course a 36-hole golf course. The nearest golf course to the project site is the Kiahuna 18-hole golf course. This course is privately owned, but is open to the public.

There are numerous County, State and privately owned recreational resources in the Koloa District. Some of these facilities include Waita Reservoir Recreational area, Moir's Cactus Gardens, the Pacific Tropical Botanical Gardens in Lawai Valley, Kukuiula Small Boat Harbor and Park, Prince Kuhio Park, and Spouting Horn Park.

The development will create additional coastal and inland recreational facilities in the Koloa District. The proposed marina at Kukuiula Bay will provide 100+ boat slips. This marina will extend inland from Kukuiula Bay.

The market study done in May 1988 (summary attached as Appendix I) projected that 200 boat slips could be required by 1995 and about 340 boat slips by the year 2015, not including the existing slips. Kauai has an inventory of only about 120 slips or moorings on the island. Kauai is expected to have the highest ratio of registered boats in the State per 1,000 defacto population, yet Kauai has the lowest ratio of mooring capacity to registered boats.

In March 1988, 28 slips were offered at Nawiliwili Harbor. By mid-April 1988, the 28 slips were leased with approximately 20 more names on the waiting list. Waiting periods have been as long as three years for private boat slips.

The expected market demand would primarily be private boat owners and visitor industry-related commercial venture. Approximately 8 to 10 boat slips per month could be leased during Phase I and an additional 4 to 7 boat slips per month for Phase II.

Inland recreational facilities include expansion of the existing Prince Kuhio park, an 18-hole golf course and three neighborhood recreational parks. The resort and golf course clubhouse will probably have tennis and swimming pool facilities. A&B will donate land adjacent to the Prince Kuhio Park for expansion of their facilities. In addition, pedestrian/bike paths are planned within the development along the major roadways. The 100-foot wide setback along Lawai Road may be developed into beach parking and pedestrian/bike paths.

A. Impacts

The recreational facilities planned will add to the recreational resources of the Koloa District. The project is expected to have an impact on the existing recreational resources because of the increase in population. The use of existing facilities will gradually increase as the development becomes occupied over the 25-year time frame.

B. Mitigation

This project will enhance the Koloa District by providing new recreational facilities and opportunities, which will be enjoyed by the community.

The 100 to 150 boat marina will support the present demand for boat slips as well as encourage boat owners previously discouraged by the lack of facilities and long waiting list. The visitor industry in the Poipu area could also benefit. The marina will provide facilities for cruise vessels and sightseeing or recreational fishing boats.

In addition to the golf course, two swimming and tennis facilities and three neighborhood parks will help to decrease the impact on neighboring facilities. The golf course and related facilities, although privately operated, should be open to the public at reasonable rates. The 100-foot setback along Lawai Road may include beach parking and pedestrian/bike paths that would provide access to coastal amenities. The pedestrian/bike path could also continue to the end of Lawai Road providing additional public access to the oceanfront. Land has also been reserved adjacent to the existing boat launch ramp for expansion of these facilities. Space is available for development of an additional ramp, trailer parking and a new washdown area. This public facility will create additional oceanfront property for the residents of this community. The park dedication requirements will be met through dedication of land or payment of park dedication fees.

SECTION 6

Relationship to Plans, Policies and Controls

SECTION 6

RELATIONSHIP TO PLANS, POLICIES AND CONTROLS

6.1 THE 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. The Plan identifies, in general, the goals, objectives, policies and priorities for the development and growth of the State. Guidelines have been provided in the Plan to give direction to the overall development of the State.

The Kukuiula Planned Community is generally consistent with the objectives and policies of the Hawaii State Plan. The following pages describe the relationship and/or compatibility of the proposed project with the overall plans for the State of Hawaii, as set forth in the Hawaii State Plan.

6.1.1 Population (HRS, Section 226-5)

The addition of a variety of housing units, employment opportunities and recreational facilities will complement the projected population growth for the Koloa District. The phased development over the next 20 to 25 years will provide the community with these basic necessities concurrently with the population growth. This development may indirectly increase the rate of population growth in the Koloa District. People will be attracted to this planned community with all its amenities, proximity to the ocean and resort facilities, and employment opportunities. The island-wide population, however, is not expected to increase dramatically, since many of the new residents of the Kukuiula project may already reside on Kauai.

6.1.2 Economy (HRS, Section 226-6, 7, 8, and 10)

The proposed project will create numerous short-term and long-term employment opportunities. Short-term employment will be available during the course of construction. Diversified employment opportunities will be created by the resort complex, multi-family units, the marina, two commercial areas, an 18-hole golf course, and operation and maintenance of the new public facilities proposed.

Part of the development is planned on agricultural lands planted in sugarcane. Approximately 600 acres of sugarcane fields will be removed from the inventory over the next 20 to 25 years. However, the low profitability of the sugar industry has motivated McBryde Sugar Co., who are presently cultivating this land, to consider diversification into other areas of agriculture such as macadamia nuts, coffee and tea.

The visitor industry in the Koloa-Poipu area is rapidly growing. People are becoming more aware of the beauty of the neighbor islands and as a result, the visitor count has increased tremendously. Recent visitor trends on the neighbor islands indicate a need for more visitor accommodations to assist in promoting Hawaii's "aloha," the tropical climate and the coastal resources. Development of the resort complex at Kukuiula Bay and a new marina will help to accommodate the growing number of visitors and provide employment opportunities for the Kauai residents.

6.1.3 Physical Environment (HRS, Section 226-11, 12 and 13)

The development of the marina will increase water related recreational activities. The existing Kukuiula Bay will remain intact except for a channel which will extend inland to create a new boating facility. Existing marine resources will not be affected significantly because excavation of the marina will be performed on land. Marine resources at the entrance to the marina will be affected by dredging operations. Dredging for this channel will not cause significant long-term impacts to nearshore waters or marine habitats. Surveys performed on land and in the sea indicated no threat to rare or endangered plant or animal species. The relatively fast flushing rate of nearshore waters contributes to the favorable water quality in the vicinity.

An archaeological survey performed on the site indicated a significant number of historical sites. Most of the sites covered large areas of agricultural and habitation uses. Three of the sites will be preserved, including a large unnamed heiau which was discovered during this survey. One of these sites includes a large habitation and agricultural site containing raised auwais. Four caves recently placed back on the State Register of Historic Places, and a Portuguese oven site will also be preserved.

Other significant sites will be tested and/or excavated to retrieve scientific or cultural materials of importance. Preservation or testing and excavation of significant sites will help to achieve further understanding of Hawaii's ethnic and cultural heritage.

Scenic views will be enjoyed by the new residents of this development. Views of the ocean, mountain and the beautiful Pacific Tropical Botanical Gardens will be available. Designed landscaping will also be incorporated to enhance the various residential neighborhoods.

Removal of sugarcane land will reduce the amount of particulate matter and other pollutant emissions resulting from burning sugarcane. Increased emissions will be caused by the addition of more traffic, however tighter emission control standards for new vehicles will reduce the amount of lead emissions in motor vehicles. The circulation pattern of the internal roadways and improvements to adjacent intersections will also assist in reducing the amount of carbon monoxide emissions by providing an efficient movement of traffic. Fugitive dust emissions caused during construction will be controlled in accordance with Department of Health regulations. Impacts on air quality will not be significant.

The proposed drainage system will improve existing conditions by capturing and diverting storm water runoff above the existing residents to two potential ocean outlet points. Retention basins will be incorporated into the drainage system which will reduce the amount of silt entering the coastal waters at two outlet points. Threat to life and property from flooding will be reduced.

The development's close proximity to existing resort, residential, recreational and commercial areas will complement the overall growth of the Koloa District. The proposed project will be compatible with current growth trends in the vicinity.

6.1.4 Facility Systems (HRS, Section 226-14 through 18)
Development of the new wastewater treatment and disposal facility will support the County in its plans for a regional system. The proposed wastewater treatment and disposal facility will include additional land in the vicinity for expansion of this plant into a regional wastewater treatment and disposal facility. Installation of the underground wastewater collection system will provide existing residents using cesspools or private treatment plants a means by which to access the new system. Operation and maintenance costs for this aerated lagoon type treatment plant will be significantly less than a mechanical plant. However, should a mechanical plant prove to be more feasible, then a mechanical plant will be constructed. Treated effluent generated by the development will be chlorinated and used to irrigate the golf course.

A new water source/storage facility is planned be developed for this project. A new well is planned to be developed in Mahaulepu and two new 1 mg storage tanks will be installed near the site. This new source/storage facility, distribution lines and upgrades to the existing transmission lines will improve the existing water system. Use of treated effluent for irrigation of the golf course will help to conserve this precious resource. The new water source will be developed in accordance with Chapter 20, Title 11, Administrative Rules.

To assist the County's goal to improve traffic circulation in the Koloa District, intersection improvements and roadway widening are planned on Koloa and Poipu Roads. The intersection of Poipu and Lawai Road with the new project road will be reconfigured into a "X" intersection to improve the present movement of traffic currently being experienced with a "Y" configuration.

Power and communication services for the Koloa area will be improved if a new electric substation and telephone switching station are required to be developed on site.

6.1.5 Socio-Cultural Advancement (HRS, Section 226-19, 20, 21, 23 & 25)

This project offers the community a wide variety of housing accommodations. Single-family lots and multi-family units are proposed at various densities. Provisions for on and off site affordable housing are also being planned. People will have a variety of choices in terms of quality, location, cost, density, style and size of housing.

Land will be reserved next to the existing Koloa Elementary School for expansion of its facilities. Expansion of the school will support the education system and enhance personal development of the children in the community. This educational facility is within close proximity of the development and is easily accessible.

A wide range of recreational activities are proposed on land and water. An 18-hole golf course, two recreational parks, tennis facilities, swimming pools and a marina are proposed. The larger of the two park sites will be designed to incorporate a significant archaeological site which has been recommended for preservation. Portions of this site will be donated to the adjacent Prince Kuhio Park for expansion of their cultural park. The marina and expansion of the existing boat launching facility will create additional water related recreational opportunities.

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, Recreation, Health, Education, Housing, Conservation Lands, Higher Education, Agriculture and Tourism. The following is a description of the proposed development as it relates to the policies of the State Functional Plans.

6.2.1 State Energy Functional Plan

To conserve energy consumed by motor vehicles, sidewalks and a bikeway have been incorporated into the development plan. The use of pedestrian paths/bikeways to nearby employment opportunities, recreational facilities and commercial areas will reduce the number of motor vehicles on the road traveling to these destinations. Generous landscaping of the walkways and bikeway will encourage the use of these facilities.

Energy conservation devices or methods can be used to conserve energy. The use of solar water heaters and designing homes to maximize indoor light without increasing heat will help to lessen electrical power demand.

6.2.2 State Transportation Functional Plan

To provide a safe, efficient and convenient movement of people and goods, roadway improvements will be provided to improve the roadway system in the Koloa District. Major improvements at the intersection of Poipu and Lawai Roads with the project road will be constructed. This intersection will be reconfigured from a "Y" intersection into a "X" intersection. Storage lanes and signalization will also be provided for a safe and efficient movement of traffic.

There is a possibility that the marina facilities will include commercial boating activities, such as commercial fishing or boat tours. Private boat owners may rent or purchase slips at this marina to house their boats. Development of the marina will be consistent with the State's policy to foster and support commerce, industry and agriculture.

6.2.3 State Water Resources Development Functional Plan

To conserve the potable water resource, treated effluent will be used for irrigation of the golf course. Approximately 1 mgd of effluent will be generated from the development, which is sufficient to irrigate an 18-hole golf course.

To prevent flooding during storms, the golf course will serve as a major drainage swale and retention basin to capture most of the storm water runoff above the golf course and route its flows to an outlet at Kukuiula Bay. Runoff from areas below the golf course will be directed by underground drain lines to retention basins on site, then possibly to an outlet near the Beachhouse Restaurant. Retention basins are proposed to reduce the amount of silt entering the Class A coastal waters, minimizing adverse effects to the water quality.

The addition of a new well and two storage tanks will improve the water supply system in the Koloa District. The new internal water system will be connected to the existing system to provide a complete loop to the new water source/storage facilities.

6.2.4 State Historic Preservation Functional Plan

All significant archaeological sites not recommended for preservation will be subject to a program of subsurface testing followed by intensive excavation of selected sites to retrieve scientific and/or historic information of significance. A data recovery plan and preservation plan will be prepared and approved by the appropritate governmental agencies. Three of the sites found will be preserved in their natural state. Two of the significant sites to be preserved are heiaus. The larger of the two is an unnamed heiau discovered during the survey. A raised aqueduct (auwai), which is not known to be found anywhere else in Hawaii except in Koloa is also recommended for preservation. The auwai and the habitation and agricultural complex surrounding this feature will be incorporated into the park design. In addition a Portuguese oven site, a large portion of an elevated railway berm and cave sites, which were not recommended for preservation, will be preserved. Other sites not recommended for preservation may be incorporated into open space or landscaped areas within the development. If burials are found, reinterment will be done according to Department of Health regulations. Necessary approvals will be obtained prior to any work performed. All phases of the archaeological work will be coordinated with the Kauai County Historic Sites Commission and the State Historic Preservation Office.

6.2.5 State Recreation Functional Plan

There are a number of recreational facilities that will be provided for the enjoyment of the community. The new marina, proposed to accommodate 100 to 150 boat slips, will increase water related recreational activities. Land is available for expansion of the existing boat launching facilities at Kukuiula Bay. An additional ramp, a wash-down area and trailer parking facilities may be developed to support the community's recreational needs.

Land related recreational activities include an 18-hole golf course, tennis courts, swimming pools and two recreational parks. The project's close proximity to existing recreational facilities and the addition of the proposed recreational facilities will provide ample recreational opportunities for both new and existing residents.

6.2.6 State Health Functional Plan

The proposed development will provide a wastewater treatment and disposal facility to include a completed network of gravity sewer lines, force mains, and pumping stations. The treatment plant is proposed to provide treatment by aerated lagoons. Two lagoons will be needed to treat 1 mgd of raw sewage generated by this development. An 18-acre site has been reserved to allow enough space for two additional lagoons that will be needed if this facility becomes a regional wastewater treatment and disposal facility. Since there is no public sewer system in this area, the new wastewater system will provide the County the opportunity to implement their regional plans for the Koloa District as described in their Facilities Plan. Alternatively, a mechanical plant utilizing less land may be constructed. Treated effluent generated by the project will be used for irrigation of the golf course. It is recommended that irrigation be performed in the evenings to minimize health risks.

The project will reduce air emissions caused by cane burning since about 600 acres of cane lands will be replaced by this development. Increased carbon monoxide emissions will result from the increase in traffic, however tighter emission control standards in new vehicles will reduce the amount of lead emissions from new vehicles. Improvements to the roadway system will help to reduce the amount of carbon monoxide emissions generated from the increased traffic because idling time at intersections and slow moving traffic causing more pollutant emissions will be decreased. Fugitive dust generated during construction will be controlled in accordance with the Department of Health regulations.

An Erosion Control Plan will be developed to reduce soil erosion caused during construction. Siltation basins used during construction and for the overall development of the drainage system will reduce the amount of water and silt that will enter Class A coastal waters, thereby improving the water quality.

Short term noise impacts will be caused during construction and cannot be avoided. The temporary nature of noise impacts during construction is not expected to jeopardize public health and welfare. Muffled construction equipment and incorporation of State Department of Health construction noise limits and curfew times will be recommended during construction.

Noise impacts from traffic and marina activities are projected to be below Federal and State standards. However, to minimize noise impacts from traffic, a landscaped buffer strip along both sides of the major project roads will be incorporated.

6.2.7 State Education Functional Plan

The existing elementary school in the Koloa District is currently operating at capacity. A&B will reserve land adjacent to the Koloa Elementary School for expansion of their facilities to accommodate the projected increase in enrollment.

6.2.8 State Housing Functional Plan

This project will consist of a variety of housing types, densities, size and cost. Aside from the approximately 4,000 residential units for the overall development, 10 percent of the units in Phase I is planned to be developed on or off site for affordable housing. The project's close proximity to resort oriented activities along the coastline encourages development of affordable housing units further inland where the environment is more suited to young couples raising families. Affordable housing may also be integrated among the market units. The variety of housing products proposed will attract a wide socio-economic range of households and offers flexibility in the choice of housing types.

6.2.9 State Agriculture Functional Plan

The proposed project will be developed on land currently planted in sugarcane. Approximately 600 acres of cane lands will be withdrawn from McBryde Sugar Company, which represents 1.4 percent of sugarcane lands on Kauai and 0.3 percent of the State's inventory of sugarcane lands. Because of the low profitability of the sugarcane industry in Hawaii, McBryde is diversifying into other areas of agriculture. In 1984 macadamia nut orchards were planted on land not required for cane. Presently, approximately 500 acres of macadamia nut orchards have been planted by McBryde. Other areas of diversified agriculture with which McBryde is experimenting include coffee and tea. Although cane lands will be withdrawn from the inventory, it will not adversely impact the availability of agricultural lands in the State. Much of the agricultural lands presently available are not being utilized. McBryde's plans for diversified agriculture may prove to be more profitable than current sugar operations. If McBryde's diversified agriculture program proves to be more profitable, the agricultural economy will be augmented.

6.2.10 State Tourism Functional Plan

The tourist industry on Kauai as well as on the neighbor islands has grown tremendously in recent years. The Koloa-Poipu area is one of Kauai's major visitor destinations. To support the growing visitor industry, this project will provide a resort complex to accommodate approximately 500 rooms at Kukuiula Bay. This waterfront complex will overlook the proposed marina. Some of the multi-family units and possibly single-family lots may also provide visitors a choice of accommodations.

New employment opportunities will also be created by the development of this resort complex. This development will increase Kauai's economy by providing additional accommodations for visitors who will spend their money on Kauai and provide additional employment opportunities for Kauai residents.

6.3 STATE LAND USE

The State Land Use Commission classifies the land proposed for urban development "agriculture." A District Boundary Amendment Petition will be filed with the Land Use Commission after approval is received on the County General Plan Amendment.

6.4 COUNTY OF KAUAI GENERAL PLAN

The proposed project is generally consistent with the objectives and goals of the Kauai General Plan. A variety of housing needs, numerous employment opportunities, and land and water related recreational facilities will be developed to provide the basic needs of a growing community. Facilities to support the visitor industry will also be incorporated with the development of the resort complex. A general plan amendment to reclassify the "agriculture" and "open" lands to "resort" and "urban residential" has been filed with the Planning Commission.

An archaeological survey performed indicated a number of sites in the project area. Expansion and preservation of significant historical sites found on the site will encourage a better understanding of Hawaii's culture.

Infrastructure development proposed will enhance the existing conditions in the Koloa-Poipu area. In addition, improvements and/or upgrades to existing systems will be performed. As described in previous sections, infrastructure development will include a new wastewater treatment and disposal facility; a new water source/storage facility; and drainage, electric, roadway and telephone systems.

6.5 KOLOA-POIPU-KALAHEO DEVELOPMENT PLAN

The Koloa-Poipu-Kalaheo Development Plan contains basically similar goals and objectives as the Kauai General Plan as well as the Hawaii State Plan. Development for this area is compatible with the overall objectives and goals for this region. This project will enhance the region by providing a planned housing development, new or upgraded public facilities, employment opportunities and accompanying amenities.

6.6 COUNTY ZONING

Approximately 213 acres of Phase I received County zoning approval from "agriculture" to residential, commercial and park uses. The remaining 800+ acres are zoned "open" and "agriculture." As the development progresses, and approvals are received from the State and County for desired land use designations, additional zoning applications will be filed to change the zoning designations to the proposed uses.

6.7 COASTAL ZONE MANAGEMENT/SPECIAL MANAGEMENT AREA REGULATIONS

Approximately 100 acres of the site are within the Special Management Area. Except for steep cliffs west of the Spouting Horn Park and the area around Kukuiula Bay, the project area is not contiguous with the shoreline. Much of the shoreline areas have been developed into urban uses. The proposed development will not foreclose access to coastal recreational opportunities. A Special Management Area Permit will be obtained from the County of Kauai. A shoreline set back variance for the proposed marina and related facilities will also be obtained.

SECTION 7

Relationship Between Local Short Term Uses of the Environment and the Maintenance and Enhancement of Long Term Productivity

SECTION 7

RELATIONSHIP BETWEEN LOCAL SHORT TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG TERM PRODUCTIVITY

Approximately two-thirds of the land proposed for development is currently used for sugarcane production and the other one-third is periodically used as pasturelands. The future of the sugarcane industry in Hawaii is uncertain because of its relatively low profitability and increased competition with foreign countries and other sugar sources (i.e., sugar beet and corn syrup). Ample agricultural lands are availabe on Kauai which are not being used. Implementation of the proposed development will increase the housing inventory, employment opportunities and additional recreational facilities in place of the somewhat insecure future of the sugarcane industry.

The development on pasturelands will enhance the presently unproductive lands by converting them into a variety of productive uses which will increase the value of the land.

Productivity of the property, in terms of generating tax revenues, will increase significantly when the agricultural lands are developed into urban use. State and County income from property, personal and excise taxes is expected to offset expenses associated with expanded public facilities to meet the requirements of the development and population growth. Improvements to public facilities will provide long-term community gains.

Except for the golf course, parks and open space buffer areas, which could more easily be altered, the development will foreclose the option to develop these lands for other purposes for a long-term period. If the project is implemented as proposed, using the recommended mitigation measures to alleviate impacts from this development, significant risks to the health and safety of the people and the environment are not anticipated.

SECTION 8

Irreversible and Irretrievable Commitment of Resources

SECTION 8

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Construction of the proposed project will commit the necessary construction materials, energy, human and fiscal resources. Commitment of these resources will provide benefits to the residents of the region and to the County as discussed in previous sections. Additionally, the economy will be augmented through direct employment and its multiplier effects, and increased County and State tax revenues.

Existing vegetation, including sugarcane fields, will be removed by this development and the visual character of the existing landscape will be altered. The development will replace the vegetation with pavement, homes, planned landscaping, open space and the golf course which will enhance its present use.

Commitment of land for a long term period will foreclose the use of this land for other purposes. Excavation for the marina will commit land for this boating recreational facility which is essentially irreversible. Except for the golf course, open space and parks, which could more readily be altered, the existing sugarcane and pasturelands will be committed for a long period of time. In time, the proposed uses could be changed. However, it is doubtful that the land would ever be recycled to a lower intensity use such as agriculture.

SECTION 9

List of Individuals, Organizations and Agencies Consulted

SECTION 9

LIST OF INDIVIDUALS, ORGANIZATIONS AND AGENCIES CONSULTED

9.1 FEDERAL

Department of Housing and Urban Development

U.S. Army Corps of Engineers

9.2 STATE

Department of Education

Department of Business and Economic Development

Department of Health

Department of Land and Natural Resources

Department of Transportation

Office of Environmental Quality Control

Department of Agriculture

Housing Finance and Development Corporation

Land Use Commission

State Historic Preservation Office

Office of Hawaiian Affairs

9.3 COUNTY

Office of the Mayor

County Planning Commission

County Council

Planning Department

Department of Public Works

Building Department

Fire Department

Police Department

9.4 INDIVIDUALS AND ORGANIZATIONS

Kauai Electric Company
Koloa Community Association
Poipu Beach Resort Association
Royal Order of Kamehameha
Metropolitan Mortgage Company
Pacific Tropical Botanical Gardens
B.P. Bishop Museum
American Lung Association

SECTION 10

List of Preparers

SECTION 10

LIST OF PREPARERS

10.1 LIST OF EIS PREPARERS

R. M. Towill Corporation	Bruce Tsuchida, Project Manager Joanne Hiramatsu, Staff Planner Roy T. Tsutsui, Project Engineer James Yamamoto, Sr. Design Engineer
Darby & Associates (Noise)	Ron A. Darby, Principal
Root & Neal (Air Quality)	Barry D. Neal
Char & Associates (Flora)	Winona Char, Principal
Andrew J. Berger (Fauna)	Dr. Andrew J. Berger
William A. Brewer & Assoc. (Marine Biologist)	William A. Brewer
Cultural Surveys Hawaii (Archaeology)	Hallett H. Hammatt, Ph.D.
Pacific Business & Economic Consultants (Agriculture)	Richard L. Bowen, Economist
Peat, Marwick, Main & Co. (Market & Economic Analysis)	Anne Bouslog, Manager Dean Ando
Parsons, Brinckerhoff, Quade & Douglas, Inc. (Traffic)	Julian Ng, Traffic Engineer Susan Uejo, Traffic Engineer

SECTION 11

Preparation Notice Comments Received

STATE OF HAWAII
DEPARTMENT OF BUSINESS
AND ECONOMIC DEVELOPMENT

LAND USE COMMISSION

Room 104, Old Federal Bldg., 335 Merchant Street
Honolulu, Hawaii 96813 Telephone 548-4611

RMT DK RYK REC'D APR 1 GSY BT

April 15, 1988

JH

Mr. Bruce T. Tsuchida, Manager
Planning & Land Development Department
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941

Dear Mr. Tsuchida:

Subject: EIS Preparation Notice for the Kukuiula Planned Community at Koloa, Kauai, Hawaii

We have no comments to offer except that the proposed project site is designated within the AGricultural and Urban Land Use Districts. Portions of the project within the Agricultural District appear to require a district boundary amendment.

Thank you for the opportunity to comment.

Sincerely,

ESTHER UEDA
Executive Officer

EU:to

STATE OF HAWAII
DEPARTMENT OF BUSINESS
AND ECONOMIC DEVELOPMENT

LAND USE COMMISSION

Room 104, Old Federal Building, 335 Merchant Street
Honolulu, Hawaii 96813 Telephone: 548-4611

BT

May 16, 1988

Mr. Bruce Tsuchida, Manager
Department of Planning and
Land Development
R.M. Towill Corp.
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817

Dear Mr. Tsuchida:

Subject: EISPN for Kukuiula Planned Community, Kukuiula, Kauai

This is to request to be a consulted party for the above subject matter.

Sincerely,

ESTHER UEDA
Executive Officer

EU:to

cc: OEQC

R. M. TOWILL CORPORATION

420 WAIAKAMILO RD • SUITE 411
HONOLULU HAWAII 96817-4941
(808) 842-1133
FAX (808) 842-1937

Engineering • Planning • Photogrammetry • Surveying • Construction Management • Energy Systems

June 14, 1988

Ms. Esther Ueda, Executive Officer
Land Use Commission
Department of Business & Economic
Development
State of Hawaii
335 Merchant Street, Rm. 104
Honolulu, Hawaii 96813

Dear Ms. Ueda:

SUBJECT: Environmental Impact Statement
Preparation Notice
Kukuiula Planned Community
Kauai, Hawaii

Thank you for your comments of April 15, 1988 and your May 15, 1988 letters of request to be a consulted party. The Draft Environmental Impact Statement for the above named project is in preparation and when the document is finalized, we will forward a copy to you for your review.

As part of the development process, portions of this project will require State reclassification from Agriculture to Urban. This EIS is being prepared as part of the County of Kauai's requirements for a General Plan Amendment.

Should you have any questions or additional comments and suggestions, please direct them to the undersigned at 842-1133.

Very truly yours,

B. Tsuchida

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

STATE OF HAWAII
Department of Business and Economic Development
Housing Finance and Development Corporation
P. O. BOX 17907
HONOLULU, HAWAII 96817

Joseph K. Con
Executive Dire

IN REPLY REFER TO:
88:PLNG/1762JT

April 18, 1988

Mr. Bruce T. Tsuchida, Manager
Planning & Land Development Department
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941

Dear Mr. Tsuchida:

Re: Environmental Impact Statement Preparation Notice (EISPN) for the Proposed Kukuiula Planned Community

We have reviewed the subject EISPN and offer the following comments:

1. The proposed resort, commercial, marina and golf course facilities will create a number of jobs during construction and operation. A discussion of the projected affordable housing demand operated by the project should be included in the draft EIS. The discussion should also include plans to meet the housing demand (eg. timetable, location and types of affordable housing units).

2. Furthermore, the project's impact on housing should be evaluated in light of other proposed developments in the area.

3. What are the proposed price ranges of the residential component of the project?

Thank you for the opportunity to comment.

Sincerely,

JOSEPH K. CONANT
Executive Director

R. M. TOWILL CORPORATION

420 WAIAKAMILO RD • SUITE 411
HONOLULU HAWAII 96817 4941
(808) 842-1133
FAX (808) 842-1937

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June 14, 1988

Mr. Joseph K. Conant, Executive Director
Housing Finance & Development Corp.
Department of Business & Economic Development
State of Hawaii
P.O. Box 17907
Honolulu, Hawaii 96817

Dear Mr. Conant:

SUBJECT: Environmental Impact Statement Preparation Notice
Kukuiula Planned Community
Kauai, Hawaii

Thank you for your comments of April 18, 1988. The Draft Environmental Impact Statement for the above named project is in preparation and when the document is finalized, we will forward a copy to you for your review.

As part of the EIS process a market assessment and economic impact reports will be prepared. The findings will be published in the Draft EIS. The Draft EIS will also address the issue of affordable housing.

Should you have any questions or additional comments and suggestions, please direct them to the undersigned at 842-1133.

Very truly yours,

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JOHN WAIHEE
GOVERNOR

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

CHARLES T. TOGUCHI
SUPERINTENDENT

OFFICE OF THE SUPERINTENDENT

April 19, 1988

Mr. Bruce T. Tsuchida, Manager
Department of Planning and
Land Development
R. M. Towill Corporation
420 Waiakamilo Rd., Suite 411
Honolulu, Hawaii 96817-4941

Dear Mr. Tsuchida:

SUBJECT: Kukuiula Planned Community
Koloa, Kauai, Hawaii

Our review of the proposed 4,000 - 4,300 housing units indicates that it may have the following enrollment impact on our area schools:

SCHOOL	GRADE	APPROXIMATE ENROLLMENT
Koloa Elem.	K-6	300 - 500
Kauai Int./High	7-12	200 - 300

Our area schools are presently operating at capacity.

The Department of Education cannot assure the availability of classroom space at both schools. Legislative appropriations may be required to accommodate the additional growth in this area.

Thank you for the opportunity to comment.

Sincerely,

Charles T. Toguchi

Charles T. Toguchi
Superintendent

CTT:jl

cc E. Imai, OBS
S. Akita, Dist. Supt.

R. M. TOWILL CORPORATION

420 WAIAKAMILO RD. • SUITE 411
HONOLULU, HAWAII 96817-4941
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June 14, 1988

Mr. Charles Toguchi, Superintendent
Department of Education
State of Hawaii
P.O. Box 2360
Honolulu, Hawaii 96804

Dear Mr. Toguchi:

SUBJECT: Environmental Impact Statement
Preparation Notice
Kukuiula Planned Community
Kauai, Hawaii

Thank you for your comments of April 20, 1988. The Draft Environmental Impact Statement for the above named project is in preparation and when the document is finalized, we will forward a copy to you for your review.

Should you have any questions or additional comments and suggestions, please direct them to the undersigned at 842-1133.

Very truly yours,

B. Tsuchida

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

TONY T. KUNIMURA
MAYOR

COUNTY OF KAUAI
DEPARTMENT OF PUBLIC WORKS
4396 RICE STREET
LIHUE, KAUAI, HAWAII 96766

STEVEN M. KYONO
COUNTY ENGINEER
TELEPHONE 245-3318

RUSSELL SUGANO
DEP COUNTY ENGINEER
TELEPHONE 245-3602

April 20, 1988

RMT	WE	
DK		BT
RYK		
REC'D APR 2		
GSY		

Mr. Bruce T. Tsuchida, Manager
Planning & Land Development Dept.
R.M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, HI 96817-4941

Dear Mr. Tsuchida:

RE: KUKUIULA PLANNED COMMUNITY
KOLOA, KAUAI, HAWAII

Your EIS Preparation Notice includes us as a party to be consulted during the preparation of the EIS for subject project. This is to confirm that we wish to be consulted.

Very truly yours,

STEVEN KYONO, P.E.
County Engineer

KM/sm

R. M. TOWILL CORPORATION

420 WAIAKAMILO RD • SUITE 411
HONOLULU HAWAII 96817 4941
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FAX (808) 842 1937

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June 14, 1988

Mr. Steve Kyono, P.E.
County Engineer
Department of Public Works
County of Kauai
4396 Rice Street
Lihue, Kauai, Hawaii 96766

Dear Mr. Kyono:

SUBJECT: Environmental Impact Statement
Preparation Notice
Kukuiula Planned Community
Kauai, Hawaii

Thank you for your comments of April 20, 1988. The Draft Environmental Impact Statement for the above named project is in preparation and when the document is finalized, we will forward a copy to you for your review.

Should you have any questions or additional comments and suggestions, please direct them to the undersigned at 842-1133.

Very truly yours,

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
BUILDING 230
FT. SHAFTER, HAWAII 96858-5440

REPLY TO ATTENTION OF:

April 28, 1988

Planning Branch

BT

Mr. Bruce T. Tsuchida, Manager
Planning & Land Development Department
R.M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941

Dear Mr. Tsuchida:

Thank you for the opportunity to review the Environmental Impact Statement Preparation Notice (EISPN) for proposed Kukuiula Planned Community, Koloa, Kauai, Hawaii. The following comments are offered:

a. Department of the Army permits would be required for any work in tidal waters and for discharges of fill material into streams or wetlands. Please contact Operations Branch at 438-9258 if you have any questions regarding permits.

b. No tax map keys were provided in the EISPN; however, comparison of EISPN maps with those in the Flood Insurance Study for the City and County of Honolulu (copy of relevant portion enclosed) indicates that the project site is located in the following zones:

(1) Zone X, unshaded (areas outside of the 500-year floodplain).

(2) Zone X, shaded (areas within the 100-year floodplain).

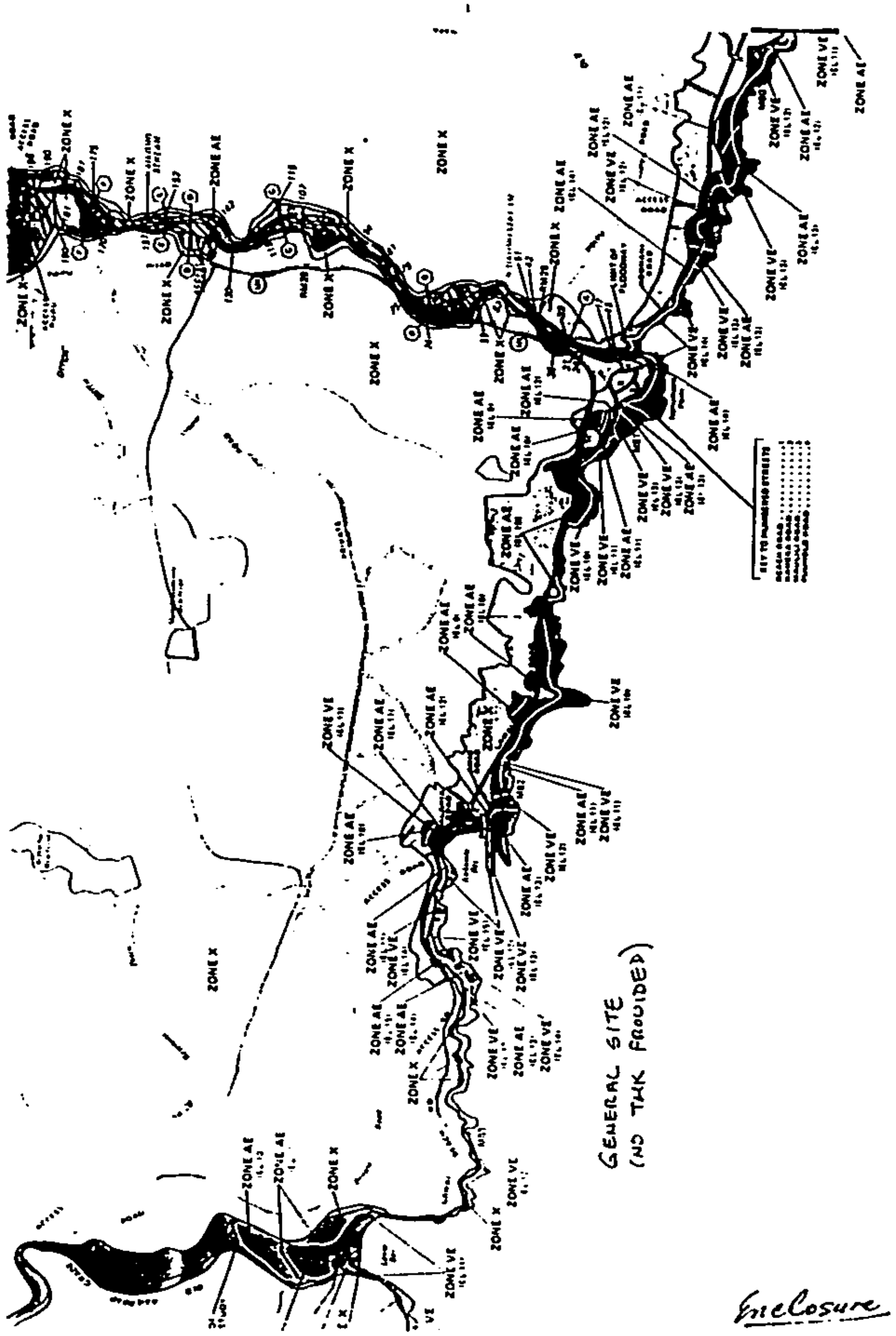
(3) Zone AE (special flood hazard areas within the 100-year floodplain), with base flood elevations of 10 feet, 36-39 feet, and 67-75 feet.

(4) Zone VE (coastal high hazard areas innundated by the 100-year flood that have additional hazards due to wave velocity), with base flood elevations of 12 feet MSL.

Sincerely,

Kisuk Cheung
Chief, Engineering Division

Enclosure



GENERAL SITE
(NO TMK PROVIDED)

Enclosure

R. M. TOWILL CORPORATION

420 WAIAKAMILO RD • SUITE 411
HONOLULU, HAWAII 96817-4941
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June 14, 1988

Mr. Kisuk Cheung, Chief
Engineering Division
Department of the Army
Building 230
Ft. Shafter, Hawaii 96858-5440

Dear Mr. Cheung:

SUBJECT: Environmental Impact Statement
Preparation Notice
Kukuiula Planned Community
Kauai, Hawaii

Thank you for your comments of April 28, 1988. The Draft Environmental Impact Statement for the above named project is in preparation and when the document is finalized, we will forward a copy to you for your review.

As part of the development process, necessary permits will be obtained, including Department of the Army permits. As the need for permits arise, we will contact you for further consultation.

Should you have any questions or additional comments and suggestions, please direct them to the undersigned at 842-1133.

Very truly yours,

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

STATE OF HAWAII
OFFICE OF HAWAIIAN AFFAIRS
1600 KAPIOLANI BLVD., SUITE 1500
HONOLULU, HAWAII 96814
(808) 548-8960
(808) 946-3642

RMT | WE | OK | DIT | RYK | VD
REC'D MAY
GSY | YK

April 28, 1988

Mr. Bruce T. Tsuchida, Manager
Dept. of Planning and Land Development
R.M. Towill Corp.
420 Waiakamilo Road, Suite 411
Honolulu, HI. 96817

Dear Mr. Tsuchida:

SUBJECT: EIS Prep. Notice: Kukuiula Planned Community, Koloa, Kauai.

Thank you for the opportunity to comment on the proposed undertaking.

Topics of concern to our office include the loss of agricultural lands and the displacement of small farmers, the loss of lands potentially available for small farms and diversified agriculture, the need for rural planning rather than urban development, the loss of significant archaeological sites, and the need for preservation and access to historic Hawaiian sites. Our office would like to receive copies of all archaeological reports, preliminary reports, draft reports, proposals and scopes-of-work related to archaeological studies on this project.

Sincerely,

Kamaki A. Kanahele III
Administrator

cc: OEQC

R. M. TOWILL CORPORATION
420 WAIAKAMILO RD • SUITE 411
HONOLULU HAWAII 96817-4941
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June 14, 1988

Mr. Kamaki A. Kanahele III
Administrator
Office of Hawaiian Affairs
State of Hawaii
1600 Kapiolani Blvd., Suite 1500
Honolulu, Hawaii 96814

Dear Mr. Kanahele:

SUBJECT: Environmental Impact Statement
Preparation Notice
Kukuiula Planned Community
Kauai, Hawaii

Thank you for your comments of April 28, 1988. The Draft Environmental Impact Statement for the above named project is in preparation and when the document is finalized, we will forward a copy to you for your review.

An archaeological survey and an agricultural impact study are being performed. Results of their findings will be published in the Draft EIS.

Should you have any questions or additional comments and suggestions, please direct them to the undersigned at 842-1133.

Very truly yours,

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

245 North Kukui Street, Honolulu, Hawaii 96817 Telephone (808) 537-59

RECD MAY

AMERICAN LUNG ASSOCIATION *of Hawaii*
The Christmas Seal People®

April 29, 1988

Mr. Bruce T. Tsuchida, Manager
Planning & Land Development Dept.
R. M. Towill Corp.
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941

Dear Mr. Tsuchida:

Subject: EIS Preparation Notice: Kukuiula Planned Community, Kukuiula, Kauai

Pursuant to State EIS Rules §11-200-15, we hereby request consulted party status for the subject project and offer the following suggestions for your consideration during preparation of the environmental impact statement.

The proposed action will have a variety of air quality-related impacts which should be addressed in the EIS. These include, but are not necessarilty limited to, the following:

1. traffic generated by the project which should be cumulatively analyzed;
2. indirect offsite impacts such as electrical generation and solid waste disposal necessary to serve the project;
3. pesticide usage and drift particularly in relation to the proposed golf course;
4. sewage treatement plant operation;
5. boat operations in the proposed marina;
6. construction related activities, e.g., fugitive dust, vehicle activity, concrete batching, asphalt concrete batching, etc.
7. potential agricultural field burning impacts on the project site itself.

All the aforementioned sources of air pollution emissions should be evaluated cumulatively along with other existing and proposed sources in order to assess as accurately as possible the impact of the project on local air quality as well as the impact of local air quality on the project.

Should you have any questions concerning these suggestions or wish further clarification, do not hesitate to contact us.

Sincerely yours,

Helene Takemoto/ct

Helene Takemoto
Chairman
Environmental Health Committee

HT:ct
18820

R. M. TOWILL CORPORATION

420 WAIAKAMILO RD • SUITE 411
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(808) 842-1133
FAX (808) 842-1937

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June 14, 1988

Ms. Helene Takemoto, Chairman
Environmental Health Committee
American Lung Assoc. of Hawaii
245 North Kukui Street
Honolulu, Hawaii 96817

Dear Ms. Takemoto:

SUBJECT: Environmental Impact Statement
Preparation Notice
Kukuiula Planned Community
Kauai, Hawaii

Thank you for your comments of April 29, 1988. The Draft Environmental Impact Statement for the above named project is in preparation and when the document is finalized, we will forward a copy to you for your review.

Air quality impacts will be addressed in the Draft EIS. A traffic study is being prepared to determine traffic generated by this project. Its findings will be published in the Draft EIS.

Should you have any questions or additional comments and suggestions, please direct them to the undersigned at 842-1133.

Very truly yours,

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

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

LIBERT K. LANDGRAF
DEPUTY

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

MAY 4 1988

DOC. NO.: 3302E
FILE NO.: 88-457

Mr. Bruce T. Tsuchida, Manager
Planning and Development Department
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941

Dear Mr. Tsuchida:

SUBJECT: Kukuiula Planned Community EIS Preparation Notice

We have reviewed the document cited above and have the following comments to offer:

The Kauai Coastal Resource Inventory reports that Kukuiula Harbor is one of the focal points for shoreline recreation on the southern shore of Kauai. Pole fishing is very popular off the harbor breakwater. The entire Lawai-Poipu shoreline is considered to be one of the best sport diving and spearing areas on the island. The same conditions that attract the commercial operations also attract recreational divers and trollers, making the harbor a heavily used launching facility. The recreational values of these resources should be preserved.

To safeguard the quality of the coastal environment which attracts public use, consideration should be given to possible impacts of drainage and stormwater runoff, wastewater disposal and nutrient enrichment and mitigation measures proposed. Precautions should be taken to prevent contamination of coastal waters and resources by eroded soils, construction materials and debris, pesticides, herbicides, and petroleum products.

The developers should assure reasonably convenient public access and parking near the shoreline for fishermen and other recreational users should their activities interfere with, or inhibit traditional movement along the shore.

In addition, the developers should declare intentions regarding commercial activities on public lands (such as charging customers to windsurf, jet ski, participate in snorkel or boat tours, etc.) which could interfere with public use.

Any planned shoreline improvements and/or beach modifications including the marina should be adequately described in the DEIS and the Department should have the opportunity to review all proposed activities that may restrict or discourage existing public use of State shoreline for fishing or other recreational use.

The EIS Preparation Notice indicates that an archaeological survey is being done for this project area, so we will await the findings before initiating a historic preservation review.

We would like to emphasize that the Draft EIS should include in the Existing Conditions the following:

1. Evidence that the entire project area has been adequately surveyed. Sugar cane lands need not be surveyed if land disturbance was deeper than the depth of sites likely to have been found in these areas. Documentation needs to be included both on depth of cane disturbance and on likely sites in the area and their likely subsurface depths. Undisturbed areas within the general cane lands should undergo archaeological survey.

2. Sufficient information to evaluate the significance of any sites found. This information can be in the appended archaeological survey report.

3. At least, initial significance assessments for each historic site (using the criteria of the National and Hawaii Registers of Historic Places). Finalized assessments can be included if the applicant gets the survey findings and significance assessments to our office and the County Planning Department for review and approval prior to writing up the Draft EIS.

4. Conclude the section with a clear indication of how many significant historic sites are present in the project area.

The impacts section should simply note whether there will be effects to any significant sites. And the Mitigation Measures section should cover proposed treatment of significant historic sites that will be effected by the project.

If the applicant has any questions on this review process and our expectations, please have them feel free to contact our Historic Sites Section (548-7460). Dr. Ross Cordy, our Head Archaeologist, is temporarily handling Kauai County projects.

Thank you for the opportunity to comment on this project.

Very truly yours,

WILLIAM W. PATY, Chairperson
Board of Land and Natural Resources

R. M. TOWILL CORPORATION

420 WAIAKAMILO RD • SUITE 411
HONOLULU, HAWAII 96817 4941
(808) 842-1133
FAX (808) 842-1937

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June 14, 1988

Mr. William Paty, Chairperson
Board of Land & Natural Resources
State of Hawaii
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Paty:

SUBJECT: Environmental Impact Statement
Preparation Notice
Kukuiula Planned Community
Kauai, Hawaii

Thank you for your comments of May 4, 1988. The Draft Environmental Impact Statement for the above named project is in preparation and when the document is finalized, we will forward a copy to you for your review.

Special studies are being conducted for development of the marina facilities. Results of these studies will be published in the Draft EIS.

Impacts to the coastal waters from drainage, wastewater disposal and erosion will be addressed in the Draft EIS.

The archaeological survey and report are part of the EIS process to identify and record historic and cultural features. The findings and recommendations will be published in the Draft EIS.

Should you have any questions or additional comments and suggestions, please direct them to the undersigned at 842-1133.

Very truly yours,

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JOHN WAIHEE
GOVERNOR

State of Hawaii
DEPARTMENT OF AGRICULTURE
1428 So. King Street
Honolulu, Hawaii 96814-2512

SUZANNE D. PETERSON
CHAIRPERSON, BOARD OF AGRICULTURE

ROBERT Y. TSUYEMURA
ACTING DEPUTY
TO THE CHAIRPERSON

Mailing Address:
P. O. Box 22159
Honolulu, Hawaii 96822-0159

May 4, 1988

Mr. Bruce T. Tsuchida, Manager
Department of Planning and Land Development
R. M. Towill Corporation
420 Waiakamilo Road
Suite 411
Honolulu, Hawaii 96817-4941

Dear Mr. Tsuchida:

Subject: Environmental Impact Statement Preparation Notice (EISPN) for Kukuiula Planned Community
TMK: 2-6-03: por. 1, 4, 23, por. 31, por. 32
2-6-04: 10, 11, 16, 18, 38, 39, 40, 44, 45
Alexander and Baldwin Properties, Inc.
Koloa, Kauai
Area: approximately 800 acres

The Department of Agriculture has reviewed the subject EISPN and offers the following comments.

According to the subject document, the Kukuiula Planned Community includes the 218.8-acre area already reclassified to the State Urban District and redesignated Urban Residential by the Kauai General Plan. Our comments will focus on the subject 800-acre area.

Soils Information

The property is composed of approximately 366 acres of "Prime" and 341 acres of "Other Important" according to the Agricultural Lands of Importance to the State of Hawaii (ALISH) system. The remaining 93 acres (situated primarily along Poipu Road) are not classified according to the ALISH system.

There are about ten (10) soil series in the project area, according to the Soil Conservation Service Soil Survey. The soil series include Hanamaulu, Ioleau, Koloa, Lihue, Makaweli, Nonopahu, Puhi, Pohakupu, Pakala and Waikomo. The majority of these soils are used for sugarcane and pasture.

The Land Study Bureau Overall Productivity Ratings for the project site range from "A" to "E". Much of the land area was irrigated at the time the study was done. These irrigated Land

Types generally have good productivity potential for most agricultural uses.

The draft EIS should include discussion on the following issues:

- A complete soils description with references to the Agricultural Lands of Importance to the State of Hawaii (ALISH) system, Land Study Bureau Overall Productivity Rating system, and the Soil Conservation Service Soil Survey which indicate the suitability of agricultural use on the site;
- The full impact on the economic viability of McBryde Sugar Company resulting from the cessation of sugarcane production on the subject property. This would include the loss in tons of sugar per acre, lost revenues, location and cost of replacement field preparation (if any), and any other indicators of adverse impact;
- The impact of this development on future agricultural production requirements and expansion of diversified agriculture, as identified in the Final Report of the Land Evaluation and Site Assessment (LESA) Commission (February 1986);
- The potential of establishing viable alternative agricultural uses on the project site;
- The broader economic and resource impact on the State from the irrevocable loss of prime agricultural lands;
- Conformity to the State Agriculture Functional Plan and its objectives and policies, particularly, Implementing Action B(5)(c); and
- The relationship to the following Hawaii State Plan objectives, policies and priority guidelines:

  226-7(b)(6) "Assure the availability of agriculturally suitable lands with adequate water to accommodate present and future needs."

  226-103(c)(1) "Provide adequate agricultural lands to support the economic viability of the sugar and pineapple industries."

226-103(d)(1) "Identify, conserve and protect agricultural and aquacultural lands of importance and initiate affirmative and comprehensive programs to promote economically productive agricultural and aquacultural uses of such lands."

226-104(b)(2) "Make available marginal or non-essential agricultural lands for appropriate urban uses while maintaining agricultural lands of importance in the agricultural district."

Thank you for the opportunity to comment. We will provide further comment upon our receipt and review of the Draft Environmental Impact Statement.

Sincerely,

for SUZANNE D. PETERSON
Chairperson, Board of Agriculture

cc: OSP (Attn: LUD)
LUC
OEQC

R. M. TOWILL CORPORATION
420 WAIAKAMILO RD. • SUITE 411
HONOLULU, HAWAII 96817-4941
(808) 842-1133
FAX (808) 842-1937
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June 14, 1988

Ms. Suzanne D. Peterson, Chairperson
Board of Agriculture
Department of Agriculture
State of Hawaii
1428 South King Street
Honolulu, Hawaii 96814-2512

Dear Ms. Peterson:

SUBJECT: Environmental Impact Statement
Preparation Notice
Kukuiula Planned Community
Kauai, Hawaii

Thank you for your comments of May 4, 1988. The Draft Environmental Impact Statement for the above named project is in preparation and when the document is finalized, we will forward a copy to you for your review.

An agricultural assessment report is being prepared as part of this EIS process. Results of the findings will be published in the Draft EIS.

Should you have any questions or additional comments and suggestions, please direct them to the undersigned at 842-1133.

Very truly yours,

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

POIPU BEACH RESORT ASSOCIATION
P.O. Box 730, Koloa, Kauai, HI 96756 (808) 742 7444

May 5, 1988

Mr. Bruce T. Tsuchida
Manager
Department of Planning
and Land Development
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941

Dear Mr. Tsuchida,

In reviewing the preparation notice for the Kukuiula Planned Community Environmental Impact Statement, I noticed that the Poipu Beach Resort Association is listed as a party to be consulted. I would like for the Association to continue to be a consulted party. I would also like to offer assistance you may need with regard to information about the visitor inventory, the projected inventory, and the statistics we have gathered about the Poipu area.

Very truly yours,

Margy Parker
Executive Director

MP/b

R. M. TOWILL CORPORATION
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June 14, 1988

Ms. Margy Parker
Executive Director
Poipu Beach Resort Association
P.O. Box 730
Koloa, Kauai, Hawaii 96756

Dear Ms. Parker:

SUBJECT: Environmental Impact Statement
Preparation Notice
Kukuiula Planned Community
Kauai, Hawaii

Thank you for your comments of May 5, 1988. The Draft Environmental Impact Statement for the above named project is in preparation and when the document is finalized, we will forward a copy to you for your review.

We appreciate your offer of assistance with regard to information and statistics for the Poipu area, and would like to follow up on this offer in the near future.

Should you have any questions or additional comments and suggestions, please direct them to the undersigned at 842-1133.

Very truly yours,

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

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:
EPHSD

May 18, 1988

5H

Mr. Bruce T. Tsuchida, Manager
Department of Planning & Land Development
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941

Dear Mr. Tsuchida:

Subject: Environmental Impact Statement Preparation Notice (EISPN) for Kukuiula Planned Community, Kukuiula, Kauai, Hawaii

Thank you for allowing us to review and comment on the subject EISPN. We provide the following comments:

Water Pollution

Kukuiula Bay is a Class A embayment. Chapter 11-54 specifically prohibits any new industrial or sewage discharges into the Bay.

Any placement of dredge or fill material into the receiving waters may require a Section 401 Water Quality Certification (WQC). Coordination should be made with the U.S. Army Corps of Engineers to determine if the placement activities will require a Section 401 WQC.

Drinking Water

The proposed Kukuiula project will consist of approximately 4,000 residential units (both single and multi-family), resort facilities, a marina, commercial areas, a golf course and parks. The existing Kauai Department of Water's Koloa-Poipu System is insufficient to meet the demands of the proposed project. Additional water source and storage facilities will be developed for Kukuiula Resort.

Section 11-20-29 of Chapter 20 requires all new sources of potable water serving public water systems to be approved by the Director of Health prior to their use to serve potable water. Such approval is based primarily upon the satisfactory submission of an engineering report which adequately addresses all concerns as set down in Section 11-20-29. The engineering report must be prepared by a registered professional engineer and bear his or her seal upon submittal.

Wastewater Disposal

The EISPN does not provide details of projected waste flow, treatment facilities and a disposal system. The County of Kauai, in its Facility Plan Study for Poipu-Koloa (prepared by M&E Pacific, 1988), has proposed to construct a regional system with the Waikoma Treatment Facility located north of Prince Kuhio. The proposed STP for Kukuiula Bay Planned Community Project is also located in the general vicinity of the proposed Waikoma Treatment Facility. We strongly recommend that the developer consult with the County of Kauai regarding the wastewater disposal system for the subject project.

Individual wastewater disposal systems should not be permitted as it is a statewide goal that all wastewater be treated and disposed by means of a municipal treatment system.

Sincerely,

BRUCE S. ANDERSON, Ph.D.
Deputy Director for
Environmental Health

cc: DHSA, Kauai

R. M. TOWILL CORPORATION

420 WAIAKAMILO RD • SUITE 411
HONOLULU, HAWAII 96817-4941
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FAX (808) 842-1937

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June 14, 1988

Dr. Bruce S. Anderson, Ph.D
Deputy Director for Environmental Health
Department of Health
State of Hawaii
P.O. Box 3378
Honolulu, Hawaii 96801

Dear Dr. Anderson:

SUBJECT: Environmental Impact Statement
Preparation Notice
Kukuiula Planned Community
Kauai, Hawaii

Thank you for your comments of April 20, 1988. The Draft Environmental Impact Statement for the above named project is in preparation and when the document is finalized, we will forward a copy to you for your review.

Water pollution, drinking water and wastewater disposal will be addressed in the Draft EIS.

Should you have any questions or additional comments and suggestions, please direct them to the undersigned at 842-1133.

Very truly yours,

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

METROPOLITAN MORTGAGE & SECURITIES CO., INC.

WEST 929 SPRAGUE AVENUE / P.O. BOX 2162 / SPOKANE, WASHINGTON 99210 / PHONE (509) 838-3111

June 2, 1988

RMT		WES	
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REC'D JUN			RMTC
GSY		YJK	

JH —

Mr. Bruce T. Tsuchida, Manager
Planning and Land Development Department
R.M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941

Re: A & B Properties, Inc.
Kukuiula Planned Community
Koloa, Kauai, Hawaii

Dear Mr. Tsuchida:

Please be advised that Metropolitan Mortgage Company is the owner and developer of the Lawai Beach Resort, which is adjacent to the above-referenced proposal, and further that we have received a copy of your EIS preparation notice and scope for the subject proposal dated March 31, 1988.

We appreciate the inclusion of Metropolitan Mortgage as a "party to be consulted" and hereby extend our full cooperation in whatever assistance or information we could provide toward your preparation of the EIS. Please feel free to contact Bill Arsenault, our Corporate Architect, or myself at the address noted above or via our toll-free telephone number: 1-800-541-0828.

In addition, we would appreciate receiving three (3) copies of the completed EIS document. Please inform us of the charges for said copies.

We are looking forward toward working with you and your staff on this endeavor. Mahalo for your Kokua.

Sincerely,

Mike Teramoto
Development Consultant

cc: C. Paul Sandifur, Sr.
C. Paul Sandifur, Jr.
Bill Arsenault

R. M. TOWILL CORPORATION

420 WAIAKAMILO RD • SUITE 411
HONOLULU HAWAII 96817 4941
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FAX (808) 842-1937

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June 14, 1988

Mr. Michael Teramoto
Development Consultant
Metropolitan Mortgage & Securities Co., Inc.
West 929 Sprague Avenue
P.O. Box 2162
Spokane, Washington 99210

Dear Mr. Teramoto:

SUBJECT: Environmental Impact Statement
Preparation Notice
Kukuiula Planned Community
Kauai, Hawaii

Thank you for your comments of June 2, 1988. The Draft Environmental Impact Statement for the above named project is in preparation and when the document is finalized, we will forward a copy to you for your review.

Should you have any questions or additional comments and suggestions, please direct them to the undersigned at (808) 842-1133.

Very truly yours,

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JOHN WAIHEE
GOVERNOR

RMT		WES	
DK	25	BTT	BT
RYK		WD	
REC'D JUL			RMTC
GSY		YJK	

JH —

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

EDWARD Y. HIRATA
DIRECTOR

DEPUTY DIRECTORS
JOHN K. UCHIMA
RONALD N. HIRANO
DAN T. KOCHI
JEANNE K. SCHULTZ

IN REPLY REFER TO:
STP 8.294

June 28, 1988

Mr. Bruce T. Tsuchida, Manager
Department of Planning and Land Development
R.M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941

Dear Mr. Tsuchida:

Environmental Impact Statement (EIS)
Preparation Notice
Kukuiula Planning Community
Koloa, Kauai

A Traffic Impact Analysis Report (TIAR) must be prepared and incorporated in the draft EIS. The calculations in deriving the values for the TIAR should be submitted.

Since the area designated for a marina will impact the mooring area of our Kukuiula Boat Harbor, close consultation and coordination with our Harbors Division should be maintained.

Thank you for this opportunity to provide comments.

Very truly yours,

Edward Y. Hirata
Director of Transportation

R. M. TOWILL CORPORATION

420 WAIAKAMILO RD • SUITE 411
HONOLULU HAWAII 96817 4941
(808) 842 1133
FAX (808) 842-1937

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August 25, 1988

Mr. Edward Y. Hirata
Director of Transportation
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, Hawaii 96813

Dear Mr. Hirata:

SUBJECT: Environmental Impact Statement
Preparation Notice
Kukuiula Planned Community
Kauai, Hawaii

Thank you for your comments of June 28, 1988. The Draft Environmental Impact Statement for the above named project is in preparation and when the document is finalized, we will forward a copy to you for your review.

A traffic impact study is being prepared as part of this EIS. Results of the findings will be published in the Draft EIS.

Should you have any questions or additional comments and suggestions, please direct them to the undersigned at (808) 842-1133.

Very truly yours,

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

PACIFIC TROPICAL BOTANICAL GARDEN

CHARTERED BY CONGRESS TO CREATE A NATIONAL RESOURCE IN TROPICAL BOTANY

RMT		WES	
DK		BTT	BT
RYK		WD	
REC'D AUG			RMTC
GSY		YJK	

August 5, 1988

JH

Mr. Bruce T. Tsuchida, Manager
Department of Planning and Land
Development
R. M. Towill Corporation
420 Waiakamilo Rd., Suite 411
Honolulu, HI 96817-4941

Dear Mr. Tsuchida:

I am sorry I did not get back to you earlier regarding the Kukuiula Planned Community report that our office received in early April. Unfortunately I was away at that time and for the remainder of April through early May. As a result I did not have a chance to respond. On my return I read it with great interest and would like to remain on your mailing list for all other special reports that are prepared regarding the Kukuiula Planned Community. Our Garden is intimately associated with this project as we represent the western most boundary of the long-term plan. If you have any questions, or would like to speak to me in this regard, please call 332-7324.

Yours sincerely,

William L. Theobald
Director

WLT:hko

POST OFFICE BOX 340, LAWAI, KAUAI, HAWAII 96765 • (808) 332 7324

R. M. TOWILL CORPORATION

420 WAIAKAMILO RD • SUITE 411
HONOLULU, HAWAII 96817-4941
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August 25, 1988

Mr. M. William L. Theobald, Director
Pacific Tropical Botanical Garden
P.O. Box 340
Lawai, Kauai, Hawaii 96765

Dear Mr. Theobald:

SUBJECT: Environmental Impact Statement
Preparation Notice
Kukuiula Planned Community
Kauai, Hawaii

Thank you for your comments of August 5, 1988. The Draft Environmental Impact Statement for the above named project is in preparation and when the document is finalized, we will forward a copy to you for your review.

Should you have any questions or additional comments and suggestions, please direct them to the undersigned at 842-1133.

Very truly yours,

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

SECTION 12

Draft EIS Comments Received

DEPARTMENT OF THE NAVY
COMMANDER
NAVAL BASE PEARL HARBOR
BOX 110
PEARL HARBOR, HAWAII 96860-5020

RMT		WES	
DK		BTT	
RYK		WD	
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5090 (108)
Ser 032/2258
7 SEP 1988

JH

Mr. Tom Shigemoto
County of Kauai Planning Department
4280 Rice Street
Lihue, Kauai 96766

Dear Mr. Shigemoto:

KUKUIULA PLANNED COMMUNITY DEIS

The Draft Environmental Impact Statement (DEIS) for Kukuiula Planned Community has been reviewed and we have no comments to offer. Since we have no further use for the DEIS, it is being returned to the Office of Environmental Quality Control.

Thank you for the opportunity to review the Draft EIS

Sincerely,

W. K. Liu

W. K. LIU
Assistant Base Civil Engineer
By direction of
the Commander

Enclosure

Copy to:
Mr. Bruce Tsuchida
R.M. Towill Corporation
420 Waikamilo Road, Suite 411
Honolulu, HI 96817

Office of Environmental Quality Control

R. M. TOWILL CORPORATION

420 WAIAKAMILO RD • SUITE 411
HONOLULU, HAWAII 96817-4941
(808) 842-1133
FAX (808) 842-1937

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November 7, 1988

Mr. W. K. Liu
Assistant Base Civil Engineer
Naval Base Pearl Harbor
Box 110
Pearl Harbor, Hawaii 96860-5020

Dear Mr. Liu:

SUBJECT: Draft EIS for Kukuiula Planned Community, Koloa, Kauai, Hawaii

Thank you for your comments of September 7, 1988 relating to the proposed Kukuiula Planned Community project. We appreciated your review of this document.

If you should have any questions or additional comments and suggestions, please direct them to:

Mr. Bruce T. Tsuchida, Project Manager
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941
Phone: 842-1133

Very truly yours,

B. Tsuchida

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JH:W9

STATE OF HAWAII
DEPARTMENT OF DEFENSE
OFFICE OF THE ADJUTANT GENERAL

September 15, 1988

Engineering Office

SEP 19

Mr. Tom Shigemoto
County of Kauai Planning Department
4280 Rice Street
Lihue, Kauai, HI 96766

Dear Mr. Shigemoto:

Kukuiula Planned Community DEIS
Koloa, Kauai

Thank you for providing us the opportunity to review the subject project.

We have no comments to offer at this time regarding this project.

Sincerely,

for Jerry M. Matsuda
Major, Hawaii Air
National Guard
Contr & Engr Officer

cc: Mr. Bruce Tsuchida,
R.M. Towill Corporation

R. M. TOWILL CORPORATION

420 WAIAKAMILO RD • SUITE 411
HONOLULU HAWAII 96817-4941
(808) 842-1133
FAX (808) 842-1937

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November 7, 1988

Major Jerry M. Matsuda
Construction and Engineering Officer
Hawaii Air National Guard
Dept. of Defense
State of Hawaii
3949 Diamond Head Road
Honolulu, Hawaii 96816-4495

Dear Major Matsuda:

SUBJECT: Draft EIS for Kukuiula Planned Community, Koloa, Kauai, Hawaii

Thank you for your comments of September 15, 1988 relating to the proposed Kukuiula Planned Community project. We appreciated your review of this document.

If you should have any questions or additional comments and suggestions, please direct them to:

Mr. Bruce T. Tsuchida, Project Manager
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941
Phone: 842-1133

Very truly yours,

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JH:W9

DEPARTMENT OF WATER

COUNTY OF KAUAI
P. O. BOX 1706
LIHUE, HAWAII 96766-5706

RMT		WES	
DK		BTT	BT
RYK		WD	
REC'D SEP 1			RMTC
GSY		YJK	

JH

September 15, 1988

Office of Environmental Quality Control
465 South King Street
Room 104
Honolulu, HI 96813

RE: Environmental Impact Statement for Kukuiula Planned Community, A & B Properties, Inc., Kukuiula, Kauai, TMK: 2-6-04:16,38,44,45

We have no objections to this EIS provided that water source, storage and transmission facilities are upgraded prior to actual development or subdivision of this area.

At the present time, our source, storage and transmission facilities are not able to handle the proposed development.

The area involved in this re-zoning is outside the service area for which the Department's General Plan for Domestic Water was prepared. If this area is urbanized, new source, storage and transmission water system facilities will have to be developed to serve the additional water demand of this area. Presently, the Department's capital improvement plans do not include water facility improvements for the proposed area or development. However, the Department may allow the developer to provide the necessary water system improvements providing they will be constructed to the Department's standards.

Raymond H. Sato
Raymond H. Sato
Manager and Chief Engineer

GF:kd
cc: Planning Department
R.M. Towill ✓

R. M. TOWILL CORPORATION

420 WAIAKAMILO RD • SUITE 411
HONOLULU, HAWAII 96817-4941
(808) 842-1133
FAX (808) 842-1937

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November 7, 1988

Mr. Raymond H. Sato
Manager & Chief Engineer
Department of Water
Cunty of Kauai
P.O. Box 1706
Honolulu, Hawaii 96766-5706

Dear Mr. Sato:

SUBJECT: Draft EIS for Kukuiula Planned Community, Koloa, Kauai, Hawaii

Thank you for your comments of September 15, 1988 relating to the proposed Kukuiula Planned Community project. We appreciated your review of this document.

As stated in the Draft EIS, new water source, storage and transmission facilities will be developed for this project and will be constructed according to County of Kauai Water Department's standards. These facilities will be upgraded prior to actual development or subdivision.

If you should have any questions or additional comments and suggestions, please direct them to:

Mr. Bruce T. Tsuchida, Project Manager
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941
Phone: 842-1133

Very truly yours,

B. Tsuchida
Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JH:W9

STATE OF HAWAII
DEPARTMENT OF BUSINESS AND ECONOMIC DEVELOPMENT
LAND USE COMMISSION
Room 104, Old Federal Building, 335 Merchant Street
Honolulu, Hawaii 96813 Telephone: 548-4611

RMT		WES	
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JH GW

September 21, 1988

Mr. Tom Shigemoto
County of Kauai Planning Department
4280 Rice Street
Lihue, Hawaii 96766

Dear Mr. Shigemoto:

Subject: Draft EIS for the Kukuiula Planned Community, Kukuiula, Kauai, Hawaii

We have no comments to offer on the subject Draft EIS except that based on the maps in the Draft EIS, the subject project is located within the State Land Use Agricultural and Urban Districts. It is our understanding that a district boundary amendment is proposed for the Agricultural District portion of the project.

Thank you for this opportunity to comment.

Sincerely,

Esther Ueda

ESTHER UEDA
Executive Officer

EU:to

cc: /Bruce Tsuchida

R. M. TOWILL CORPORATION
420 WAIAKAMILO RD • SUITE 411
HONOLULU, HAWAII 96817-4941
(808) 842-1133
FAX (808) 842-1937
Engineering • Planning • Photogrammetry • Surveying • Construction Management • Energy Systems

November 7, 1988

Ms. Ester Ueda
Executive Officer
Land Use Commission
Old Federal Bldg., Room 104
335 Merchant Street
Honolulu, Hawaii 96813

Dear Ms. Ueda:

SUBJECT: Draft EIS for Kukuiula Planned Community, Koloa, Kauai, Hawaii

Thank you for your comments of September 21, 1988 relating to the proposed Kukuiula Planned Community project. We appreciated your review of this document.

This EIS is being prepared as part of the requirements for a General Plan Amendment to change the designation from "agricultural" and "open" to "urban residential" and "resort." Thereafter, we will request to change lands within the State Land Use Agricultural District to "urban."

If you should have any questions or additional comments and suggestions, please direct them to:

Mr. Bruce T. Tsuchida, Project Manager
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941
Phone: 842-1133

Very truly yours,

B. Tsuchida

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JH:W9

STATE OF HAWAII
OFFICE OF HAWAIIAN AFFAIRS

ROUTE TO:
Shigemoto

SEP 22

September 21, 1988

Mr. Tom Shigemoto
County of Kauai Planning Dept.
4280 Rice Street
Lihue, HI 96766

Dear Mr. Shigemoto:

Subject: Draft EIS: Kukuiula Planned Community, Koloa, Kaua'i

Thank you for the opportunity to comment on the proposed undertaking. The project area contains Site No. 3075, the Koloa Caves, which was placed on the Hawaii Register of Historic Places in 1975 (although not currently on the Register). This is not mentioned in the Draft EIS or Appendix E, the archaeological survey report.

While the Draft EIS contains an archaeological survey report, it does not contain a data recovery plan with sufficient details to allow the reviewer to comment on the adequacy of the mitigation measures being proposed. Nor does it contain a cultural resources management plan sufficient to allow the reviewer to comment on the preservation measures being proposed.

The archaeological survey report should not be distributed in the reduced format used in the draft EIS. It is a valuable reference document that should be printed full size, just like the main body of the Draft EIS.

Other archaeological documents associated with this project should also be distributed to interested persons, such as data recovery plans and excavation reports. This should be one of the required mitigating measures.

The island of Kaua'i has suffered from the loss of archaeological sites representative of our Hawaiian heritage. It is important that the proposed development address the needs of Hawaiians, scientists, visitors and the community by preserving and allowing access to ancient Hawaiian ruins and sites.

All kinds of sites are important to the proper interpretation and understanding of our ancient Hawaiian culture: places of worship, irrigation systems, terraced fields, house sites, trails, burial sites, lava tubes, and 19th century Hawaiian historic period sites. In our opinion, the acreage covered by the few remaining Hawaiian sites in the project area is an insignificant portion of the total project area, and it is not asking too much to expect that these sites be preserved and protected. The time is past when archaeologists believed that only the large luakini heiau sites were worth preserving. The Hawaiian people set up heiaus of many kinds for the worship of innumerable gods, including unu, waihau, ko'a, and kuahu. Prominent persons, or po'e ko'iko'i, also had heiaus, as did the po'e malama akua, who observed a particular god's kapu, and the po'e haipule akua, those who said prayers on particular occasions, and the po'e pa'a akua, those who constantly made offerings to their god, and po'e pa'a mua akua, those who kept images of gods in their hale mua. If only the largest and best preserved heiaus are set aside, then the vast uncharted expanses of ancient Hawaiian culture and religion will be lost and forgotten. Not only does the wide variety of Hawaiian heiau deserve greater attention, so does the Hawaiian settlement pattern, and the farms and house sites of the Hawaiian planters. The recommendations for preservation contained in the Draft EIS are inadequate. More sites should be preserved, especially in the most important categories of religious sites, house sites, and lava tubes.

Sincerely,

Kamaki A. Kanahele

Mr. Kamaki A. Kanahele III
Administrator

cc: R.M.Towill

R. M. TOWILL CORPORATION

420 WAIAKAMILO RD • SUITE 411
HONOLULU, HAWAII 96817-4941
(808) 842-1133
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November 7, 1988

Mr. Frank A. Kanahele III
Administrator
Office of Hawaiian Affairs
State of Hawaii
1600 Kapiolani Blvd., Suite 1500
Honolulu, Hawaii 96814

Dear Mr. Kanahele:

SUBJECT: Draft EIS for Kukuiula Planned Community, Koloa, Kauai, Hawaii

Thank you for your comments of September 21, 1988 relating to the proposed Kukuiula Planned Community project. We appreciated your review of this document.

A data recovery plan will be prepared for the 51 significant sites found on the project site. Thirty of these sites are significant only for their information content and 21 for multiple criteria according to the State and National Registers of Historic Places. Fourteen of the multiple criteria sites are excellent examples of site types, however, larger and better examples of these site types are already preserved at Kiahuna.

A field trip of the Kiahuna and Kukuiula sites was conducted on October 24, 1988. Participants included representatives from the Kauai Historic Sites Commission, Kauai County Planning Department, Dr. William Kikuchi, State Historic Sites Section, A&B Properties, Kiahuna Corporation and the consulting archaeologist, Dr. Hallett Hammett. This field inspection confirmed that the sites at Kiahuna are indeed better examples of site types than those found at Kukuiula. Three of the significant sites (two heiaus and a raised auwai) at Kukuiula have been recommended for preservation. A preservation plan will be prepared for these three sites.

The data recovery plan and preservation plan will be prepared and submitted to the State Historic Sites Section and the County of Kauai Planning Department for approval prior to any work performed on the sites. The Draft EIS will be revised to include more information as stated in this letter. Your office will be consulted during actual excavation, preservation and reinterment of any human remains that may be discovered.

For the purpose of the EIS and for an efficient means of reproducing and handling the EIS, a reduced sized copy of all the appendices is normally provided. If you desire full size copies of specific reports, you may direct your request to the undersigned.

If you should have any questions or additional comments and suggestions, please direct them to:

Mr. Bruce T. Tsuchida, Project Manager
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941
Phone: 842-1133

Very truly yours,

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JH:W9

JOHN WAIHEE
GOVERNOR

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

CHARLES T. TOGUCHI
SUPERINTENDENT

OFFICE OF THE SUPERINTENDENT

September 22, 1988

OCT 4

Mr. Tom Shigemoto
County of Kauai Planning Department
4280 Rice Street
Lihue, Hawaii 96766

Dear Mr. Shigemoto:

SUBJECT: Kukuiula Planned Community
Koloa, Kauai

A review of the subject Environmental Impact Statement indicates that our comments reflected in the document are still valid. We are still concerned about the lack of classroom space to accommodate the development and cannot assure the availability of classrooms on a timely basis.

As stated in the document, the Department of Education will require additional land adjacent to Koloa Elementary for the school's expansion. We would like to request a meeting with the developer to discuss the details on the additional land which will be required to accommodate the enrollment increase created by the development.

We request that the developer call our Facilities Branch at 737-4743 (Oahu) regarding the meeting.

Thank you for the opportunity to comment.

Sincerely,

Charles T. Toguchi

Charles T. Toguchi
Superintendent

cc E. Imai, OBS
S. Akita, Kauai District
B. Tsuchida, R.M. Towill Corp.

AN AFFIRMATIVE ACTION AND EQUAL OPPORTUNITY EMPLOYER

R. M. TOWILL CORPORATION

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FAX (808) 842-1937

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November 7, 1988

Mr. Charles T. Toguchi
Superintendent
Dept. of Education
State of Hawaii
P.O. Box 2360
Honolulu, Hawaii 968204

Dear Mr. Toguchi:

SUBJECT: Draft EIS for Kukuiula Planned
Community, Koloa, Kauai, Hawaii

Thank you for your comments of September 22, 1988 relating to the proposed Kukuiula Planned Community project. We appreciated your review of this document.

To assist the Department of Education in expediting expansion of the Koloa Elementary School, the project boundary will be extended to include the land proposed for the school expansion. A meeting will be scheduled in the near future regarding the school's land requirements.

If you should have any questions or additional comments and suggestions, please direct them to:

Mr. Bruce T. Tsuchida, Project Manager
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941
Phone: 842-1133

Very truly yours,

B. Tsuchida

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JH:W9

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

P. O. BOX 50004
HONOLULU, HAWAII
96850

September 26, 1988

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JH

Mr. Tom Shigemoto
County of Kauai Planning Department
4280 Rice Street
Lihue, Kauai, HI 96766

Dear Mr. Shigemoto:

Subject: Draft Environmental Impact Statement (DEIS) - Kukuiula Planned Community, Koloa, Kauai

We have no comments to offer at this time; however, we would appreciate the opportunity to review the final EIS.

Sincerely,

Herbert J. [illegible] acting
RICHARD N. DUNCAN
State Conservationist

cc:
Mr. Bruce Tsuchida, R.M. Towill Corporation, 420 Waikamilo Road, Suite 411, Honolulu, HI 96817

R. M. TOWILL CORPORATION

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November 7, 1988

Mr. Richard N. Duncan
State Conservationalist
Soil Conservation Service
P.O. Box 50004
Honolulu, Hawaii 96850

Dear Mr. Duncan:

SUBJECT: Draft EIS for Kukuiula Planned Community, Koloa, Kauai, Hawaii

Thank you for your comments of September 26, 1988 relating to the proposed Kukuiula Planned Community project. We appreciated your review of this document.

If you should have any questions or additional comments and suggestions, please direct them to:

Mr. Bruce T. Tsuchida, Project Manager
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941
Phone: 842-1133

Very truly yours,

B. Tsuchida

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JH:W9

September 28, 1988

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JH

MEMORANDUM

TO: Roger Evans, OCEA

FROM: Ralston H. Nagata, State Parks Administrator

SUBJECT: Review of Draft EIS -- KUKUIULA PLANNED COMMUNITY (A & B Properties, Inc.)
File No: 89-132
Koloa & Lawai, Koloa, Kauai

HISTORIC SITES SECTION CONCERNS:

Historic preservation concerns are not adequately addressed in the text of this Draft EIS under the section on Historic Sites (pp. 3-24 to -26). This text needs to be revised.

The Existing Conditions section is partly correct. In a July 30, 1988 letter to the consulting archaeologist, Dr. H. Hammatt, we reviewed the archaeological survey. We agreed that the survey adequately covered the project area, finding all historic sites -- totalling 58 sites. This information is in the Draft EIS. However, the Draft EIS fails to indicate which of these sites are significant according to the criteria of the Hawaii and National Registers of Historic Places. These significance assessments must be included in this document since the critical item in an EIS is to clearly identify the significant sites which will be affected. Significance was determined in consultations between the consulting archaeologist and our office, and we agreed upon the assessments in our July 30, 1988 letter. Table 1 of Appendix E (the consulting archaeologist's report) in this Draft EIS presents these assessments. 51 of the sites are still significant, 30 only for their information content and 21 for multiple criteria. In the multiple criteria cases, 14 sites are in part significant as excellent examples of site types. This information, again, needs to be included in the EIS text; otherwise, the reader does not know how many significant sites are present or why they are significant.

The Impact section of the report is not acceptable. We agree that the 51 significant historic sites will be affected by the development. However, the EIS does not indicate the nature of the effect. We believe that the effect will be an "adverse effect" unless an acceptable mitigation plan is developed to handle the significant historic sites.

The Mitigation Measures section of the Draft EIS is also not acceptable. In our review of the proposed mitigation plan by the consulting archaeologist, we did not approve the plan for several reasons. The most critical was that the consulting archaeologist indicated that better examples of a number of the site types had already been preserved in the adjacent Kiahuna development. Therefore, he

recommended that only 3 sites be preserved (2 heiau and 1 raised canal) and recommended that all other significant historic sites undergo archaeological data recovery. We had emphasized in our review of this project that before we could accept this plan we needed to confirm that the sites are still preserved in Kiahuna, and indeed contain all the site types in the Kukuiula area. It had been agreed, we thought, that a field check would occur with the consulting archaeologist, our staff and members of the Kauai Historic Sites Commission. Until this field check occurs, and it is verified that all site types are preserved in Kiahuna, we will not approve the mitigation plan. If some site types are not preserved in Kiahuna, it is our belief that they will need preservation within the Kukuiula project otherwise the public could well permanently lose examples of these types in the Koloa region.

We would also like to emphasize that in our opinion "coordination" of mitigation phases with our office and the County is not an acceptable procedure. It must be clear that as conditions to approved county and state permits, a detailed preservation plan and an archaeological data recovery plan will need to be approved by the State's Historic Sites Section and the County Planning Department and the execution of these plans be verified by the same offices. Otherwise, there is no way of being sure that the work is properly planned and properly executed. This conditon is vital for the public's benefit and for the benefit of the applicant.

RECREATION CONCERNS:

There are no state park recreation concerns. We note the DLNR Preparation Notice comment included public recreation impact on Kukuiula Bay. We do not feel the impact of the proposed marina on existing recreation uses of the harbor area have been adequately addressed.

RALSTON H. NAGATA

October 31, 1988

RECD NOV 2 1988

JH

MEMORANDUM

TO: Roger Evans, OCEA

FROM: Ralston H. Nagata, State Parks Administrator

SUBJECT: Historic Preservation Concerns: Draft EIS -- Kukuiula Planned Community (A & B Properties, Inc.)
Koloa & Lawai, Koloa, Kauai

HISTORIC SITES SECTION CONCERNS:

This is a follow-up response to our Draft EIS review of September 9, 1988. On October 24, 1988 our Head Archaeologist, Dr. Ross Cordy, conducted a field inspection of this project's area and of the adjacent Kiahuna area with members of the County of Kauai's Planning Department and Historic Sites Commission and with representatives of the Kiahuna Corporation and of A & B. The adjacent Kiahuna development property has indeed preserved areas which include excellent examples of site types from this region. These types include habitation and agricultural features and a heiau. The habitation and agricultural sites so preserved are more intact examples than those found in the Kukuiula project area.

Thus, we can now agree with the proposed historic preservation mitigation plan for the Kukuiula project. This plan calls for the preservation of 2 heiaus, 1 raised canal, a section of the railroad berm, and for the archaeological data recovery of the other remaining significant historic sites.

Again, as we noted in our initial Draft EIS comments, to ensure that this mitigation plan is carried out a condition should be attached to any approved permits or change of zone applications. This condition must call for the preparation and execution of a detailed archaeological data recovery plan and a detailed preservation plan, with these plans to be approved by the County of Kauai's Planning Department and the State's Historic Sites Section and with the successful execution of these plans to be verified by these same offices. These plans need to be devised and executed prior to construction in the area.

If you have any questions, please feel free to call our Historic Sites Section (548-7460). Nancy McMahon is the Staff Archaeologist handling Kauai County.

RALSTON H. NAGATA

CC: Mr. Tom Shigemoto, Planning Dept., County of Kauai
Mr. Bruce Tsuchida, R.M. Towill Coporation
Dr. Hallett Hammett

R. M. TOWILL CORPORATION

420 WAIAKAMILO RD • SUITE 411
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November 7, 1988

Mr. Ralston Nagata
State Parks Administrator
Division of State Parks
Dept. of Land and Natural Resources
State of Hawaii
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Nagata:

SUBJECT: Draft EIS for Kukuiula Planned Community, Koloa, Kauai, Hawaii

Thank you for your comments of September 28, 1988 relating to the proposed Kukuiula Planned Community project. We appreciated your review of this document.

We concur that there are 51 significant sites on the project site. Thirty of these sites are significant only for their information content and 21 for multiple criteria according to the State and National Registers of Historic Places. Fourteen of the multiple criteria sites are excellent examples of site types, however, larger and better examples of these site types are already preserved at Kiahuna.

A field trip of the Kiahuna and Kukuiula sites was conducted on October 24, 1988. Participants included representatives from the Kauai Historic Sites Commission, Kauai County Planning Department, Dr. William Kikuchi, State Historic Sites Section, A&B Properties, Kiahuna Corporation and the consulting archaeologist, Dr. Hallett Hammett. This field inspection confirmed that the sites at Kiahuna are indeed better examples of site types than those found at Kukuiula. Three of the significant sites (two heiaus and a raised auwai) at Kukuiula have been recommended for preservation. A preservation plan will be prepared for these three sites.

The data recovery plan and preservation plan will be prepared and submitted to the State Historic Sites Section and the County of Kauai Planning Department for approval prior to any work performed on the sites.

The Draft EIS will be revised to include this information as stated in your letter.

If you should have any questions or additional comments and suggestions, please direct them to:

Mr. Bruce T. Tsuchida, Project Manager
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941
Phone: 842-1133

Very truly yours,

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JH:W9

U.S. Department of Housing and Urban Development
Honolulu Office, Region IX
300 Ala Moana Blvd., Room 3318, Box 50007
Honolulu, Hawaii 96850-4991

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88-435

September 29, 1988

Mr. Tom Shigemoto
County of Kauai Planning Department
4280 Rice Street
Lihue, HI 96766

Dear Mr. Shigemoto:

SUBJECT: Kukuiula Planned Community
Draft Environmental Impact Statement (EIS)

We have reviewed the Draft EIS for the Kukuiula development in Phases I and II where 1,000 acres of land will be developed with approximately 4,000 single-family and multi-family units; 12 acres of commercial area; a 200 acre golf course; a 500 unit resort hotel; a marina; and other supporting land uses for the planned community.

Our review comments apply only if HUD assisted programs are to be utilized in developing housing units in this development. They include the following:

1. Archaeology/Historic Preservation

   Compliance with Section 106 of the National Historic Preservation Act of 1966, as amended would be required.

2. Floodplains

   Compliance with Executive Order 11988, Floodplain Management would be required if flooding would affect housing units assisted with HUD programs.

HUD supports the affordable housing units. It remains a high priority within the Department after the demonstration program held nationwide in 1982. A number of publications were developed from the program that illustrates the cost-savings techniques in construction, site planning, and modification of local standards.

We are enclosing an information kit on HUD's affordable housing initiative for your information. If the developer is interested in exploring HUD's role in providing affordable housing, he may contact Dorothy Kaneshiro at 541-1349.

If you have any questions on other concerns you may have, please contact Frank Johnson at 541-1326.

Very sincerely yours,

Original Signed By
Calvin Lew

Calvin Lew
Director
Community Planning and
Development Division

Enclosure

cc:
B. Tsuchida

R. M. TOWILL CORPORATION

420 WAIAKAMILO RD • SUITE 411
HONOLULU, HAWAII 96817-4941
(808) 842-1133
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November 7, 1988

Mr. Calvin Lew, Director
Community Planning & Development
Division
U.S. Dept. of Housing & Urban Dev.
Honolulu Office, Region IX
300 Ala Moana Blvd., Room 3318
Box 50007
Honolulu, Hawaii 96850-49911

Dear Mr. Lew:

SUBJECT: Draft EIS for Kukuiula Planned Community, Koloa, Kauai, Hawaii

Thank you for your comments of September 29, 1988 relating to the proposed Kukuiula Planned Community project. We appreciated your review of this document.

If you should have any questions or additional comments and suggestions, please direct them to:

Mr. Bruce T. Tsuchida, Project Manager
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941
Phone: 842-1133

Very truly yours,

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JH:W9

TONY T. KUNIMURA
MAYOR

COUNTY OF KAUAI
DEPARTMENT OF PUBLIC WORKS
4396 RICE STREET
LIHUE, KAUAI, HAWAII 96766

STEVEN M. KYONO
COUNTY ENGINEER
TELEPHONE 245-3318

RUSSELL SUGANO
DEP. COUNTY ENGINEER
TELEPHONE 245-3602

October 6, 1988

OCT 7 1988

Mr. Tom Shigemoto
Planning Director
County of Kauai
Planning Department
Lihue, Hawaii 96766

Dear Mr. Shigemoto:

RE: KUKUIULA PLANNED COMMUNITY DEIS,
KUKUIULA, KAUAI, HAWAII
A & B PROPERTIES

We reviewed the subject draft EIS and offer the following comments:

WASTEWATER TREATMENT AND DISPOSAL:

a) The DEIS mentions that the County's regional plans will be taken into consideration in the design and development of the Wastewater Treatment and Disposal facility for this project. However, while the report discusses the proposed facilities, the inter-relationship and/or transition of the private system into a County facility must be resolved.

For instance, 18 acres are being reserved for expansion of the facility for development of a regional wastewater treatment plant. The large land requirement is because the initial and subsequent treatment process will be aerated lagoons. However, should the County need to acquire the land, a less land intensive process may be desired by the County.

Furthermore, other issues such as sizing of improvements (private vs. County requirements), schedule for direct County involvement in the system (operations and ownership) and use of the facility for sludge disposal pursuant to provisions of State DOH Chapter 62 regulations must be resolved.

b) The County's Severage Facilities Plan for Koloa-Poipu includes ocean outfall as an option (with golf course irrigation) for effluent disposal. For maximum flexibility and to preclude being "locked in", the subject development should provide appropriate easements for a future outfall through it.

SOLID WASTE:

The DEIS states that approximately 38 tons per day of solid waste will be generated. This is approximately 25% of present solid waste generation for the Island. This means that this will be a tremendous impact on the existing and proposed County solid waste facilities and capabilities for the Koloa-Poipu area. Such must be addressed in more detail.

DRAINAGE:

The draft EIS mentions that the development will permanently change the drainage pattern of the land above Lawai Road which will impact the development along the coastal area as well as the coastal zone. The development will increase storm runoff with impervious construction. The development will increase runoff by re-contouring the land and eliminating ponding areas which presently holds storm runoff.

We have no objections to a diversionary channel and detention basin that re-routes a portion of the drainage basin to the Kukuiula Bay, as long as the channels that divert the flowage are designed to County Drainage Standards or a higher criteria. The remaining areas in the drainage basin will be drained to the developments along the coastal area. Our concern is the increased flowage as a result of development and grading which will impact the existing developed areas. We will require drainage improvements to mitigate any adverse drainage condition that is created by the development.

ROADWAY:

The draft EIS mentions that the development will impact County roads such as Poipu, Koloa, and Maluhia Roads. The report mentions that four intersections - (1) Koloa/Poipu Road; (2) Koloa/Maluhia Road; (3) Poipu/New Upper Road; and (4) Poipu/New 4 lane divided highway, where signalization and multiple lanes are required to mitigate traffic impacts. Additionally, the EIS mentions that sections of Poipu Road and Koloa Road will need to be widened to four lanes to accommodate the traffic from the project and County's Development Plan.

The traffic study uses trip generation rates from the Institute of Transportation Engineers. While these rates are acceptable, we are concerned with the rates since we have no mass transit systems and travel is primarily with private vehicles. We also noticed that there are several cars in a household with both spouses working which may provide a higher traffic generation rate.

The traffic study rates intersections at under capacity, near capacity and over capacity. We would presume that intersections operating at near capacity or over capacity are operating at a high level of congestion and traffic delay. As such, while signalization will help traffic conditions, we would expect traffic problems even though signalization and additional lanes are being provided. The traffic problems will become greater with the Phase I and 2 project in year 2000 with most intersections operating at near capacity. While the report mentions a new North-South roadway parallel to Poipu Road as an alternative, we believe it may be necessary to build this roadway to eliminate the traffic congestion on the existing County roadways and intersections.

I hope we have satisfactorily made comments to this DEIS. In the event you should have any questions pertaining to the Wastewater Treatment and Disposal and to the Solid Waste Section, please feel more then free to contact Harry Funamura at 245-4751. If you should have any questions pertaining to the Drainage and the Roadway, contact Ken Kitabayashi at 245-4751 also.

Very truly yours,

STEVEN KYONO, P.E.
for County Engineer

HF/KK/lv

R. M. TOWILL CORPORATION

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November 7, 1988

Mr. Steven Kyono, P.E.
County Engineer
Department of Public Works
County of Kauai
4396 Rice Street
Lihue, Kauai, Hawaii 96766

Dear Mr. Kyono:

SUBJECT: Draft EIS for Kukuiula Planned <u>Community, Koloa, Kauai, Hawaii</u>

Thank you for your comments of October 6, 1988 relating to the proposed Kukuiula Planned Community project. We appreciated your review of this document.

The aerated lagoon type wastewater treatment facility was recommended for the project because of low maintenance costs and low adverse impacts from odor compared to a mechanical plant. A mechanical plant is an alternative and would require only five acres of land. Additionally, an easement will be provided for an ocean outfall if this method proves to be a more effective and efficient means of disposing excess effluent with minimal adverse impacts. The EIS will be revised to include these alternatives.

Should it be mutually determined that the County will operate this wastewater treatment facility as their regional plant, discussions will take place with the County Department of Public Works regarding the County's share in the cost to expand the facilities to meet regional requirements prior to actual design and construction.

The EIS does state that 38 tons of solid waste will be generated from this project. However, the 38 tons will be generated only when the project is fully occupied, approximately 25 years from now (2015). This is a conservative (high) estimate and assumes that all units, including transient, are occupied. This estimate was derived using a factor of 3.25 persons per unit. In actuality, the transient multi-family units are not expected to be fully occupied at any given time. Occupancy will probably begin by 1991, the estimated construction completion date for the first homes. Initially, the project will not generate a significant amount of solid waste. Thereafter, an average annual increase of 1.5 tons of solid waste per day starting year 1991 is expected.

According to the 1983 engineering report on sanitary landfills, the life expectancy of the Kehaha Landfill is beyond the year 2005 because of its expansion capabilities. By full occupancy of the project, year 2015, other facilities may need to be on line.

The drainage system proposed will reduce the amount of flows that currently impact existing development along the coastline. The large drainage swale mauka of the Phase I development will reroute most of the mauka flows into Kukulula Bay. Retention basins will also be incorporated into the large swale (which will ultimately be incorporated into the golf course fairways) to hold storm water runoff and deposit silt. Flows that will impact the existing coastal residents would thus be limited to the area between the swale and existing developments. Flows in this area are proposed to be captured via an underground drainage system that will outlet near the Beachhouse Restaurant through a box culvert.

There has been concern relative to impacts to coastal waters near the proposed outlet at the Beachhouse Restaurant. To mitigate impacts to coastal waters and marine biota, we will be revising the EIS to include on-site ponding as an alternative mitigation measure in lieu of or in combination with the large box culvert at the Beachhouse Restaurant. Retention basins can be incorporated on site to retain excess flows resulting from the project to makai residences. In addition, a drainage master plan will be prepared to ensure that storm water runoff to existing residences will not be increased.

The island-wide traffic study currently being conducted will be completed in 1989. Findings and recommendations from this island-wide study could more clearly define the necessary roadway improvements required for the Koloa-Poipu area.

If you should have any questions or additional comments and suggestions, please direct them to:

Mr. Bruce T. Tsuchida, Project Manager
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941
Phone: 842-1133

Very truly yours,

B. Tsuchida

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JH:W9

RECD OCT 1 1988

JH

(P)1885.8

OCT 7 1988

Mr. Tom Shigemoto
Planning Department
County of Kauai
4280 Rice Street
Lihue, Kauai, Hawaii 96766

Dear Mr. Shigemoto:

Subject: Kukuiula Planned Community
Draft Environmental Impact Statement

We have reviewed the subject document and have no comments to offer.

Very truly yours,

T. Tominaga

TEUANE TOMINAGA
State Public Works Engineer

CI:jk
cc: Mr. Bruce Tsuchida

R. M. TOWILL CORPORATION

420 WAIAKAMILO RD • SUITE 411
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November 7, 1988

Mr. Teuane Tominaga
State Public Works Engineer
Dept. of Accounting & General Services
State of Hawaii
P.O. Box 119
Honolulu, Hawaii 96810

Dear Mr. Tominaga:

SUBJECT: Draft EIS for Kukuiula Planned
Community, Koloa, Kauai, Hawaii

Thank you for your comments of October 7, 1988 relating to the proposed Kukuiula Planned Community project. We appreciated your review of this document.

If you should have any questions or additional comments and suggestions, please direct them to:

Mr. Bruce T. Tsuchida, Project Manager
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941
Phone: 842-1133

Very truly yours,

B. Tsuchida

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JH:W9

KOLOA COMMUNITY ASSOCIATION
KOLOA, KAUAI, HAWAII 96756

October 11, 1988

Mr. Tom Shigemoto
County of Kauai Planning Department
4280 Rice Street
Lihue, Kauai, HI 96766

RE: Environmental Impact Statement

Dear Tom:

Reference is made to the Environmental Impact Statement received recently.

The Koloa Community Association Board of Directors met to discuss the item; however, it was unanimously agreed that the time frame in which to review the entire report was inadequate. Additionally, it was imperative that we report there were items of grave concern to the Board as well as the Community as a whole regarding:

1) The marina
2) Infrastructure
3) Archeological and historical findings
4) Traffic circulation
5) Traffic studies
6) The Western By-Pass

It was also concluded that the community input was necessary and recommend that such a meeting be scheduled.

We thank you for the opportunity to provide our opinion.

Sincerely,
Ronald Harker
PRESIDENT
Ronald Harker

cc: Mr. Bruce Tsuchida
R. M. Towill Corporation

Planning Commission Chairman
S. Costa

County Council Chairman
R. Kouchi

R. M. TOWILL CORPORATION

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November 7, 1988

Mr. Ronald Harker, President
Koloa Community Association
Koloa, Kauai, Hawaii 96756

Dear Mr. Harker:

SUBJECT: Draft EIS for Kukuiula Planned Community, Koloa, Kauai, Hawaii

Thank you for your comments of October 11, 1988 relating to the proposed Kukuiula Planned Community project. We regret that you were unable thoroughly to review the Draft EIS within the 45-day review period. If you would like to have a meeting to discuss the items listed in your letter please contact:

Mr. Bruce T. Tsuchida, Project Manager
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941
Phone: 842-1133

During the General Plan Amendment process, public hearings will be held where you will have the opportunity to comment further on any concerns you may have. Public hearings will also be held during the rezoning process.

Very truly yours,

B. Tsuchida

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JH:W9

METROPOLITAN MORTGAGE & SECURITIES CO., INC.
WEST 929 SPRAGUE AVENUE / P.O. BOX 2162 / SPOKANE, WASHINGTON 99210 / PHONE (509) 838-3111

October 14, 1988

BT 10/12
JH
JC

Mr. Tom Shigemoto
Planning Department
County of Kauai
4280 Rice Street
Lihue, Kauai, HI 96766

Re: Kukuiula Planned Community DEIS
August 1988

Dear Mr. Shigemoto:

We have reviewed the above-referenced document and respectfully submit our observations.

After said review and internal evaluation, it is our opinion that additional details, regarding the Proposed Action's plans and alternatives pursuant to Flooding & Drainage and Wastewater Treatment & Disposal, would be helpful. In particular, the segments of the DEIS which are of interest to this company are:

Flooding & Drainage

Paragraph	Section	Page
8	1.3	1-3
1	1.4.12	1-8
2	2.3.1	2-6
2,3,5	5.1	5-1 & 5-2
All	5.1.A	5-3 & 5-4
4	5.1.B	5-5

Wastewater Treatment & Disposal

Paragraph 2, Section 5.5, Page 5-13

Metropolitan Mortgage & Securities Company is the fee-simple land owner of both the Lawai Beach Resort and the Beach House Restaurant properties. The existing storm-water retention basin is located just east of the Makai-Mauka centerline of the Lawai Beach Resort property. Storm-water is discharged from this basin, through the existing thirty (30) inch culvert under Lawai Road, across the only sandy beach in the immediate area to the ocean just west of the Beach House Restaurant parcel. The wastewater treatment facility is situated on the Mauka-East corner of the Lawai Beach Resort property.

The above-mentioned sections of the DEIS provide very limited and general descriptions regarding potential plans and associated impacts which appear to affect the Lawai Beach Resort

property and its facilities. Due to the omission of adequate data and scenarios pertaining to projected volumes, flows and design alternatives, our consultants were not able to assess possible impacts or mitigation measures as related to cumulative inclusion with our project.

Therefore, we feel that it is appropriate to present, herewith, the inquiries posed by our consultants, which are attached hereto, as Exhibits I & II. Also, to request that the Proposed Action's design configurations, and specifications and calculations for the Flooding & Drainage and Wastewater Treatment & Disposal elements in the area around and including the Lawai Beach Resort and Beach House Restaurant properties be adequately disclosed.

Please do not construe this submittal to be an adverse posture on our part. We simply believe that we deserve to be provided with additional information. As an interested neighbor, we support such a quality development for the Poipu Area and the Island of Kauai, and at the appropriate time will, encourage Kauai County's approval for Phase II of the Kukuiula proposal.

Additionally, our management, staff and consultants are prepared to cooperate and work with Kauai County, and A & B Properties and its consultants toward development of ultimate mitigation measures for the drainage and wastewater elements which would be beneficial to the County, both the Kukuiula & Lawai Beach Resort projects, and the environment.

Thank you for the opportunity to comment on the DEIS.

Sincerely,

Mike Teramoto
Development Consultant

MT/as
cc: Bruce Tsuchida, R. M. Towill Corp.
Bill Campbell, A & B Properties, Inc.
Clarence Tanonaka, Park Engineering
C. Paul Sandifur, Sr.
C. Paul Sandifur, Jr.
Gary Crandall
Bill Arsenault

ParEn, Inc. dba park engineering

Suite 300, Kawaiahao Plaza ☐ 567 South King Street, Honolulu, Hawaii 96813 ☐ Telephone (808) 531-1676

October 11, 1988

Mr. Gary J. Crandall
Metropolitan Mortgage & Securities Co., Inc.
Property Development Group
West 929 Sprague Avenue
Spokane, Washington 99210

Dear Gary,

Subject: Lawai Beach Resort Drainage

1. After reviewing aerial photo contour maps of the vicinity and inspecting the area adjacent to the Lawai Beach Resort, it appears that due to the cane lands, earth reservoirs and natural depressions, the developments in the coastal areas depend primarily upon ponding and infiltration to absorb storm runoff from their respective drainage basins.

2. Utilizing the proposed golf course as a major drainage way with retention basins, to divert the storm waters mauka of the golf course to major drainage channels that flows into the ocean at Kukuiula Bay seems to be the best solution for this region.

3. Drainage in areas makai of the golf course may be discharged into the ocean near the Beach House Restaurant, the natural discharge point for this area.

4. Since the drainage outlet will impact the Lawai Beach Resort, the following questions may be appropriate:

   a. What effect would alteration of earth reservoirs and natural depressions mauka of Lawai Beach Resort have on drainage through the Resort?
   b. Where will the large box culvert, ocean discharge structure be located? What will be its size?
   c. How will drainage be routed through Lawai Beach Resort? Box culverts, open channels, etc.?
   d. Will the ocean discharge structure be designed to handle a 50-year storm? 100-year storm?
   e. What actions are being taken to minimize siltation at the ocean discharge site?
   f. Will the existing retention basin within Lawai Beach Resort be maintained? If so, what modifications will be required?

Sincerely yours,

ParEn, Inc. dba
PARK ENGINEERING

Larry K. Matsuo
Larry K. Matsuo
President

en

EXHIBIT I

ENGINEERS, SURVEYORS, PLANNERS

ParEn, Inc. dba park engineering

Suite 300, Kawaiahao Plaza ☐ 567 South King Street, Honolulu, Hawaii 96813 ☐ Telephone (808) 531-1676

October 6, 1988

Mr. Gary J. Crandall
Metropolitan Mortgage & Securities Co., Inc.
Property Development Group
West 929 Sprague Avenue
Spokane, Washington 99204

Dear Gary,

Subject: Kukuiula Development
Wastewater Treatment

It appears that the existing activated sludge treatment plant at Lawai Beach Resort was designed to operate as an extended aeration process. By modifying the design to operate as a conventional process, the plant can accommodate the Kukuiula development. Depending on it's wastewater flow, some of the facilities may have to be expanded and upgraded.

Provisions of Chapter 38, State Department of Health Public Health Regulations governs the designs of private wastewater treatment works. For activated sludge process, the regulations requirements are set forth in the Recommended Standards for Sewage Works, Great Lakes - Upper Mississippi River Board of State Sanitary Engineers.

To utilize the existing plant, the following questions arises:

1. What will the design capacity of the plant be upgraded to?

2. Will the wastewater flow by gravity or pumped to the treatment plant?

3. Will the piping system, etc. be able to handle the peak design flow?

4. With different sized aeration tanks, how will the flows be proportionally distributed among them?

5. If an additional settling tank is required, how will the flows be proportionally distributed from the aeration tanks?

6. Are the digester and chlorine contact tanks capacities adequate? If not, how will these problems be handled?

EXHIBIT II
PAGE 1 OF 2

ENGINEERS SURVEYORS PLANNERS

Mr. Gary J. Crandall
KIKUIULA DEVELOPMENT
WASTEWATER TREATMENT
September 30, 1988
Page 2 of 2

7. Is the aeration system adequate? If not, how will this problem be handled?

8. Is the proposed wastewater treatment plant site shown on Figure 5-5 to be the regional plant? If so, when is this plant scheduled to be completed?

9. When the regional plant is completed, how will the wastewater from the Metropolitan Mortgage & Security plant site and the areas below the proposed Kukuiula development be integrated into the system?

Sincerely yours,

ParEn, Inc.
dba PARK ENGINEERING

fr Clarence K. Tanonaka
Executive Vice President

mav

EXHIBIT II
PAGE 2 OF 2

R. M. TOWILL CORPORATION

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Engineering • Planning • Photogrammetry • Surveying • Construction Management • Energy Systems

November 7, 1988

Mr. Mike Teramoto
Development Consultant
Metropolitan Mortgage &
Securities, Co, Inc.
West 929 Sprague Avenue
P.O. Box 2162
Spokane, Washington 99210

Dear Mr. Teramoto:

SUBJECT: Draft EIS for Kukuiula Planned Community, Koloa, Kauai, Hawaii

Thank you for your comments of October 14, 1988 relating to the proposed Kukuiula Planned Community project. We appreciated your review of this document.

The drainage system proposed will reduce the amount of flows that currently impact Lawai Beach Resort and others makai of the proposed development due to major storms such as the 50-year and 100-year storms. The large drainage swale mauka of the Phase I project will reroute most of the mauka flows into Kukuiula Bay. This swale will also serve as a series of retention basins during a major storm and as a siltation basin to minimize adverse impacts to coastal waters. Flows that will impact the existing coastal residences would thus be limited to the area between the swale and existing developments. Flows in this area are proposed to be captured via an underground drainage system that will outlet near the Beachhouse Restaurant through a large box culvert.

There has been concern regarding impacts to coastal waters near the proposed outlet at the Beachhouse Restaurant. To mitigate adverse impacts to coastal waters and marine biota, we will be revising the EIS to include on-site ponding as an alternative mitigation measure in lieu of or in combination with the box culvert at the Beachhouse Restaurant. Retention basins can be incorporated on site to retain excess flows resulting from the project. In addition, a drainage master plan will be prepared to ensure that storm water impact on existing residences will not be increased. The drainage master plan does take into account a 100-year storm. Thereafter, actual design configurations, calculations and specifications will be developed for approval by the County agencies.

The use of Lawai Beach Resort wastewater treatment plant in the initial phase of the project was considered in the event the project's wastewater treatment facility was not fully operational. Lawai Beach Resort's plant is strategically located in a central and low portion of the project site. This plant could eventually be converted into a major booster pump station to pump the flows up to the project's treatment plant and conveniently handle the flows from Lawai Beach Resort as well.

Upgrades to Lawai Beach Resort's existing plant would not be significant. There are many options to be explored to upgrade the existing Metropolitan Mortgage Plant. The first option would be the conversion at the existing plant's operation from extended aeration to standard activated sludge. No additional treatment tanks would be required although new or additional pumps and blowers may be required. Other options to upgrade the existing plant will be explored with Metropolitan Mortgage to provide minimal disturbance to existing operations and to assure proper integration with the future plans of Metropolitan Mortgage.

If you should have any questions or additional comments and suggestions, please direct them to:

Mr. Bruce T. Tsuchida, Project Manager
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817
Phone: 842-1133

Very truly yours,

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JH:W99

TONY T. KUNIMURA
MAYOR

COUNTY OF KAUAI
PLANNING DEPARTMENT
4280 RICE STREET
LIHUE, KAUAI, HAWAII 96766

TOM H. SHIGEMOTO
Planning Director

ROLAND D. SAGUM, III
Deputy Planning Director

Telephone (808)245-3919

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RYK		WD	
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GSY		YJK	

JH

October 18, 1988

Mr. Bruce Tsuchida
R. M. Towill Corporation
420 Waikamilo Road, Suite 411
Honolulu, Hawaii 96817

Subject: Kukuiula Planned Community
Draft Environmental Impact Statement (DEIS)

Thank you for meeting with my staff on October 17, 1988. As discussed at that time, we will trust you to correct the minor errors which we noted throughout the DEIS. You have been sent all agency comments received to date by transmittal dated October 11, 1988. We will thus limit our comments to those areas of the DEIS which we feel need clarification, further discussion or revision.

1. <u>Drainage</u> - We are concerned with the impacts of the outlet structure proposal by the Beach House Restaurant. This is the site of a sandy beach and extensive reef area immediately offshore. The area is popular for running, swimming, snorkeling, diving, and surfing. Although the waters are Class A, they are of good clarity and abut Class AA waters. The existing culvert does not work and inland waters presently pond on the Lawai Beach Resort property and eventually filter down and out to the ocean. The proposed culvert would detrimentally affect recreational activities in that area, and the fresh water and silt could impact the offshore ecology. The <u>Marine Study</u> does not cover the existing environment for this area, nor impacts of the additional fresh water and sedimentation on such environment, impacts on the recreational resources of this shore area, nor discuss mitigative measures for such impacts. Alternatives to routing drainage through this

culvert should be discussed. We would strongly recommend using retention basins and incorporating lakes and ponds into the project to handle drainage so that it is filtered rather than channeled to the ocean. Alternatives to reduce the amount of drainage reaching shore waters, and elimination of the culvert, if at all possible, should be explored.

It is also mentioned that the project will result in an "increased amount of suspended solids entering coastal waters." Ponding areas presently holding storm runoff waters should <u>not</u> be eliminated. These waters should be retained on the site, or shifted/redirected to new ponding areas if they must be eliminated from their present location. Plans for mosquito breeding control should also be discussed as they relate to drainage control basins, etc.

2. <u>Archaeology</u> - The mitigative measures proposed are unacceptable to both the DLNR and OHA. This section should be discussed with these agencies and revised to address their concerns.

3. <u>Recreation Facilities</u> - We strongly disagree with the conclusion that the project will not adversely impact recreational resources of the area. A project of this scale will definitely impact such resources. This section should be expanded to address impacts (such as the proposed culvert at the Beach House), crowding of beaches, etc., along with mitigative measures proposed by A & B (such as bike paths, walkways, beach access parking, dedication of additional park lands rather than payment of park dedication fees, marina construction, golf course, etc.)

4. <u>Water Quality</u> - How long will it take to flush and stabilize the excavated marina and channel sediments? Will the duration be longer than periods of heavy sediment outfall caused by storms? If so, what mitigative measures are proposed? Is there anything that can be done to speed up the flushing process?

5. <u>Potable Water</u> - Please contact the State Health Department concerning new stringent EPA standards on line for drinking water. They would encourage the use of tanks versus reservoirs for storage of drinking water.

6. <u>Solid Wastes</u> - Please refer to and discuss Public Works Department's comments.

7. Circulation - The mitigative measures discussed in the Traffic Report may not be possible or may be inadequate, in part, because of lack of adequate right-of-way widths, narrow bridge crossing, and parking and portions of structures within the right-of-ways. Please see Public Works Department's comments. Further discussion of a possible future western by-pass road should be incorporated into the EIS as an additional possible mitigative measure.

8. Noise - Has the possibility of constructing a berm to mitigate noise from cane haul operations been explored? Disclosure of haul cane road noise (and dust) should be incorporated into the deeds of affected lots. Hours of operation as proposed in the noise study should be followed.

9. Dust Control - It is the County's experience that "watering twice daily" will not be sufficient to reduce fugitive dust. Additional mitigative measures should be offered, such as more frequent watering, cleaning of severely affected neighboring residences, etc.

10. Schools - The fact that the County Development Plans identify future school sites DOES NOT "imply" that the State has plans for such facilities. The Department of Education should be contacted to verify such.

    It is also noted that the existing schools which will be impacted by this project are at capacity now. As such, need for expansion of these facilities is urgent. Would A & B consider incorporating the land needed for this expansion, along with the abutting land proposed to satisfy part of the Phase I housing condition, in the Phase II proposal? This would tremendously expedite these sorely needed facilities.

11. Agricultural Study - More clarification is needed to understand the thought process of the writer. For example, if the statement that A & B will need two (2) more years to fully assess the potential for diversification and come up with a plan for such, how can it be concluded now that these "prime" Phase II lands are not viable for diversified agriculture? How many acres can be sacrificed to urban related uses before McBryde is forced to close?

12. Landscaping - The DEIS needs to discuss landscaping within the 100' buffer strip between Lawai Road and Phase I.

13. Soils - A few soil types have been omitted from the DEIS, specifically Hanamaulu silty clay, 3 to 8 percent slopes (HsB), Rough Broken Land (rRR), Makaweli Silty Clay Loam, 0 to 12 percent slopes (MgB & MgC), and Nonopahu Clay, 2 to 10 percent slopes (NnC). These soil types should be included and discussed in the DEIS.

14. General Plan - It was mentioned that A & B would be coming in shortly for a general plan amendment for Phase II, yet the proposed designations are not indicated. As discussed at the October 17, 1988 meeting with my staff, the DEIS should indicate such, and will need to incorporate a Resort designation to accommodate a "hotel" as defined by our zoning ordinance. The marina and multi-family units geared primarily for transient vacation rentals should also fall within an area general planned for Resort.

15. Figures

    Figure 2-3 Landscaping - Please define the proposed right-of-way lines. The bike way and sidewalk should fall within such right-of-way.

    Figure 5-2 Drainage - Please provide a key and more detail as to location of retention basins, etc. if such can be located at this time.

    Figure 5-5 Solid Wastes - The Health Department confirms that both the Poipu Beach and Sheraton Hotel connect to Moana's (Kiahuna's) STP. Poipu Village Resort should be labeled Whaler's Cove. Waikomo Villas has been renamed Lawai Beach Resort, but there are two separate STP plants as you correctly indicate.

    As well, Proposed Zoning and Proposed General Plan Figures should be incorporated into the EIS presentation.

16. Wastewater Treatment - A backup generator should be incorporated into design of the STP as a mitigative measure for power outages. Mitigative measures for mosquito control (carp) for associated ponds should also be mentioned. Public Works Department comments should also be addressed.

Should you have any questions or require further clarification, please contact either Michael Laureta or Heather Harvey of my staff at 245-3919.

TOM H. SHIGEMOTO
Planning Director

R. M. TOWILL CORPORATION

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November 7, 1988

Mr. Tom Shigemoto
Planning Director
Dept. of Public Works
County of Kauai
4280 Rice Street
Lihue, Kauai, Hawaii 96766

Dear Mr. Shigemoto:

SUBJECT: Draft EIS for Kukuiula Planned Community, Koloa, Kauai, Hawaii

Thank you for your comments of October 18, 1988 relating to the proposed Kukuiula Planned Community project. We appreciated your review of this document.

1. Drainage - Your suggestion regarding ponding of the storm water runoff is well taken. We will revise the EIS to include on-site ponding as an alternative mitigation measure in lieu of or in combination with the outlet at the Beachhouse Restaurant. Retention basins can be incorporated on site to retain excess flows from the project. Suspended solids entering the ocean at the outlet at Kukuiula Bay will be minimized by retention basins within the large drainage swale above Phase I of the project. A small swale will be incorporated into this larger swale to handle daily flows. In the event of a major storm, the 50-year or 100-year storm, this large swale (which will ultimately be incorporated into the golf course fairways) will act as a series of retention basins to hold storm water runoff as well as deposit silt. The resort area will also incorporate retention basins to further reduce the amount of silt before the final entry into the ocean. We will further clarify this in the EIS.

   Retention basins are not expected to be filled throughout the year. However, to prevent mosquito breeding, a small swale system will be incorporated, to keep the daily flows moving at all times.

2. Archaeology - A data recovery plan will be prepared for the 51 significant sites on the project site. Thirty of these sites are significant only for their information content and 21 for multiple criteria according to the State and National Registers of Historic Places. Fourteen of the multiple criteria sites are excellent examples of site types, however, larger and better examples of these site types are already preserved at Kiahuna.

A field trip of the Kiahuna and Kukuiula sites was conducted on October 24, 1988. Participants included representatives from the Kauai Historic Sites Commission, Kauai County Planning Department, Dr. William Kikuchi, State Historic Sites Section, A&B Properties, Kiahuna Corporation, and the consulting archaeologist, Dr. Hallett Hammett. This field inspection confirmed that the sites at Kiahuna are indeed better examples of site types than those found at Kukuiula. Three of the significant sites (two heiaus and a raised auwai) at Kukuiula have been recommended for preservation. A preservation plan will be prepared for these three sites.

The data recovery plan and preservation plan will be prepared and submitted to the State Historic Sites Section and the County of Kauai Planning Department for approval prior to any work performed on the site. The Draft EIS will be revised to include this information.

3. Recreational Facilities - We agree that the proposed project will increase the use of existing recreational facilities during the project's 25-year time frame. However, the project will also add new recreational facilities that will enhance the area. In addition to the 18-hole golf course, the marina, pedestrian/bike paths and open space, land will be made available to meet the park dedication requirements. We will revise the EIS and expand on the recreational impact and mitigation sections.

4. Water Quality - Sediment load from construction of the marina is not expected to be significant except when the dike has been opened to the sea. The excavation of the marina will generally occur on land. The walls of the marina will either be cut slopes or bulkheads. If a slope wall is designed the slopes may be protected by some form of riprap armor underlain with a filter to minimize the loss of fine grain soils. The soils are expected to contain hard basalt which will be desirable in terms of reduced siltation, however, may require blasting, depending on the extent of the basalt layer. An erosion control plan will be provided in the design documents prior to actual construction of these facilities. These documents will be submitted for approval by the appropriate agencies prior to construction.

5. Potable Water - The proposed water storage facilities are not intended to be open reservoirs. Two 1.5 mg water storage tanks are proposed, we will however change the word "reservoir" to "storage tanks" or "water tanks" for clarity.

6. Solid Waste - The EIS states that 38 tons of solid waste will be generated from this project. However, the 38 tons will be generated only when the project is fully occupied, 25 years from now (2015). This is a conservative (high) estimate and assumes that all units, including transient rental units, are occupied. This estimate was derived using a factor of 3.25 persons per unit. In actuality, the transient multi-family units are not expected to be fully occupied. Occupancy will probably begin in 1991, the estimated construction completion date for the first homes. Initially, the project will not generate a significant volume of solid waste. Thereafter an average annual increase of 1.5 tons of solid waste per day starting year 1991 is expected.

According to the 1983 engineering report on sanitary landfills, the life expectancy of the Kehaha Landfill is beyond the year 2005 because of its expansion capabilities. By full occupancy of the project, year 2015, other facilities need to be on line.

7. Circulation - The island-wide traffic study currently being conducted will be completed in 1989. The EIS does state that the project's north/south road may eventually be extended to meet with Koloa Road in the north. Findings and recommendations from the island-wide study could more clearly define the necessary roadway improvements required for the Koloa-Poipu area.

8. Noise - The concept of constructing a berm to mitigate noise from the cane haul trucks will be included as an alternative in the EIS. A disclosure statement in the deed will also be included to inform prospective buyers of the noise and air pollution caused by the cane haul trucks and cane burning.

9. Dust Control - The EIS does not state as part of mitigation during construction that watering twice daily is sufficient. The EIS states that watering twice daily will reduce the amount of fugitive dust by 50 percent according to EPA estimates. Frequent watering is proposed during construction. Dust control measures will be implemented according to Department of Health Regulations.

10. Schools - To assist the Department of Education in expediting expansion of the Koloa Elementary School, the project area will be increased to include the land proposed for the school expansion. A meeting will be scheduled with the State Department of Education in the near future regarding land requirements. The EIS will include the area for expansion of Koloa Elementary School and expansion of the Paanao Low Income Housing site.

11. Agricultural Study - The reduction of 600 acres of McBryde's agricultural lands will not endanger the company's economic viability. McBryde has approximately 13,000 acres of sugarcane land and an additional 500 acres of macadamia nut orchards which were planted on non-cane lands. It is not to say that the 300 acres of "prime" agricultural lands are not viable for diversified agriculture. There are approximately 25,000 acres of agricultural lands on Kauai that are not actively being used for agriculture. The "prime" agricultural lands will not be eliminated from agricultural use immediately. Agricultural lands will be converted to urban on a phased basis.

    The proposed project is contiguous to urban and resort development in the Koloa District. This area also has a relatively high demand for housing. The Kauai Housing Agency estimated that approximately 1,200 units will be needed by 1990, in a report dated October 1987, "Assessment Report for Kauai's Housing Needs." By the year 2005 an additional 1,900+ units will be needed for the Koloa District. Conversion of agricultural lands to urban uses will help to meet the needs of this growing community. In addition to the variety of housing products proposed, recreational facilities, open space and commercial uses are proposed to complement the overall development.

12. Landscaping - A 100-foot wide setback has been established along Lawai Road from the west of Metropolitan Mortgage Company's development to the proposed marina/resort development. This area may be developed to include beach parking, pedestrian/bike paths and landscaping. Parking facilities will be provided for the development at Kukuiula Bay. These development options for the 100-foot setback along Lawai Road will be addressed in the EIS.

13. Soils - The soil types that were not discussed in the Draft EIS will be discussed in the Final EIS.

14. General Plan - The proposed General Plan designations for the site will be submitted as part of the General Plan Amendment package. This map will indicate the "Resort" and "Urban Residential" designations.

15. Figures - The three figures mentioned in your letter will be revised as requested. The proposed zoning map, however, will not be included as part of this EIS. Until such time that approval is received on the General Plan Amendment and State Land Use, the proposed zoning designations will not be mapped. Conditions which may be placed on the project may greatly influence the various uses proposed.

16. Wastewater Treatment - A backup generator for the wastewater treatment facility is generally incorporated into the design of this facility. The EIS will be revised to include this as a mitigative measure in the event of a power failure.

The aerated lagoon type wastewater treatment facility was recommended for the project because of low maintenance costs and low adverse impacts from odor as compared to a mechanical plant. A mechanical plant is an alternative and would require only five acres of land. Additionally, an easement will be provided for an ocean outfall if this method proves to be a more effective and efficient means of disposing excess effluent with minimal adverse impacts. The EIS will be revised to include these alternatives.

Should it be mutually determined that the County will operate the wastewater treatment facility as their regional plant, discussions will take place with Department of Public Works regarding the County's share in the cost to expand the facilities to meet regional requirements prior to actual design and construction.

If you should have any questions or additional comments and suggestions, please direct them to:

Mr. Bruce T. Tsuchida, Project Manager
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817
Phone: 842-1133

Very truly yours,

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JH:W99

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, HONOLULU
BUILDING 230
FT. SHAFTER, HAWAII 96858-5440

REPLY TO ATTENTION OF:

October 19, 1988

Planning Branch

JH

Mr. Tom Shigemoto
County of Kauai Planning Department
4280 Rice Street
Lihue, Kauai 96766

Dear Mr. Shigemoto:

Thank you for the opportunity to review the Draft Environmental Impact Statement (DEIS) for the proposed Kukuiula Planned Community, Kukuiula, Kauai, Hawaii. Our previous review comments on the Preparation Notice (letter dated April 28, 1988) have been incorporated into the DEIS. We have no additional comments.

Sincerely,

Kisuk Cheung
Chief, Engineering Division

Copy furnished:

Mr. Bruce Tsuchida
R.M. Towill Corporation
420 Waikamilo Road, Suite 411
Honolulu, Hawaii 96817

R. M. TOWILL CORPORATION

420 WAIAKAMILO RD • SUITE 411
HONOLULU, HAWAII 96817-4941
(808) 842-1133
FAX (808) 842-1937

Engineering • Planning • Photogrammetry • Surveying • Construction Management • Energy Systems

November 7, 1988

Mr. Kisuk Cheung, Chief
Engineering Division
Corps of Engineers
U.S. Army Engineer District, Honolulu
Building 230
Fort Shafter, Hawaii 96858-5440

Dear Mr. Cheung

SUBJECT: Draft EIS for Kukuiula Planned Community, Koloa, Kauai, Hawaii

Thank you for your comments of October 19, 1988 relating to the proposed Kukuiula Planned Community project. We appreciated your review of this document.

If you should have any questions or additional comments and suggestions, please direct them to:

Mr. Bruce T. Tsuchida, Project Manager
R. M. Towill Corporation
420 Walakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941
Phone: 842-1133

Very truly yours,

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JH:W9

CITIZENS UTILITIES COMPANY

P.O. BOX 278 · ELEELE, KAUAI, HAWAII 96705

October 20, 1988

In reply refer to:
File #H-79E

Mr. Tom Shigemoto
County of Kauai
Planning Department
4280 Rice Street
Lihue, HI 96766

SUBJECT: KUKUIULA PLANNED COMMUNITY DEIS

Dear Mr. Shigemoto:

We have reviewed the EIS and have no comments.

Thank you for the opportunity to review the document.

Very truly yours,

ALTON H. MIYAMOTO
Manager, Engineering

AHM:dk

cc: Mr. Bruce Tsuchida
R. M. Towill Corporation

KAUAI ELECTRIC

A DIVISION OF CITIZENS UTILITIES COMPANY

ELECTRIC, TELEPHONE, WATER AND GAS SERVICE TO CUSTOMERS IN OVER 500 COMMUNITIES IN MANY STATES ACROSS THE NATION

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HONOLULU, HAWAII 96817-4941
(808) 842-1133
FAX (808) 842-1937

Engineering • Planning • Photogrammetry • Surveying • Construction Management • Energy Systems

November 7, 1988

Mr. Alton H. Miyamoto
Manager, Engineering
Kauai Electric
P.O. Box 278
Eleele, Kauai, Hawaii 96705

Dear Mr. Miyamoto:

SUBJECT: Draft EIS for Kukuiula Planned Community, Koloa, Kauai, Hawaii

Thank you for your comments of October 20, 1988 relating to the proposed Kukuiula Planned Community project. We appreciated your review of this document.

If you should have any questions or additional comments and suggestions, please direct them to:

Mr. Bruce T. Tsuchida, Project Manager
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941
Phone: 842-1133

Very truly yours,

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JH:W9

JOHN WAIHEE
GOVERNOR

BMT		WES	
DK		BTT	BT
RYK		WD	
REC'D	7 1988	RMTC	
GSY		YK	

JH

YUKIO KITAGAWA
CHAIRPERSON, BOARD OF AGRICULTURE

SUZANNE D. PETERSON
DEPUTY TO THE CHAIRPERSON

State of Hawaii
DEPARTMENT OF AGRICULTURE
1428 So. King Street
Honolulu, Hawaii 96814-2512

Mailing Address:
P. O. Box 22159
Honolulu, Hawaii 96822-0159

October 21, 1988

COPY

MEMORANDUM

To: Mr. Tom Shigemoto, Director
Planning Department
County of Kauai

Subject: Kukuiula Planned Community
Draft Environmental Impact Statement (DEIS)
TMK: 2-6-03: por. 1, 4, 23, por. 31, por. 32
2-6-04: 10, 11, 16, 18, 38, 39, 40, 44, 45
Alexander and Baldwin Properties, Inc.
Koloa, Kauai
Area: approximately 1,019 acres

The Department of Agriculture has reviewed the subject DEIS and has the following comments to offer.

The DEIS does a generally excellent job of addressing the impacts of the proposed project and the issues raised in our comments of May 4, 1988, on the EIS Preparation Notice. There are, however, a few remaining concerns which we wish to express.

The Agricultural Assessment (Appendix E) states on page 4 that there is "very little apparent demand for agricultural land at present". However, members of the Kauai Farm Bureau have expressed strong interest to us at several public meetings regarding their need for additional land for diversified farming. We note that the Kauai Farm Bureau was not a consulted party to this EIS process (page 9-2). Their views may be important to a full assessment of the project impacts.

The Agricultural Assessment also states on page 6 that there are "significant acreages of prime agricultural land available in Hawaii which are not being intensively utilized at present". Page 3-27 of the DEIS indicates that there are 25,000 such acres on Kauai. These statements should be supported by

more specific evidence of the location and availability of the land, at reasonable terms and conditions, for diversified farming.

The Agricultural Assessment indicates (pages 7 and 8) that the sugarcane lands of the project site are irrigated and are relatively more sunny than comparable lands to the east. As such, the cultivated portions of the site yield higher than average sugar yields (12.59 tons) than the average for the McBryde Plantation as a whole (9.56 tons). It is therefore reasonable to assume that these portions of the project site would also be a better than average location for Alexander and Baldwin's committed program of evaluation and experimentation with alternative crops at the McBryde Plantation. This alternative appears not to have been considered in section 1.7 on page 1-12.

Comparison of Figures 3-7 (LSB map) and 3-8 (ALISH map) with Figure 2-1 (Proposed Development Plan) indicates that the prime agricultural lands of the site are largely targeted for the golf course portion of the project. We question whether such use of prime lands meets the test of "overriding public interest," and therefore whether the use would be consistent with priority guideline 226-104(b)(2) of the Hawaii State Plan.

Thank you for the opportunity to comment.

Yukio Kitagawa

YUKIO KITAGAWA
Chairperson, Board of Agriculture

cc: Mr. Bruce Tsuchida, R. M. Towill Corp.
Mr. James Nishida, Kauai Farm Bureau
OSP (attn: LUD)
LUC
OEQC

R. M. TOWILL CORPORATION

420 WAIAKAMILO RD • SUITE 411
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Engineering • Planning • Photogrammetry • Surveying • Construction Management • Energy Systems

November 7, 1988

Mr. Yukio Kitagawa, Chairperson
Board of Agriculture
Dept. of Agriculture
State of Hawaii
1428 South King Street
Honolulu, Hawaii 96814-2512

Dear Mr. Kitagawa:

SUBJECT: Draft EIS for Kukuiula Planned Community, Koloa, Kauai, Hawaii

Thank you for your comments of October 21, 1988 relating to the proposed Kukuiula Planned Community project. We appreciated your review of this document.

The EIS states that approximately 25,000 acres of Class A, B and C agricultural lands under the Land Study Bureau system are not actively being used for agriculture. These figures were obtained from the 1987 report by HSPA, entitled "Hawaiian Sugar Manual." A significant amount of time would be required to map all of the Class A, B and C LSB lands, and the lands which are actively being utilized, to determine the locations of available agricultural land for the entire Island of Kauai.

The west side of the project, proposed for residential development and the second nine holes of the golf course, is situated on land being cultivated by McBryde Sugar Company. These fields are located approximately midway (east to west) of all sugarcane fields that McBryde utilizes. The agricultural report in the EIS states that higher yields are expected in a westerly direction. Thus, the fields for which development is proposed lie in a suitable location for sugarcane cultivation, however, higher yields are better farther west of the project site.

The reduction of 600 acres of McBryde's agricultural lands will not endanger the company's economic viability. McBryde has approximately 13,000 acres of sugarcane land and an additional 500 acres of macadamia nut orchards which were planted on non-cane lands. This is not to say that the 300 acres of "prime" agricultural lands are not viable for diversified agriculture. These "prime" agricultural lands will not be eliminated from agricultural use immediately. Reduction of this acreage will be on a phased basis. The acreage in question will be developed during the latter phases of the project because of McBryde's diversified agricultural pursuits.

The proposed project is contiguous to urban and resort development in the Koloa District. This area also has a relatively high demand for new housing. The Kauai Housing Agency estimated that approximately 1,200 units will be needed by 1990, in a report dated October 1987, "Assessment Report for Kauai's Housing Needs." By the year 2005 an additional 1,900+ units will be needed for the Koloa District. Conversion of agricultural land to urban use will help to meet the needs of this growing community. In addition to the variety of housing products, recreational facilities, open space and commercial uses are proposed to complement the overall development.

If you should have any questions or additional comments and suggestions, please direct them to:

Mr. Bruce T. Tsuchida, Project Manager
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941
Phone: 842-1133

Very truly yours,

B. Tsuchida

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JH:W9

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
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LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

OCT 21 1988

DOC. NO.: 4461E
FILE NO.: 89-132

The Honorable Tom Shigemoto, Director
County of Kauai
Department of Planning
4280 Rice Street
Lihue, Kauai 96766

SUBJECT: Kukuiula Planned Community DEIS
Koloa, Kauai, Hawaii

Dear Mr. Shigemoto:

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

Our Department's Historic Sites Section points out that the historic preservation concerns are not adequately addressed in the text of this Draft EIS under the section on Historic Sites (pp. 3-24 to -26). This text needs to be revised.

The Existing Conditions section is partly correct. In a July 30, 1988 letter to the consulting archaeologist, Dr. H. Hammatt, we reviewed the archaeological survey. We agreed that the survey adequately covered the project area, finding all historic sites--totalling 58 sites. This information is in the Draft EIS. However, the Draft EIS fails to indicate which of these sites are significant according to the criteria of the Hawaii and National Registers of Historic Places. These significance assessments must be included in this document since the critical item in an EIS is to clearly identify the significant sites which will be affected. Significance was determined in consultations between the consulting archaeologist and our Historic Sites Section office, and we agreed upon the assessments in our July 30, 1988 letter. Table 1 of Appendix E (the consulting archaeologist's report) in this Draft EIS presents these assessments. Evidence exists that 51 of the sites are still significant, 30 only for their information content and 21 for multiple criteria. In the multiple criteria cases, 14 sites are in part significant as excellent examples of site types. This information, again, needs to be included in the EIS text; otherwise, the reader does not know how many significant sites are present or why they are significant.

The Impact section of the report is not acceptable. We agree that the 51 significant historic sites will be affected by the development. However, the EIS does not indicate the nature of the effect. We believe that the effect will be an "adverse effect" unless an acceptable mitigation plan is developed to handle the significant historic sites.

The Mitigation Measures section of the Draft EIS is also not acceptable. In our review of the proposed mitigation plan by the consulting archaeologist, we did not approve the plan for several reasons. The most critical was that the consulting archaeologist indicated that better examples of a number of the site types had already been preserved in the adjacent Kiahuna development. Therefore, he recommended that only 3 sites be preserved (2 heiau and 1 raised canal) and recommended that all other significant historic sites undergo archaeological data recovery. We had emphasized in our review of this project that before we could accept this plan we needed to confirm that the sites are still preserved in Kiahuna, and indeed contain all the site types in the Kukuiula area. It had been agreed, we thought, that a field check would occur with the consulting archaeologist, our staff and members of the Kauai Historic Sites Commission. Until this field check occurs, and it is verified that all site types are preserved in Kiahuna, we will not approve the mitigation plan. If some site types are not preserved in Kiahuna, it is our belief that they will need preservation within the Kukuiula project otherwise the public could well permanently lose examples of these types in the Koloa region.

We would also like to emphasize that in our opinion "coordination" of mitigation phases with our Historic Sites Section office and the County is not an acceptable procedure. It must be clear that as conditions to approved county and state permits, a detailed preservation plan and an archaeological data recovery plan will need to be approved by the State's Historic Sites Section and the County Planning Department and the execution of these plans be verified by the same offices. Otherwise, there is no way of being sure that the work is properly planned and properly executed. This conditon is vital for the public's benefit and for the benefit of the applicant.

Our Department's Recreation Section indicates that there are no state park recreation concerns. We note the DLNR Preparation Notice comment included public recreation impact on Kukuiula Bay. We do not, however, feel the impact of the proposed marina on existing recreation uses of the harbor area have been adequately addressed.

Our Division of Aquatic Resources suggests that the document could be improved by presenting more data on:

1) the diversity and abundance of organisms within the bay that could be directly impacted by the proposed construction and use of these facilities, and the organisms immediately adjacent to the bay that will also likely be impacted, particularly during the construction phase;

2) nearshore water quality and ocean current patterns, silt load, heavy metal, pesticide and petrochemical levels, salinity concentrations, nutrient levels (eg. N,P,K, etc.) in order to detect eutrophication (for mitigation), and determination of "zones of mixing";

3) the socioeconomic conditions of recreational and commercial fishers that use the existing facilities in regards to the proposed project that will likely:

   a. increase the total number of fishers that compete for the fishery resources, and

   b. increase traffic congestion and therefore increase fishing costs; and

4) the use of the bay and adjacent areas as feeding and resting habitats for threatened green sea turtles, Chelonia mydas, which are relatively abundant along this shoreline and are documented to nest at nearby Lawai Bay.

The Division of Aquatic Resources offers the following specific comments:

Pg 1-5 (1.4.3), the Erosion Control Plan cited (designed to protect receiving waters from silt laden storm runoff water) should have been included in this document since the water quality of the receiving waters will directly affect the quality of the living aquatic resources that live there. A detailed "stormwater runoff budget" is also desirable to compare the existing and proposed (post-development) conditions.

Pg 1-6&7 (1.4.7) states that the marine biological survey (done on one day) found no rare or endangered species in the bay (ie. Kukuiula Bay). Threatened green sea turtles are very common along this shoreline and are documented to nest at nearby Lawai Bay. Therefore, because sea turtles were not seen the day of the survey should not be interpreted that sea turtles are not found in, or consistently use, the bay as feeding or resting habitat (see general comments 4, above).

Pg 2-4 (2.2.3), an increase of 100-150 boat slips for vessels ranging in size from 25-60 feet in length may cause a significant influx and increase in the total number of recreational, commercial, and charter fishing vessels on Kauai, resulting in an increase in fishing effort and increased competition between fishers for the fishery resources (see general comment 3. above). Also, the last 2 paragraphs imply that boat dock facilities may be constructed in the future. Added facilities could mean an increase of pollutants (eg. anti-fouling paints, resins, petrochemicals, etc.) into the bay.

Pg 2-6 (2.3.1), proposed drainage system with swale will route significant amounts of silt, fertilizers, and pesticides into the bay, particulary during construction phases. Major siltation during construction phases could result in long-term negative impacts on the biota, particularly to benthic corals downcurrent (west) of the bay (see first general comment above).

Pg 2-8 (2.3.4), project will result in an increase in solid wastes of approx. 38 tons/day to be disposed of at the Kekaha landfill. There is no discussion on whether or not harmful pollutants could be leaching out of this coastal (sand substrate) landfill which could have a negative impact on adjacent living aquatic resources.

Pg 2-9 (2.3.5), the proposed emergency effluent disposal system (ie. injection wells) may cause eutrophication of nearshore, oligotrophic, waters to impact aquatic resources. To the extent possible, eutrophication should be minimized.

Pg 3-20 (3.8), regarding the chronic silt input into the bay from the existing (2) storm water discharge channels, one appropriate mitigation effort may be for the developer to eliminate these discharges via siltation basins.

The statement that the low salinity of the bay is characteristic of nearshore marine waters that are subject to stormwater discharges...should also include the phrase and surgarcane irrigation effluent, since this is also a source of siltation in this bay.

A 31.2 ppt salinity reading was taken on the outside of the breakwater indicating freshwater is discharged even along the wave exposed coastline. This indicates that the incorporation of dispersion wells for wastewater disposal could result in increased eutrophication of the nearshore marine ecosystem if not properly located.

Pg 3-21 (1st para.) should also state that the lack of silt observed on living corals may be due to no large discharges of silt occurring the day the survey was done. The resultant situation could be entirely different during heavy rainfall with "kona" (onshore) winds.

Pg 5-2 (5.1, 2nd para.) the channeling of all stormwater runoff into the bay will result in increased water runoff velocities and concomitant increases in siltation which would negatively impact the water quality and potentially cause negative impacts on the aquatic biota (see also pg 5-3, 1st and last para).

Pg 5-4 (B), erosion control plans should be of a caliber that will guarantee protection of the nearshore marine ecosystem.

Pg 5-5 (1st para.) states that the golf course could increase the amount of chemical pollutants (ie. fertilizers, pesticides, herbicides, and petrochemicals) that enter the ocean. The cumulative impact of all on of these (and above mentioned) impacts on living aquatic resources and their habitats is not clarified in the document.

Pg 6-2 (6.1.3), marina development will also increase commercial water related activities. The living marine resources within the bay will be negatively affected by dredging operations, and these impacts could be significant and long-term with respect to the benthic biota. As a mitigation measure, corals occurring within the area to be dredged should be transplanted to other areas as a conservation and mitigation effort if possible.

Page 6-6 (6.2.3), the ability of the golf course to prevent flooding during heavy storm runoff is unsubstantiated. Detailed "water budgets" should be developed, and compared, for the existing and proposed runoff situations so that impacts to aquatic resources can be objectively addressed.

Finally, in append. D (pg. 14), the statement that the further addition of silt resulting from marina construction, use, and maintenance (which includes dredging) will unlikely result in any negative impacts greater than those that already exist is misleading and likely incorrect for the following reasons. During major storms with heavy stormwater runoff, meteorological conditions are such that silt laden runoff waters are quickly swept away from the shoreline by strong nearshore currents generated by strong storm-driven winds; in contrast, low chronic levels of silt discharged during "calm weather" periods (ie. no wind or rain) may have more negative impacts on the bay. Similar negative (and cumulative) impacts on the biota may also occur as a result of chronically low levels of petrochemicals, pesticides and herbicides that are expected to wash or leach into Kukuiula Bay.

Our Department's Division of Forestry and Wildlife suggests that the subject E.I.S. is probably adequate in its discussion of impacts to wildlife already existing within the project site. There are however, two areas of concern that need to be brought to the attention of the developer which may become an impact in the future:

1. Golf course development and waterbirds: As with many of these large land developments on Kauai, golf courses and their usual ponds or water hazards can be either a blessing or a curse to both the golf course manager and/or certain wildlife attracted to them. Ponds designed without the birds in mind can be a nuisance, attracting birds to areas where they are not compatible with golf course management. On the other hand, properly designed ponds can be a benefit to the waterbirds, including some endangered species, and also provide an esthetic asset to the golf course. We are prepared to provide the golf course architect technical assistance on pond design, to avoid bird problems, yet provide useful endangered species waterbird habitat.

2. Shearwater light attraction: The choice of lighting fixtures for streetlights, security lights and the placement of them in relation to utility wires should be considered to avoid unnecessary light attraction and fallout, which has become an increasing problem on Kauai. A brochure is attached, which should be forwarded to the developer to apprise him of this problem, and how to keep light attraction to a minimum.

We strongly recommend that the developer consult the Kauai District Forestry and Wildlife office prior to the development of final plans, so that the above-mentioned concerns can be mitigated.

As a final comment, our Division of Water and Land Development supports the use of treated effluent for golf course irrigation and siltation basins for water hazard. These basins also provide a good mitigative measure for non-point source pollution control. Please also note that the proposed well will require a permit from the Commission on Water Resource Management.

Please feel free to call me or Roy Schaefer of our Office of Conservation and Environmental Affairs, at 548-7837, if you have any questions.

Very truly yours,

WILLIAM W. PATY

Attachment

cc: Mr. Bruce Tsuchida

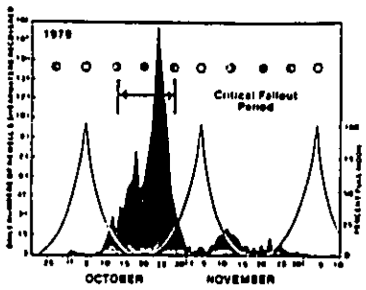


Figure 4. Relationship of shearwater fallout to the moon phases. The critical period of fallout occurs during the week before and after the new moon (darkest nights). Dimming lights that are not absolutely necessary during that period could substantially reduce the annual shearwater fallout problem.

What To Do If Shearwaters Fall In Your Area

1. Collect birds as soon as possible to avoid losses to dogs and cats. They are generally docile birds and are easily handled. Take them to the nearest "Shearwater Aid Station" located at county fire stations and at a few private business locations around the island. If birds must be held overnight keep them in a ventilated cardboard box with a secure lid.

2. Do not release birds by tossing them into the air. They may have unseen internal injuries and could become more badly injured.

TECHNICAL ASSISTANCE IS AVAILABLE

FOR ADDITIONAL INFORMATION, CONTACT:

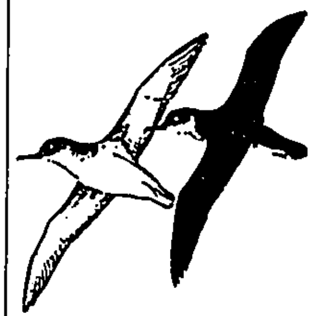
State of Hawaii
Department of Land and Natural Resources
Division of Forestry and Wildlife
P.O. Box 1671
Lihue, Hawaii 96766
245-4433

U.S. Dept. of the Interior
Fish and Wildlife Service
P.O. Box 87
Kilauea, Hawaii 96754
828-1413

The Nature Conservancy
of Hawaii
1026 Nuuanu Avenue, Suite 201
Honolulu, Hawaii 96813
537-4508

FORESTRY & WILDLIFE
HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES



THE NEWELL'S SHEARWATER LIGHT ATTRACTION PROBLEM

A GUIDE FOR ARCHITECTS, PLANNERS, AND RESORT MANAGERS

INTRODUCTION:

The future of a native Hawaiian seabird, the Newell's Shearwater, is threatened by the growth of new urban developments. Every year on Kauai nearly 1,500 Newell's Shearwaters are attracted to bright urban lights, fly into unseen objects and fall stunned to the ground. Fortunately 90% of them are recovered and successfully returned to the wild through the "SOS" (Save our Shearwaters) program which involves the cooperation of the general public.

This brochure is designed to describe the bird, its problems with lights and specifically what architects, planners, resort managers and the general public can do to reduce or avoid the light attraction problem.

THE BIRD

The Newell's Shearwater once nested on all of the major Hawaiian Islands but the mongoose, introduced to Hawaii, Maui, Molokai and Oahu in the late 1800's is believed to have caused the extinction of shearwaters on those islands. Kauai is the last strong-hold for this unique native Hawaiian seabird.

Newell's Shearwaters nest during the spring and summer months in the interior mountains of Kauai. They dig a long burrow in the ground beneath dense vegetation and lay a single egg each year. The eggs hatch during July and August, and the nestlings are reared within the burrow. The adult birds abandon the nestlings a week or two before they are old enough to fly. The nestlings become hungry, and leave the nesting grounds by themselves shortly after nightfall. They head for the open ocean, and must depend upon their instincts to find food. They do not return to their nest but fly south towards the equator where they will remain all winter on the open seas until the following spring.

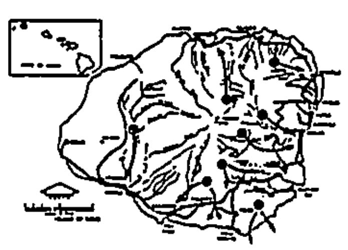


Figure 1. Map showing known nesting areas of the Newell's [illegible]

THE THREATS:

PREDATORS. Dogs, cats, rats and feral pigs are known to kill some shearwaters and their young on the nesting grounds each year. The accidental establishment of a new predator in Kauai such as the mongoose could cause the rapid extinction of this bird. Mongoose sightings on Kauai should be reported to wildlife officials promptly.

LIGHT ATTRACTION. Young shearwaters leaving their nests for the first time do so only after dark. They are inexperienced and have a natural attraction to bright lights. Flying near urban areas, they become temporarily blinded by the lights and fly into unseen objects such as utility wires, trees, buildings and automobiles. Oftentimes they are just confused and exhausted. Most often they are only stunned and fall to the ground, but about 10 percent of them die each year. The problem is growing because of the increased number of urban lights associated with new resort and residential developments. The greatest "fallout" problem occurs near coastal towns, particularly near river mouths.

AVOID THESE TYPES OF LIGHTS AND LIGHTING SITUATIONS

Figure 2. Avoid these types of lights. A. Unshielded high intensity floodlights on tall structures. B. Street lights without shields. C. Unshielded spotlights. D. Spotlights aimed upwards. Avoid using these types of lighting situations during peak fallout periods (new moons during October and November). E. Floodlights on surf. F. Spotlights aimed up at vegetation. G. Spotlights [illegible]

WHAT CAN WE DO TO HELP?

Architects and Planners

- Be aware of the light attraction problem during the plan[ning] stages of new development.
- Make every effort to avoid lighting situations where lighting projects upwards or laterally (see figure 2). Avoid large h[igh] intensity floodlights located on building tops or poles wh[en]ever possible.
- Use shielded lights, cut off luminaires, or indirect ligh[ting] whenever possible (see figure 3).
- Avoid locating bright lights near utility wires or other obs[tacles] that could be difficult for birds to see at night.

Hotel, Resort and Condominium Managers

- When converting to new exterior light fixtures, cons[ider] installing shielded lights, cut off luminaires or indirect li[ght]ing.
- Consider installing shields on exterior lights that are know[n to] attract shearwaters. Some light manufacturers offer re[ady] made shields. In some cases inexpensive shields can [be] fabricated.
- Avoid using unnecessary lighting during the critical she[ar]water fallout period (October and November each ye[ar]. Note: The heaviest fallout occurs on and around the n[ew] moon, generally for only 10 to 12 days. (See figure [4]). Dimming unnecessary floodlights that light up the su[rf or] shine upward upon buildings or trees for that short pe[riod] could significantly reduce shearwater fall-out.

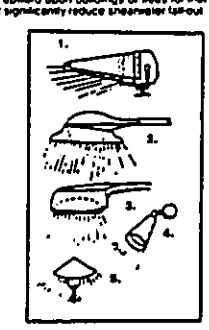


Figure 3. Use these types of lights whenever possible. 1. Shielded floodlights. 2. Shielded streetlights. 3. Cut-off luminaire streetlights. 4. Shielded spotlights aimed downwards. 5. [illegible]

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Engineering • Planning • Photogrammetry • Surveying • Construction Management • Energy Systems

November 7, 1988

Mr. William W. Paty, Chairperson
Board of Land & Natural Resources
Dept. of Land & Natural Resources
State of Hawaii
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Paty:

SUBJECT: Draft EIS for Kukuiula Planned Community, Koloa, Kauai, Hawaii

Thank you for your comments of October 21, 1988 relating to the proposed Kukuiula Planned Community project. We appreciated your review of this document.

We concur that there are 51 significant sites on the project site. Thirty of these sites are significant only for their information content and 21 for multiple criteria according to the State and National Registers of Historic Places. Fourteen of the multiple criteria sites are excellent examples of site types, however, larger and better examples of these site types are already preserved at Kiahuna.

A field trip of the Kiahuna and Kukuiula sites was conducted on October 24, 1988. Participants included representatives from the Kauai Historic Sites Commission, Kauai Planning Department, Dr. William Kikuchi, State Historic Sites Section, A&B Properties, Kiahuna Corporation and the consulting archaeologist, Dr. Hallett Hammett. This field inspection confirmed that the sites at Kiahuna are indeed better examples of site types than those found at Kukuiula. Three of the significant sites (two heiaus and a raised auwai) at Kukuiula have been recommended for preservation. A preservation plan will be prepared for these three sites.

The data recovery plan and preservation plan will be prepared and submitted to the State Historic Sites Section and the County of Kauai Planning Department for approval prior to any work performed on the sites.

The Draft EIS will be revised to include this information as stated in your letter.

Additional information will be provided on aquatic resources as requested for items 1 through 4 of page 3 in your letter.

In response to your comments on impacts from storm water runoff entering receiving waters thereby affecting marine biota, retention basins are proposed in the development. These retention basins are intended to reduce the amount of silt, fertilizers and pesticides generated by the proposed project that would enter receiving waters. An erosion control plan will be provided along with the design documents prior to actual construction of infrastructure. These documents will be submitted for approval by the appropriate agencies prior to construction. The EIS will be revised to include on-site ponding as an alternative mitigation measure in lieu of or in combination with the box culvert at the Beachhouse Restaurant because of impacts to receiving waters and marine biota. Retention basins will be developed on site to retain excess flows resulting from the project.

In addition, a drainage master plan will be prepared to provide mitigative measures for the increase in storm water runoff due to the proposed project for the 100-year storm. This drainage master plan will determine the size and location of retention basins on the site.

Discussion of project impacts on the threatened green sea turtle was erroneously omitted from the marine biological discussion. The Final EIS will include a section specifically on endangered and threatened species, including the green sea turtle. Thank you for bringing this omission to our attention.

The proposed project will increase the use of existing recreational facilities during the project's 25-year time frame. However, the project will also add new recreational facilities that will enhance the area. In addition to the 18-hole golf course, the marina, pedestrian/bike paths and open space, land will be made available to meet the park dedication requirements.

A 100-foot wide setback has been established along Lawai Road from the west of Metropolitan Mortgage Company's development to the proposed marina/resort development. This area may be developed to include beach parking, pedestrian/bike paths and landscaping. Parking facilities will be provided for the development at Kukuiula Bay. These development options for the 100-foot setback along Lawai Road will be addressed in the EIS.

Except for the dredging of the navigational channel into the marina, the existing boat launching facilities will not be disrupted. Dredging of this navigational channel is in the general location of the previously dredged area. Land will be made available in the immediate area for expansion of the boat launching facilities. There is ample space to develop an additional ramp, additional parking for trailers and a new washdown area, nearly doubling its present size.

It is expected that the increase in population and marina development will increase the use of the existing boat launch facilities. Kauai is estimated to have the highest pent-up demand for mooring facilities because it has the lowest ratio of mooring capacity to registered boats. The marina development will help to provide these needed facilities.

The EIS states that drydock facilities are not planned for this project. Boats can be taken to Nawiliwili Harbor for repairs. Expansion in the vicinity of the marina refers to the existing boat launch facilities.

An engineering report dated December 1983, entitled "Kauai Island-Wide Landfill" indicated that the underlying water table at the Kekaha Landfill is brackish water and has no potential for drinking water. Leachate that will be generated in this region is expected to be very low because of the very low rainfall. The little leachate that will be generated will move with the groundwater and be filtered through the sand during its route toward the ocean. The leachate will also be diluted with the brackish groundwater before entering the ocean.

The injection wells proposed will be used only as an emergency effluent disposal system. The great distance of the injection wells from the coastline will filter the treated effluent before it enters coastal waters.

Discharge of sugarcane irrigation effluent will be added as one of the existing sources of water quality degradation in Kukuiula Bay.

Nearshore water current data collected for the Poipu Wastewater Facilities System supports the observation that eutrophication of nearshore waters (outside of Kukuiula Bay) is highly unlikely because of the tremendous dilution and dispersion rates. A similar pattern is anticipated in waters fronting Kukuiula Bay. We know of no sources of nutrients in the region which could account for any eutrophication in these waters. Any information you could provide to the contrary would be extremely helpful in developing the Final EIS.

We agree that the lack of silt observed on living coral may be due to no large discharges of silt on the day of the survey. Chronic discharges of silt and sediment represent an expensive, energy-wise, exogenous factor for corals. Silt and sediments also contribute to abrasion of corals and a loss of living tissues in areas subject to wave and tidal scouring. The observation that corals living immediately below the silty discharge waters at Kukuiula Bay were at least as healthy as corals associated with the deeper harbor basin suggests that long-term impacts of such discharges are not adversely affecting the nearshore coral community.

There is an existing 100-foot wide draglined channel which extends from the toe of the breakwater to the existing boat launching ramp. Although it is too early to determine if additional dredging will be necessary to improve the navigational safety within the harbor, your concerns in terms of direct and indirect long-term effects to benthic biota will be elaborated upon in the Final EIS. Coral transplantation may well represent an effective mitigation measure, however, massive colonies of porites that occur adjacent to the existing draglined channel, may not be feasible for transplantation. Small colonies may lend themselves to relocation.

The statement made on page 14 of Appendix D was written generically. It was not intended to represent the entire range of physical conditions that could be experienced at Kukuiula Bay (hurricanes, Kona winds, tsunamis, etc.), or to suggest that chronic, small discharges are of no environmental concern. Consideration of your remarks will be reflected in the Final EIS.

Your office will be consulted when the golf course and lighting system is in the design stage to avoid bird problems or bird hazards in the future as stated in your letter. The Kauai District Forestry and Wildlife Office will also be consulted.

A permit will be obtained from the Commission of Water Resources Management prior to development of the new well.

If you should have any questions or additional comments and suggestions, please direct them to:

Mr. Bruce T. Tsuchida, Project Manager
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817
Phone: 842-1133

Very truly yours,

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JH:W99

DEPARTMENT OF BUSINESS AND ECONOMIC DEVELOPMENT
ENERGY DIVISION, 335 MERCHANT ST., RM. 110, HONOLULU, HAWAII 96813

JOHN WAIHEE, GOVERNOR
ROGER A. ULVELING, DIRECTOR
BARBARA KIM STANTON, DEPUTY DIRECTOR
LESLIE S. MATSUBARA, DEPUTY DIRECTOR

88:663e

October 21, 1988

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JH

Mr. Tom Shigemoto
County of Kauai Planning Department
4280 Rice Street
Lihue, Kauai, Hawaii 96766

Dear Mr. Shigemoto:

Subject: Draft Environmental Impact Statement for Kukuiula Planned Community

The Energy Division has received the above-referenced Draft Environmental Impact Statement (DEIS) and has the following comments:

We are concerned that the DEIS contains only a minimal discussion of energy impacts that will result from the project.

No estimate of total electricity consumption within the project is presented. Also, apart from a brief discussion (Section 6.2.1) of pedestrian paths and bikeways to reduce consumption of transportation fuel within the project, there is no discussion of conservation considerations or renewable energy sources that might help meet the project's energy requirements.

We believe that this DEIS should include a fuller discussion and evaluation of the amount of energy consumption anticipated, the planned application of energy conservation devices, and the availability of renewable energy sources. The mandate for such an evaluation is found in Chapters 226 and 344, Hawaii Revised Statutes.

Thank you for the opportunity to provide these comments. We hope they will be useful to you.

Sincerely,

Maurice H. Kaya
Energy Program Administrator

MHK/PE:do

cc: Bruce Tsuchida

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November 7, 1988

Mr. Maurice H. Kaya
Energy Program Administrator
Energy Division
Dept. of Business and Economic Development
State of Hawaii
335 Merchant Street, Room 110
Honolulu, Hawaii 96813

Dear Mr. Kaya:

SUBJECT: Draft EIS for Kukuiula Planned Community, Koloa, Kauai, Hawaii

Thank you for your comments of October 21, 1988 relating to the proposed Kukuiula Planned Community project. We appreciated your review of this document.

The electrical consumption for the project at full occupancy is estimated at eight megawatts, using a factor of two kilowatts per unit. This information will be included in the Final EIS.

We will encourage the use of energy conservation devices or methods within the development. The use of landscaping within developed areas can provide shade thereby reducing the use of air conditioners or fans. Wherever possible, structures may be situated such that the hotter southwest solar rays will not directly penetrate the interior. Proper ventilation will also aid air circulation within the units utilizing the natural breezes. In situations where this is not possible, the use of landscaping to provide shade or tinting of glass windows can be used. Because of the relatively sunny climate, solar water heaters may be used to reduce the amount of electrical consumption.

The EIS will be revised to include additional discussions as stated herein.

If you should have any questions or additional comments and suggestions, please direct them to:

Mr. Bruce T. Tsuchida, Project Manager
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817
Phone: 842-1133

Very truly yours,

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JH:W99

POIPU BEACH
RESORT ASSOCIATION
P.O. Box 730, Koloa, Kauai, HI 96756 (808) 742 7444

October 22, 1988

BT

SH

Mr. Bruce T. Tsuchida
Project Manager
Kukuiula Planned Community
Environmental Impact Statement
R. M. Towill Corporation
420 Waiakamilo rd., Suite 411
Honolulu, HI 96817-4941

Dear Mr. Tsuchida,

Please find enclosed comments and questions formulated from reading the E.I.S. prepared for Alexander & Baldwin for their project in Poipu. I am submitting them as a consulted party, on behalf of the Poipu Beach Resort Association. I would appreciate a reponse to the questions posed within the attached pages.

Please feel free to contact me if you have an questions that need to be directed toward this Association.

Very truly yours,

Margy Parker

Margy Parker
Executive Director

c - Tom Shigemoto
B. Campbell

POIPU BEACH
RESORT ASSOCIATION
P.O. Box 730, Koloa, Kauai, HI 96756 (808) 742 7444

QUESTIONS AND COMMENTS ON E.I.S.FOR KUKUIULA COMMUNITY REGARDING

ISSUES WHICH AFFECT THE POIPU REGION

OCTOBER 22, 1988

(SUBMITTED BY THE POIPU BEACH RESORTASSOCIATION)

The following are comments and questions regarding the E.I.S. report prepared for the proposed housing/resort development on the west side of Poipu to be developed by Alexander and Baldwin. These comments are submited by the Poipu Beach Resort Association, a non-profit organization of 160 business members which is involved in issues affecting the Poipu area.

MARKET

What market studies have been developed to show the need for housing at this price level and in this region for the first phase and for the second phase? What statisitcs have been developed to show need for the second phase, including the 500 room hotel?

DESIGNATION

If the total development is to include resort hotel and transient vacation rentals in the multi-family units, would the project be considered as part of the Poipu Resort destination, and be subject to planning concepts that apply to a resort destination?

RE-ALIGNMENT AND SIGNALIZATION OFINTERSECTION/POIPU & LAWAI RD.

-Have traffic studies been done during peak months and time periods such as August, October, late December, February, March, and April to determine peak period traffic counts?

- How would the Waikomo Stream Villas Resort be affected and how would the stream be affected by new road re-alignments?

-Will the developer tear down the Poipu Beach entry sign? If so, what guarantees will the County and the Poipu Beach Resort Association have for re-construction and new landscaping? (Cost of replacement estimated at $40,000 - $50,000)

-E.I.S. should state Poipu Road <u>only</u> route, rather than major route.

-Have any studies been done as to the effect of signalization on traffic when the Hyatt hotel and golf course guests and employees start using the roadsas well as when other approved densities are built out?

-Have a signal and project entry been considered for Hoonani and Lawai Rd., instead of Poipu and Lawai Rd?

-As regards to traffic circulation in general, which roads have priorities to maintain traffic flow, and how are these priortities determined?

DRAINAGE

-What provisions are there for deposit of golf course drainage?

- Is the developer aware that the largest coral reef on the South Shore is situated between Kuhio Shores and Kukuiula Harbor, and there are several dive sites used by Kauai dive companies in this area, specifically, right outside of Kukuiula Harbor, and in front of the Beach House? The same area is also a habitat for the green sea turtle, an endangered species.

-How will drainage from project construction and implementation into Kukuiula Harbor and in front of the Beach House affect the coral and the water visibility? How can the eco-system of the coral reefs be maintained, considering the drainage of water flowing off of the project?

-Regarding drainage in general, how will class A water be maintained, in view of the possibility of additional siltation and chemicals draining into the ocean?

LANDSCAPING

-As regards to roadway landscaping, will provisions be made for roadway landscaping in front of the neighborhood commercial center on Lawai Rd.?

-As regards to Lawai Road, will a sidewalk along that road be constructed in view of increased pedestrian traffic along that road?

PARKS

-Since there is no beachfront park or beach access tying into this project, the use of established parks, such as Poipu Beach Park and Kukuiula Harbor Park will increase dramatically. What provisions are being made to mitigate the impact upon these parks?

-What plans will be implemented to provide for construction and maintenance of a neighborhood park within the project?

POTABLE WATER

-Who will construct and maintain the additional well required by full project implementation?

UNDERGROUND UTILITIES

Since the project is within a resort area, are underground utilities planned for project perimeters and access areas to mitigate visual impact?

On behalf of the Board of Directors of the Poipu Beach Resort Association, I would appreciate learning whether the above issues have been addressed, or will be addressed, and, if so, by what means.

Respectfully submitted,

Margy Parker

Margy Parker
Executive Director

R. M. TOWILL CORPORATION

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November 7, 1988

Ms. Margy Parker
Executive Director
Poipu Beach Resort Association
P.O. Box 730
Koloa, Kauai, Hawaii 96756

Dear Ms. Parker:

SUBJECT: Draft EIS for Kukuiula Planned Community, Koloa, Kauai, Hawaii

Thank you for your comments of October 22, 1988 relating to the proposed Kukuiula Planned Community project. We appreciated your review of this document.

A market study was prepared for both Phase I and Phase II of the project and the summaries of both studies were attached as Appendices G and H of the Draft EIS. The market study indicated that all the units proposed for Phase I can be absorbed within the first six-year sales period with still more units in demand. Projections in the Phase II study indicated that an additional 2,050 single family lots, 530 multi-family units and 620 hotel rooms could be supported by the year 2015. Details which support these figures are included in the market studies which are available for review at our office.

The hotel and transient vacation rentals planned for Kukuiula would not be considered a part of the Poipu Resort destination.

The traffic study was conducted on October 1987 and is attached as Appendix J of the EIS. This traffic study did take into account other growth in the area when developing traffic assignments. An island-wide traffic study is currently being conducted by the State Dept. of Transportation for the Island of Kauai. This study may reveal other roadway requirements needed for the growing Koloa district.

Adverse noise effects on Waikomo Stream Villas Resort would probably occur during construction of the reconfigured intersection of Lawai and Poipu Roads. The reconfigured intersection is not expected to affect Waikomo Stream. The existing bridge over Waikomo Stream will remain intact. The existing Poipu Beach entry sign will be affected during construction and possibly destroyed. This entry sign will be reconstructed as part of the roadway improvements.

Signalization and entry was not considered at Hoonani and Lawai Road because the right-of-way width is insufficient to carry the projected traffic volumes. Poipu Road is the only road providing access to coastal areas of the Koloa district. Poipu Road from the intersection with Lawai Road traveling east is also the main access road into the Poipu area with a right-of-way width of 50 to 60 feet. The right-of-way widths generally determine traffic circulation patterns as well as traffic generation.

We will revise the EIS to include an alternative mitigation method for preventing excess storm water runoff caused by the project to downstream developments. This alternative may be used in lieu of or in combination with the outlet at the Beachhouse Restaurant. Retention basins can be incorporated on site to retain excess flows. Suspended solids entering the ocean at the outlet at Kukuiula Bay will be minimized by retention basins within the large drainage swale proposed above Phase I of the project. A small swale will be incorporated into this larger swale (which will ultimately be integrated into the proposed golf course fairways) to handle daily flows. In the event of a major storm, this large swale will act as a series of retention basins to hold most of the increase in storm water runoff due to the project as well as deposit silt. The proposed resort area will also incorporate retention basins to further reduce the amount of silt before the final entry into the ocean. The incorporation of retention basins within the project site is expected to reduce the amount of silt presently entering receiving waters. An erosion control plan will be provided in the design documents prior to actual construction of these facilities. These documents will be submitted for approval by the appropriate agencies prior to construction. In addition, a drainage master plan will be prepared to provide mitigative measures for a 100-year storm. This drainage master plan will determine the size and location of retention basins on site.

Landscaping is planned along the edge of the commercial area fronting the project road and Lawai Road. A 100-foot wide setback has been established along Lawai Road from the west of Metropolitan Mortgage Company's development to the proposed marina/resort development. This area may be developed to include beach parking, pedestrian/bike paths and landscaping. Parking facilities will be provided in the development at Kukuiula Bay.

We agree that the proposed project will increase the use of existing recreational facilities during the project's 25-year time frame. However, the project will also add new recreational facilities that will enhance the area. In addition to the 18-hole golf course, the marina, pedestrian/bike paths and open space, land will be made available to meet the park dedication requirements. The two neighborhood park sites are proposed to be developed by the County. We will revise the EIS and expand on the recreational impact and mitigation sections.

The new source and storage facilities proposed are planned to be developed by A&B. These facilities will be maintained by the County Water Department.

Underground power and communication lines are proposed.

Items not clearly stated in the Draft EIS will be revised and included in the Final EIS.

If you should have any questions or additional comments and suggestions, please direct them to:

Mr. Bruce T. Tsuchida, Project Manager
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941
Phone: 842-1133

Very truly yours,

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JH:W9

United States Department of the Interior
FISH AND WILDLIFE SERVICE
PACIFIC ISLANDS OFFICE
P.O. BOX 50167
HONOLULU, HAWAII 96850

OCT 25

Mr. Tom Shigemoto
Planning Department
County of Kauai
4280 Rice Street
Lihue, Kauai 96766

Re: Draft Environmental Impact Statement, Kukuiula Planned Community, Kauai

Dear Mr. Shigemoto:

We have reviewed the referenced document and offer the following comments for your consideration.

The Service's main concerns regarding the proposed project are the potential impacts to nearshore fishery resources from the construction and operation of the proposed marina and the degradation of coastal water quality from increased run-off and erosion from the proposed development.

Given the conceptual nature of the proposed project, we recommend that the drainage system be designed to contain storm water run-off entirely within the project site. Open areas, parks, green belts, golf course, and infiltration wells should be designed to act as sediment traps and retention basins for stormwater run-off. By preventing the direct discharge of stormwater run-off into coastal waters, nearshore water quality would be protected.

We note that the marine biological survey was done in a single day using semi-quantitative sampling methods. This survey is inadequate to define the "baseline" conditions of fishery resources and water quality in Kukuiula Bay. We recommend that additional studies be conducted to quantitatively describe the coral and fishery resources in Kukuiula Bay and surrounding areas, to map the location of benthic communities in relation to the proposed entrance channel, and to determine coastal currents and water quality under different seasonal and weather conditions.

In addition, we understand that the threatened green sea turtle (Chelonia mydas) is commonly observed in the surrounding coastal waters. Additional surveys should be conducted to document the use of the area by green sea turtles and to identify foraging and loafing habitats for this species along the project site.

Whale researchers have expressed concern regarding the potential adverse impacts to the endangered humpback whale (Megaptera novaeangliae) from the construction and operation of marinas on Maui and West Hawaii. We recommend that the National Marine Fisheries Service be consulted regarding the potential impacts on the endangered humpback whale and threatened green sea turtle from the construction and operation of the proposed marina at Kukuiula Bay.

Based on the botanical survey of the project area, we understand that no wetlands would be affected by this project.

We appreciate this opportunity to comment.

Sincerely yours,

Ernest Kosaka

Ernest Kosaka
Field Office Supervisor
Environmental Services

cc: NMFS - WPPO
DLNR

R. M. TOWILL CORPORATION

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November 7, 1988

Mr. Ernest Kosaka
Field Office Supervisor
Environmental Services
Fish and Wildlife Service
Pacific Islands Office
P.O. Box 50167
Honolulu, Hawaii 96850

Dear Mr. Kosaka:

SUBJECT: Draft EIS for Kukuiula Planned Community, Koloa, Kauai, Hawaii

Thank you for your comments of October 24, 1988 relating to the proposed Kukuiula Planned Community project. We appreciated your review of this document.

The proposed drainage system will reduce the amount of flows that currently impact existing developments along the coastline. The large drainage swale mauka of the Phase I development will reroute most of the mauka flows into Kukuiula Bay. Retention basins will also be incorporated into the large swale (which will ultimately be incorporated into the golf course fairways) to hold storm water runoff and deposit silt. Flows that will impact the existing coastal residents would thus be limited to the area between the swale and existing developments. Flows in this area are proposed to be captured via an underground drainage system that will outlet near the Beachhouse Restaurant through a large box culvert.

There has been concern voiced relative to impacts to coastal waters near the proposed outlet at the Beachhouse Restaurant. To mitigate impacts to coastal waters and marine biota, we will be revising the EIS to include on-site ponding as an alternative mitigation measure in lieu of or in combination with the large box culvert at the Beachhouse Restaurant. Retention basins will be incorporated on site to retain excess flows resulting from the project. In addition, a drainage master plan will be prepared to ensure that storm water impact on existing residences will not be increased.

Because of the small size of Kukuiula Bay and the extremely low diversity of marine organisms encountered (see checklists in Appendix D of the EIS) a one-day survey was found to be adequate to describe existing conditions within the harbor for the level of detail necessary for a Draft

EIS. As noted in the EIS, an existing 100-foot wide draglined channel parallels the breakwater and dock area. Such areas can be censused quite rapidly with a relatively high degree of reliability. A more detailed baseline survey may be appropriate as the full scope of the proposed project develops and more detailed siting and engineering requirements (additional harbor channel dredging, etc.) are identified.

The green sea turtle is known to nest at Lawai Bay and at the Pacific Missile Range Facility and may well rest or forage in or around the vicinity of Kukuiula Bay. Coordination with the National Marine Fisheries Service will be initiated to clarify the importance of Kukuiula Bay for sea turtles as well as the endangered humpback whale.

If you should have any questions or additional comments and suggestions, please direct them to:

Mr. Bruce T. Tsuchida, Project Manager
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817
Phone: 842-1133

Very truly yours,

B. Tsuchida

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JH:W99

245 North Kukui Street, Honolulu, Hawaii 96817, Telephone (808) 537 5966

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OCT 25 1988 RMTC			
GSY		YJK	

AMERICAN LUNG ASSOCIATION of Hawaii
The Christmas Seal People®

October 24, 1988

JH

Mr. Tom Shigemoto
County of Kauai Planning Department
4280 Rice Street Street
Lihue, Kauai 96766

Dear Mr. Shigemoto:

Subject: Draft EIS for Kukuiula Planned Community

We have reviewed the subject EIS with particular attention to the section addressing air quality impacts and have the following comments to offer.

1. Pages 1-5 to 1-6. "Carbon monoxide emissions from new motor vehicles is expected to decrease in the future because of tighter emission control standards."

The above statement may be true in the short-term, but not the long-term. The decline in emissions from individual new motor vehicles since the early 1970's due to federal emission standards will soon level off since no new, more stringent standards have been promulgated. This means that increases in motor vehicle activity will no longer be offset by reductions in per vehicle emissions. The net result is that an increase in motor vehicle activity will cause a concomitant increase in emissions. This will be particularly true in the case of the Kukuiula Development because of its great magnitude and the fact that traffic levels are currently quite low in the area. With traffic volume increasing by a factor of 2 - 3 or more, the ambient levels of carbon monoxide and other automotive pollutants will also increase.

2. Page 1-6. "The efficiency of the proposed roadway system will contribute to the reduction of carbon monoxide emissions by reducing the idling time at intersections and the slow movement of traffic. Improvements are planned at the intersection of the project road with Lawai and Poipu Roads. Other improvements, as recommended in the "Circulation System" paragraph, will also contribute to the efficient movement of traffic."

While this may be theoretically true, in this instance it is pure conjecture because no quantitative impact analysis was done to identify what the ambient impact would be with and without the project including the "improved" roadway system. Without a quantitative impact analysis, one cannot predict to what extent the increases in ambient pollutant levels due to the sharp increases in traffic volume will be offset by road improvements. The lack of a quantitative impact analysis also makes it virtually impossible to determine whether State and Federal air quality standards will be met.

3. Page 3-13. "Carbon monoxide will be increased, especially during peak hours. Vehicles that idle at intersections or move at very low speeds will increase the carbon monoxide emissions. Roads that operate at service levels E or F will add to the increase of emissions. The major cane haul road traversing the length of the project will remain in operation indefinitely. Residents living near the cane road will be exposed to dust generate by its use."

While the above-cited paragraph does indicate that there will be air quality impact, no effort was made to quantify that impact. Quantitative impact analysis is necessary to demonstrate compliance with state and federal air quality standards, to track consumption of the standards, to track the rate of deterioration of air quality, and to determine potential health and environmental effects. The absence of a quantitative analysis is a major shortcoming.

4. Page 3-14. "Increases in carbon monoxide emissions from motor vehicle traffic can be reduced in a variety of ways. Increased capacity at intersections will allow vehicles to idle for a shorter period of time thereby reducing carbon monoxide emissions."

The degree to which increased intersection capacity will reduce CO concentrations could have been determined in a quantitative impact analysis. Such an analysis could also help determine whether CO standards would be violated as a result of the cumulative impact of the project and whether intersections improvements would reduce or eliminate those violations.

5. Page 3-14. "The amount of carbon monoxide emissions from motor vehicles in the future is expected to decrease. The Federal motor vehicle emissions control program mandates tighter emission standards for new vehicles."

Again, this is only true in the near-term. See Comment 1.

6. Pesticide Drift. While the potential impacts of field burning and fugitive dust from active sugar cane cultivation activities was addressed, no mention was made of pesticide usage, possible drift, or possible exposure to pesticide combustion products from cane fires for future residents.

7. Consultation Period. As part of the EIS Consultation Process, we submitted a list of air quality related impacts that should have been addressed in the EIS. The following potential sources of air pollution associated with the project and listed in our April 29, 1988 letter were not addressed:

a. pesticide usage and drift particularly in relation to the proposed golf course

b. boat operations in the proposed marina

c. indirect offsite impacts of electrical generation

In summary, the lack of a quantitative impact analysis, the failure to recognize the long-term effect of no new federal motor vehicle standards, and the failure to address previously identified air quality impacts are serious shortcomings in this Draft EIS. We strongly urge you not to accept the EIS until those shortcomings have been corrected.

Sincerely yours,

Helene Takemoto /CT

Helene Takemoto
Chairman
Environmental Health Committee

HT:ct
L8836

cc: OEQC
R. M. Towill
UH-Environmental Center

R. M. TOWILL CORPORATION

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November 7, 1988

Ms. Helene Takemoto, Chairman
Environmental Health Committee
American Lung Association of Hawaii
245 North Kukui Street
Honolulu, Hawaii 96817

Dear Ms. Takemoto:

SUBJECT: Draft EIS for Kukuiula Planned Community, Koloa, Kauai, Hawaii

Thank you for your comments of October 24, 1988 relating to the proposed Kukuiula Planned Community project. We appreciated your review of this document.

An air quality study is presently being prepared. Results of the findings will be published in the Final EIS. Impacts and mitigation measures will also be discussed.

If you should have any questions or additional comments and suggestions, please direct them to:

Mr. Bruce T. Tsuchida, Project Manager
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941
Phone: 842-1133

Very truly yours,

B. Tsuchida

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JH:W9

University of Hawaii at Manoa

Environmental Center
Crawford 317 • 2550 Campus Road
Honolulu, Hawaii 96822
Telephone (808) 948-7361

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October 24, 1988
RE:0509

JH

Mr. Tom Shigemoto
Planning Department
County of Kauai
4280 Rice Street
Lihue, Kauai, Hawaii 96766

Dear Mr. Shigemoto:

Draft Environmental Impact Statement
Kukuiula Planned Community
Koloa, Kauai

Alexander and Baldwin, Incorporated, have proposed to develop approximately 1,000 acres of land over the next 20-25 years in the Koloa District on the Island of Kauai. The proposed project will change the land use of the area from sugarcane cultivation and pastureland to single-family lots, multi-family units, an 18-hole golf course, a resort complex, a marina, two neighborhood park sites, a sewage treatment plant, two commercial areas, walkways and bike ways, greenbelts, and open space buffer areas. This will require a change of zoning for 800+ acres of the site from "open" and "agriculture" to "urban."

The Environmental Center has conducted a review of the above referenced Draft Environmental Impact Statement (EIS), with the assistance of Peter Flachsbart, Urban and Regional Planning; P. Bion Griffin, Anthropology; Jon Matsuoka, Social Work; and Randall Rush, Environmental Center.

General Comments

Approximately 20% of the land (219 acres) in the project area is designated "Urban Residential" and the remaining 800+ acres is designated "Agriculture" and "Open." An amendment to both state and county land classifications for the 800+ acres will be required. The Final EIS should discuss the overall impacts on the existing population of Koloa of conversion from a rural society to an urban society.

Specific Comments

Housing

Page 4-12. Hawaii already has one of the largest out-of-state home ownerships in the United States and Kauai is faced with a shortage of affordable housing. In an attempt to address this shortage the County of Kauai has recommended that the developers provide 10 percent of their units in the "affordable" price category. The Final EIS should define what constitutes "affordable" housing and provide figures comparing proposed "affordable" prices to the average wage scale in Kauai. Furthermore, the discussion of affordable housing is vague in defining the specific location of the affordable housing sites. The Final EIS should clarify where the proposed 10 percent affordable housing will be built and the relationship of its construction to the needs of the community and this development.

Appendix E: Archaeology

The Archaeological Inventory Survey adequately describes many sites and features located in the project area. We note that the archaeological consultants have recommended that certain features should be preserved and others subject to further study including subsurface testing and excavation preceding development impact and removal of sites. Compliance with the full text of the mitigation recommendations contained in the survey study should assure that adequate attention to archaeological features in the project area is provided.

Circulation and Appendix J: Traffic Impact Report

The section dealing with circulation of traffic provides appropriate solutions to the anticipated increases in traffic. However, the Draft EIS does not provide any quantitative analysis of the impacts on air quality that will be produced by the increased traffic. We recognize that air quality standards are not likely to be exceeded by the traffic generated by this project. However, the emissions produced will result in a significant increase above the existing low ambient air quality parameters. From the standpoint of long term planning and the prevention of significant deterioration of air quality, it is imperative that each development that will contribute to modifications of air quality should provide quantitative figures as to their contributions to air quality pollutants. It is only by requiring such information that we can be assurred that adequate planning and environmental management on Kauai can be maintained.

Marina

We note that some 10 acres inland of the coastline will be dredged to form a marina. A new 80 to 160-foot wide entrance channel is proposed to Kukuiula Bay. The Final EIS should provide considerably more information on the environmental impacts associated with the construction and operation of the marina. For example, a discussion is needed of the excavation methods that will be employed, procedures that will be followed to minimize sedimentation to the nearshore waters, whether or not blasting will be required and if so what precautions will be taken to assure that endangered species are not affected. The effect of the marina excavation on the groundwater hydrology should also be included in the Final EIS.

Document Organization

We note that some of the Appendices are not lettered and that others are incorrectly lettered. For example, Appendix E is listed as the Archaeological Report in the Table of Contents. In the document, Appendix E is titled Agricultural Assessment.

We appreciate the opportunity to comment on this Draft EIS.

Yours truly,

Jacquelin N. Miller

Jacquelin N. Miller
Associate Environmental Coordinator

cc: OEQC
Bruce Tsuchida ✓
L. Stephen Lau
Peter Flachsbart
P. Bion Griffin
Jon Matsuoka
Randall Rush

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November 7, 1988

Ms. Jacqueline N. Miller
Associate Environmental Coordinator
University of Hawaii at Manoa
Environmental Center, Crawford 317
2550 Campus Road
Honolulu, Hawaii 96822

Dear Ms. Miller:

SUBJECT: Draft EIS for Kukuiula Planned Community, Koloa, Kauai, Hawaii

Thank you for your comments of October 24, 1988 relating to the proposed Kukuiula Planned Community project. We appreciated your review of this document.

The proposed project is contiguous to urban and resort development in the Koloa District. This area also has a relatively high demand for new housing. The Kauai Housing Agency estimated that approximately 1,200 units will be needed by 1990, in a report dated October 1987, "Assessment Report for Kauai's Housing Needs." By the year 2005 an additional 1,900+ units will be needed for the Koloa District. Conversion of agricultural land to urban uses will help to meet the needs of this growing community. In addition to the variety of housing products, recreational facilities, open space and commercial uses are proposed to complement the overall development.

A mix of single family and multi-family housing will be provided for affordable housing either on or off site. On-site affordable housing may be integrated among market units rather than designating a specific area for this development. Land may also be donated to the County for development of affordable housing. An off-site location has not been determined at this time.

A data recovery plan will be prepared for the 51 significant sites found on the project site. Thirty of these sites are significant only for their information content and 21 for multiple criteria according to the State and National Registers of Historic Places. Fourteen of the multiple criteria sites are excellent examples of site types, however, larger and better examples of these site types are already preserved at Kiahuna.

A field trip of the Kiahuna and Kukuiula sites was conducted on October 24, 1988. Participants included representatives from the Kauai Historic Sites Commission, Kauai County Planning Department, Dr. William Kikuchi, State Historic Sites Section, A&B Properties, Kiahuna Corporation and the consulting archaeologist, Dr. Hallett Hammett. This field inspection confirmed that the sites at Kiahuna are indeed better examples of site types than those found at Kukuiula. Three of the significant sites (two heiaus and a raised auwai) at Kukuiula have been recommended for preservation. A preservation plan will be prepared for these three sites.

The data recovery plan and preservation plan will be prepared and submitted to the State Historic Sites Section and the County of Kauai Planning Department for approval prior to any work performed on the sites.

An air quality study is presently being prepared. Results of the findings will be published in the Final EIS. Impacts and mitigation measures will also be discussed.

Sediment loads from construction of the marina are not expected to be significant except when the dike has been opened to the sea. The excavation of the marina will generally occur on land. The walls of the marina will either be cut slopes or bulkheads. If a slope wall is designed, the walls may be protected by some form of riprap armor underlain with a filter to minimize the loss of fine grain soils. The marina site is expected to contain hard basalt which will be desirable in terms of reduced erosion and siltation; however, blasting may be required depending on the extent of the basalt layer. If blasting is necessary, technical specifications will be prepared for construction operations. The technical specifications can include monitoring ground vibrations, size of explosive charge, type of explosives, etc. Precautionary measures to assure that endangered species are not affected can also be part of the special conditions for construction. Surveillance of endangered marine life via a helicopter is a possible condition in the specifications for blasting operations.

Appendix E was labeled incorrectly and will be corrected in the Final EIS.

If you should have any questions or additional comments and suggestions, please direct them to:

Mr. Bruce T. Tsuchida, Project Manager
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941
Phone: 842-1133

Very truly yours,

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JH:W9

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STATE OF HAWAII
Department of Business and Economic Development
Housing Finance and Development Corporation
P. O. Box 29360
Honolulu, Hawaii 96820-1760

Joseph K. Conant
Executive Director

IN REPLY REFER TO:

88:PLNG/1406B JT

October 25, 1988

Mr. Tom Shigemoto
County of Kauai Planning Department
4280 Rice Street
Lihue, Kauai 96766

Dear Mr. Shigemoto:

Re: Draft Environmental Impact Statement (DEIS) for the Proposed Kukuiula Planned Community

We have reviewed the subject DEIS and have the following comments:

Although the DEIS touches upon the provision of affordable housing, it appears that the issue is still unresolved as there is no discussion on the development timetable, location, types and estimated price ranges of affordably priced units.

In an Assessment Report of Kauai's Housing Needs, dated October 1987, the Kauai Housing Agency estimates that a housing shortfall of 5,928 units will exist by 1990. Of this total shortfall, approximately 20%, or 1,195 of the needed units are in the Koloa-Poipu-Kalaheo Planning area. The Kauai Housing Agency also estimates that from 1990 to 2005, an additional 8,950 units will be needed island-wide (with 1,925 units, or 21.5%, needed in the Koloa-Poipu-Kalaheo planning area). The vast majority of the housing units will be needed by households falling in the very low, low/mod, gap group and Hula Mae income groups (which are defined in the report as having 1980 incomes of less than $10,000, for very low income households, to incomes in the range of $30,000 - $39,999, for Hula Mae households). The report states that "this monumental demand for future residential development will require the cooperation of everyone on Kauai to achieve".

We believe that due to the magnitude of need for affordable housing, the proposed project should contribute a larger share than the 10 percent that is currently being proposed. Further, based upon the U.S. Department of Housing and Urban Development's 1988 estimate of median income for a family of four in the County of Kauai, which is $31,500, we believe that affordable homes should be priced as follows:

Income Group	Affordable Price*
50% - 80% of median	No more than $424-$634/month for rent
80% - 120% of median	$ 75,100 - $118,950
120% - 140% of median	$118,950 - $141,000

*Based on the assumption that families should pay no more than 30% of their adjusted gross income for rent. Affordable sales prices are based upon (1) a 10% fixed, interest rate; (2) 10% down payment; (3) $100 reserved for taxes and insurance; and (4) a qualifying ratio of 33%.

Sincerely,

JOSEPH K. CONANT
Executive Director

cc: Mr. Bruce Tsuchida, R.M. Towill Corporation
The Honorable Roger A. Ulveling
Department of Business and Economic Development

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November 7, 1988

Mr. Joseph K. Conant
Executive Director
Dept. of Business & Economic Dev.
Housing Finance & Development Corp.
State of Hawaii
P.O. Box 29360
Honolulu, Hawaii 96820-1760

Dear Mr. Conant:

SUBJECT: Draft EIS for Kukuiula Planned Community, Koloa, Kauai, Hawaii

Thank you for your comments of October 25, 1988 relating to the proposed Kukuiula Planned Community project. We appreciated your review of this document.

A mix of single family and multi-family housing will be provided for affordable housing either on or off site. On-site affordable housing may be integrated among market units rather than designating a specific area for this development. Land may also be donated to the County for development of affordable housing. An off-site location has not been determined at this time.

As indicated in your letter, over 3,000 units will be needed by the year 2005 for the Koloa District. This planned development will help to meet the needs of this growing community. In addition to the variety of housing products, recreational facilities, open space and commercial uses are proposed to complement the overall development.

If you should have any questions or additional comments and suggestions, please direct them to:

Mr. Bruce T. Tsuchida, Project Manager
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941
Phone: 842-1133

Very truly yours,

B. Tsuchida

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JH:W9

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

REC'D NOV 10 1988

BT

JH

JY

In reply, please refer to:
EPHSD

November 3, 1988

MEMORANDUM

To: Mr. Tom Shigemoto, Planning Department
County of Kauai

From: Deputy Director for Environmental Health

Subject: Draft Environmental Impact Statement (DEIS) for Kukuiula Planned Community, Koloa, Kauai

Thank you for allowing us to review and comment on the subject DEIS. Our environmental health concerns are as follows:

Drinking Water

Thank you for the opportunity to review and comment on the DEIS. To support this extensive residential project, a new well is being proposed on the ridge above Mahaulepu where Koloa Well C (5426-04) and Koloa Well D (5426-05) are located. A new source of water will require compliance with the State's Potable Water Systems Regulations, Chapter 20, Title 11, Administrative Rules.

Section 11-20-29 of Chapter 20 requires all new sources of potable water serving public water systems to be approved by the Director of Health prior to their use to serve potable water. Such approval is based primarily upon the satisfactory submission of an engineering report which adequately addresses all concerns set down in Section 11-20-29. The engineering report must be prepared by a registered professional engineer and bear his or her seal upon submittal.

Should you have any questions regarding Chapter 20, Title 11, Administrative Rules, please contact the Drinking Water Program at 548-2235.

Air Pollution

The DEIS does not satisfactorily address the potential impact on the ambient air quality that may result from the increased vehicular activity associated with the proposed project and all other projects which were previously approved and are in various stages of construction. Based on the existing and projected traffic volume, an air quality assessment should be conducted for the associated corridors, roadways, and highways. The results should be compared to the state and federal ambient air quality standards. Should a potential violation be determined, the environmental impact statement should address the mitigating actions which shall be implemented.

Water Pollution/Wastewater Reuse

The increased use of reclaimed wastewater in urban areas and agriculture represents a potential health risk to the general public. Contact with the reclaimed wastewater from treated domestic sewage poses potential exposure to pathogenic organisms.

Pathogenic organisms are present in the reclaimed wastewater which commonly causes infectious diseases. They include bacteria, viruses, protozoa, and helminths (or worms).

The managers of the irrigation system using reclaimed wastewater should be aware of the possible hazards and should evaluate their system for public health, safety and efficiency.

The following outline should be considered to assure the safety of the general public and personnel working with the irrigation system.

1. Assess the capability of the proposed reclaimed wastewater system to insure the public health and safety as to:

   a. Irrigated areas should be no closer than 500 feet from potable water wells and reservoirs.

   b. Irrigated areas should be no closer than 100 feet from any private residence.

   c. Application rates should be controlled to minimize ponding, and excess irrigation tailwater in the reclaimed wastewater irrigated area should be contained and properly disposed. An assessment should be made of the acceptable time and rate of application based on factors such as type of vegetation, soil, topography, climate and seasonal variations.

   d. Scheduled times of irrigation should be such that the public is not in the vicinity and the soil is sufficiently dry to accept the irrigation water.

   e. Permanent fencing or barriers should be erected around polishing or holding ponds to prevent public entry or stray feral and tame animals from gaining access to the ponds.

   f. Provision for retention of records for fields irrigated by reclaimed wastewater. Records should include dates when the fields are irrigated, rate of application, total application and climatic conditions. Records should also include any operational problems, diversions to emergency storage or safe disposal and corrective or preventive action taken.

2. Appropriate means of notification shall be provided to inform the employees and public that reclaimed wastewater is being used for irrigation on the site.

a. Posting of conspicuous signs with sufficient letter size for clear visibility with proper wording should be distributed around the use areas.

b. Signs shall be securely fastened. Periodic surveillance shall be conducted to assure permanent posting at all times. Immediate replacements shall be made that may be due to deterioration, vandalism and misuse.

3. Employees or users should be cautioned and warned of the potential health hazards associated with the ingestion of reclaimed wastewater being used at the site.

a. Employees should be warned that the ingestion of reclaimed wastewater is unsafe.

b. Employees should be protected from direct contact of the reclaimed wastewater. If necessary, protective clothing should be provided.

c. Employees should be informed of the following:

(1) The irrigation water is unsafe for drinking or washing.

(2) Avoid contact of the water or soil with any open cuts or wounds.

(3) Avoid touching the mouth, nose, ear or eyes with soiled hands, clothes or any other contaminated objects.

(4) Be aware that inanimate objects such as clothes or tools can transport pathogenic organisms.

(5) Always wear shoes or boots to protect the feet from the pathogenic organisms in the soil or irrigation water.

Wastewater Disposal

According to the DEIS, the proposed development would utilize the existing Metropolitan Mortgage Company's wastewater treatment plant (believed to be the Kuhio Shores STP) until the new wastewater treatment works is completed. The existing facility appears to have a design capacity of 107,250 gallons per day. Any plans required to expand this treatment works will have to be approved by the Director in accordance with Act 282, SLH 1985.

The proposed 1.1 MGD wastewater treatment works must comply with all of the requirements of Section 7, Act 282, SLH 1985.

Hazardous Waste/Underground Storage Tanks

As stated on page 1-5, one of the possibilities to control dust on the cane haul road is the use of oil. The developer shall be informed that used or waste oil may be considered hazardous waste and, therefore, may not be permitted to be disposed on the road to control dust.

If underground storage tanks are provided to serve the proposed fuel dock at the marina, the developer shall confer with the Department of Health, Hazardous Waste Section, prior to the installation of the tanks.

Vector Control

The sewage effluent from the proposed wastewater treatment work will be used to irrigate the proposed golf course. If ponds are constructed to store or contain the effluent prior to and after irrigation, precautionary measures shall be taken by the developer to prevent the breeding of vectors in the effluent.

Rodents harboring in the cane fields and pasture land will be dispersed to the neighboring residential areas when the project area is cleared. The developer shall inspect the area to ascertain whether rodents are present or absent. If the inspection reveals that rodents are present, the developer shall eradicate the rodents before the area is cleared.

Bruce S. Anderson
BRUCE S. ANDERSON, Ph.D.

cc: Bruce Tsuchida, R. M. Towill ✓
DHO, Kauai

R. M. TOWILL CORPORATION

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November 21, 1988

Mr. Bruce S. Anderson, Ph.D
Department of Health
State of Hawaii
P.O. Box 3378
Honolulu, hawaii 96801

Dear Mr. Anderson:

SUBJECT: Draft EIS for Kukuiula Planned
<u>Community, Koloa, Kauai, Hawaii</u>

Thank you for your comments of September 22, 1988 relating to the proposed Kukuiula Planned Community project. We appreciated your review of this document.

An engineering report will be prepared in accordance with Section 11-20-29, Chapter 20, prior to development of the new well. Thereafter, approval by the Director of Health will be requested.

An air quality study is being prepared. Results of this study will be incorporated into the Final EIS.

The managers of the irrigation system using the reclaimed wastewater will be informed of the potential health hazard. The outline of procedures to assure the safety of the general public and personnel will be provided to the managers.

Upgrades to the existing wastewater treatment plant and development of the new wastewater treatment facility will be in accordance with the requirements of Section 7, Act 282, SLH 1985.

Used or waste oil will not be used to control dust on the cane haul road.

The Department of Health, Hazardous Waste Section, will be consulted prior to installation of the underground fuel storage tanks at the marina.

Precautionary measures will be taken to prevent the breeding of vectors in the sewage effluent should ponds be used to store the effluent prior to or after irrigation. Inspection of the site will take place to determine whether rodents are present prior to excavation. If rodents are found, they will be eradicated before the area is cleared.

If you should have any questions or additional comments and suggestions, please direct them to:

Mr. Bruce T. Tsuchida, Project Manager
R. M. Towill Corporation
420 Waiakamilo Road, Suite 411
Honolulu, Hawaii 96817-4941
Phone: 842-1133

Very truly yours,

B. T. Tsuchida

Bruce T. Tsuchida, Manager
Planning & Land Development Dept.

JH:W9

APPENDICES

APPENDIX A

NOISE REPORT

DARBY & ASSOCIATES
ACOUSTICAL CONSULTANTS

#88-5
June 7, 1988

R. M. Towill Corporation
420 Waiakamilo Road, #411
Honolulu, Hawaii 96817-4941

Attention: Mr. Bruce Tsuchida

Subject: Noise Impact Evaluation for Environmental Assessment of Kukuiula Bay Project, Kauai, Hawaii

Dear Mr. Tsuchida:

Following is a summary of the noise impact analyses performed for the subject project:

A. Existing Acoustical Conditions - Noise sensitive land uses which may be impacted by the proposed project are residential, apartment, and hotels on Lawai Road and housing on Poipu Road. On a day with normal tradewinds, the residual background noise level along Lawai Road was 48 to 53 dBA with the dominant sounds being the wind in the foilage, distant traffic, the surf, and birds. Periodically, helicopters flying over the ocean, and parallel to the shore, caused maximum noise levels of 55 dBA. Automobiles traveling 25 to 35 mph, typically cause maximum noise levels of 58 to 67 dBA at a distance of 45 to 50 feet from the center of the road. On Poipu Road in the southern edge of Koloa, the average hourly noise level (L_{eq}[60 min]) is estimated as 67 dBA for a setback distance of 60 feet from the center of the road. Tour buses typically cause maximum noise levels at 50 feet of about

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75 dBA if not accelerating and levels to 85 dBA when accelerating.

Occupants in housing near sugar cane fields are affected periodically by noise, particularly when harvesting is being done. More discussion of noise from sugar cane operations will occur later.

B. Traffic Noise - Noise from motor vehicles on Poipu and Lawai Roads and on interior roads will impact activities in the open spaces as well as those inside the naturally ventilated buildings in the project. In order to assess traffic noise impact, the following has been done:

1. Averaged traffic noise level measurements were made on March 9, 1988, along Lawai and Poipu Roads while simultaneously obtaining the traffic counts including the mix of vehicles (e.g. autos, medium trucks, heavy trucks and buses). The purpose of these measurements was to validate the Federal Highway Administration's (FHWA) Traffic Noise Prediction Model (reference 1). It developed that the volume of traffic on Lawai Road was too low to obtain meaningful correlations, but Table I summarizes the comparison of the measured short term measurement Equivalent Noise Levels, e.g. (L_{eq}[10 minutes]), with predicted hourly noise levels (L_{eq}[60 minutes]) for two locations on Poipu Road. The fact that the two values agree within two dB for

measurements is considered acceptable.

2. Traffic projections for the roads based on a fully-developed project have been analyzed for the perimeter roads and the major interior roads. Figure 1 shows the six locations chosen to make traffic noise level predictions.

3. At each location, the maximum, both-direction peak-hour traffic volume was determined; that is, either the a.m. or p.m. peak hour. Then it was assumed that the noisiest hour would occur when all vehicles could move freely at the posted speed limits of 35 mph (Level C) and that this would occur when the volume in each direction would be at 80% of peak-hour volume.

4. The mix of vehicles was assumed to be 96% automobiles or light trucks or vans; 2.5% medium trucks; and 1.5% heavy trucks and buses.

5. The Federal Highway Administration (FHWA) traffic noise prediction model (reference 1) was then used to analyze the worst case traffic noise propagation condition: that is when direct sound transmission occurs from the traffic to a listener without any sound attenuation from the ground, plantings, barriers, etc. This condition occurs commonly when all lanes of traffic are completely visable from a

Table I

Comparisons of Predicted and Measured Traffic Noise Levels on Poipu Road

Roadway	(feet) Distance From Center of Roadway	(dBA) Measured L_{eq} [10 Minutes]	(dBA) Predicted L_{eq} [60 Minutes]
Poipu Road (near the Cane Haul Road)	60'	65.9	67
Poipu Road (in Koloa)	50'	66.2	66.7

Note: Microphone was about 7' above the ground.

Measurements were made on March 9, 1988, 1:53 p.m. to 2:25 p.m.

window or lanai on the 2nd floor or above.

6. The noise exposure criteria used by the Department of Housing and Urban Development (HUD) [reference 2] is then used to determine acceptability for housing. Thus, the distance from the centerline of the right-of-way (R.O.W.) to the 65 L_{dn} noise exposure contour is calculated for the worst-case condition; that is when there is no sound attenuation from plantings, walls, etc. Also the setback distances for single story housing with normal landscaping is determined.

Table II provides the estimated setback distances for multi-story, naturally ventilated buildings required by HUD traffic noise criteria. The six locations in Table II are shown in Figure 1. For example, at Location V along the Project Road, a two-story unit should be located 92 feet from the centerline of the road R.O.W. Since the edges of the R.O.W. are to be 41 to 53 feet from the center of the R.O.W., then multi-story buildings should be set-back about 41 to 49 feet from the edge of the R.O.W. It is to be realized that the set-back distances in Table II for multi-story housing are indeed worst-cases and that detailed analysis of specific building projects may allow smaller set-backs. For example, where Manuhonuhonu Road is elevated above future housing, the natural topographic features may effectively shield the open windows in second-floor units allowing substantially less set-

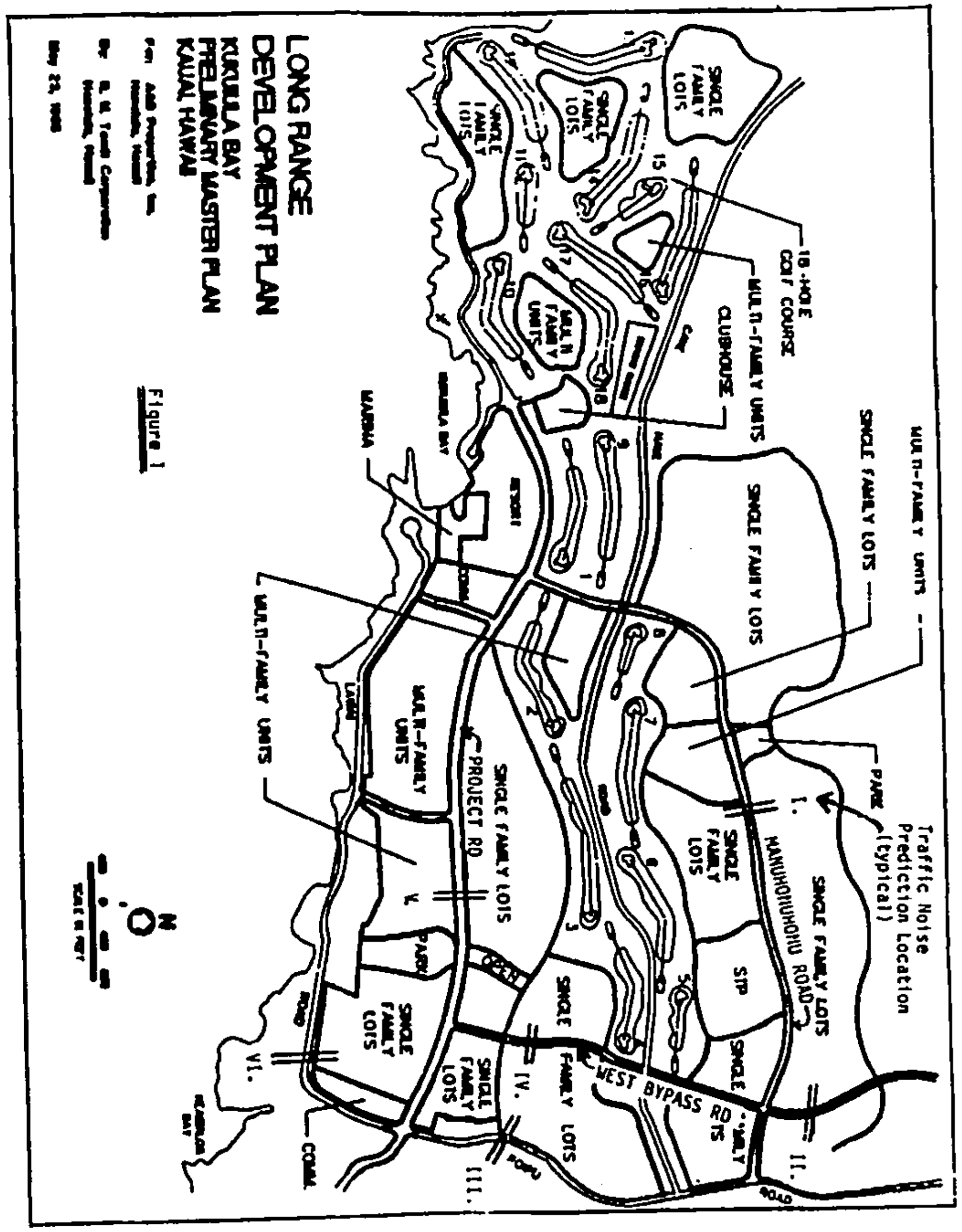

Figure 1

back if optimum planning, grading, and design are incorporated.

Table II also shows the estimated set-back distances for single-story housing required by the HUD traffic noise criteria. Because the sound energy propagating to open windows and doors passes over (and through) landscaped areas, it decreases more rapidly than when propagating unimpeded through air. For example, single story housing on Project Road would have to be setback only about 31 to 39 feet from the edge of the R.O.W. Berms and/or walls can be effectively utilized as noise barriers to shield single story housing in many situations, allowing the structures to be located closer to the roadways.

In both single and multi-story housing which are naturally ventilated, sound absorptive surfaces can be used in rooms to reduce the reverberant noise buildup. It can be shown that five decibels of reverberant noise reduction can be achieved in typical bedrooms by using carpeting with padding and louvered closet doors as compared to hard tile floors and solid closet doors. Also, acoustic ceilings or acoustic wall-panel appliques can be used in the rooms to further reduce the reverberant noise in the rooms.

C. <u>Noise from Sugar Cane Operations</u> - Residents living in housing near sugar cane fields and the cane haul road will experience noise exposures from sugar cane operations.

Table II - Estimated Setback Distance from the Centerline of the Right-of-Way for Housing Required by HUD Traffic Noise Criteria*

Roadway	(feet) Multi-Story	(feet) Single Story
I. Manuhonuhonu Road	47	47
II. West Bypass Road (North)	97	79
III. Poipu Road	32**	32**
IV. West Bypass Road	84	72
V. Project Road	92	82
VI. Lawai Road	32**	32**

* Includes HUD requirement for 6.5 feet from noise level prediction location to the building set back line

** No setback required from traffic noise considerations

Typically, sugar cane fields are harvested every two years involving bulldozers (push rakes) and clam-shell cranes loading trucks operating over 24 hours per day. At harvesting rates of 30 to 40 acres per 24 hours, the heavy equipment can cause appreciable noise exposures above the background noise for several days.

Land preparation for planting occurs typically every six years if ratoon crops are used and involves a sequence of operations such as harrowing, plowing, leveling, stone removal, etc. averaging a rate of about 13 acres per day based on two shifts per day. Thus, noise exposures during land preparations from heavy diesel-powered equipment operating in nearby fields for a total of several days every few years will be experienced in some residential areas (reference 3).

Presently there are no quantitative noise regulations in Kauai County which apply to sugar cane operations. However, there are State Department of Health (DOH) noise regulations (reference 4) presently enforced in the City and County of Honolulu, and since there is a good likelihood of these regulations being extended to Kauai as the county develops further, these DOH regulations will be considered in this study. The grandfather clause on the regulations will allow the sugar operations to make 70 dBA for 10% of the time in any 20-minute period at the property line. Furthermore, the

regulations allow conditional use of permits for agricultural field preparation and harvesting as long as 95 dBA is not exceeded at the property line. Unlike many of the present occupants in older housing on Kauai who are accustomed to the operations because many of them were associated with the sugar industry, many new residents in the project may be annoyed and complain about the periodic 24-hour loud noise events which may interfere with sleep, conversations, and radio/TV listening. It is to be noted that the field operations of land preparation every two to six years and harvesting every two years should not cause the annual average L_{dn} to exceed 65 L_{dn} at the property line which is considered a maximum acceptable exterior noise exposure by the U.S. Department of Housing and Urban Development (HUD). See reference 2. However, it is recommended that the sales documentation for new housing in the project located near cane fields contain information on the nature of the sugar operations and of the noise exposures to be expected.

Unlike the infrequent noise events associated with field operations, agricultural traffic on cane haul roads servicing many fields can potentially cause high noise exposures to nearby housing. Housing located on, or near, cane haul roads will experience 24-hour noise events from passing cane haul trucks when fields serviced by that cane haul road are being harvested. Persons located 80 feet from the edge of the cane haul road typically would experience a maximum noise level of about 78 dBA for each cane haul truck pass.

According to information obtained from the Manager of Field Operation for the McBryde Sugar Co., the fields to be serviced by the major cane haul road passing through the project are those north and west of the project. These 46 fields contain 4,500 acres and it is estimated they will generate the agricultural vehicular traffic shown in Table III using the prediction techniques developed in reference 3. It is understood that the types of cane haul truck and other equipment used at the McBryde Sugar Co. is similar to that used at Oahu Sugar Company (OSC), and thus equipment noise level measurements obtained at OSC are assumed to be applicable to this project. The L_{dn} caused by this traffic level during the approximate 56 days (24 hours/day) per year required to harvest the cane is shown in Table IV. Since setbacks for housing along the cane haul road will be in excess of 56 feet from the middle of the road, the 65 L_{dn} criteria will not be exceeded in those units. However, during nights when there is harvesting in one of the fields, persons may complain of noise from the large cane haul vehicles which will be much greater than the ambient noise level.

Other noise exposures due to cane operations that will be experienced by persons in the project include service vehicles using the cane haul roads and aircraft spraying nearby cane

TABLE III

VEHICLE COUNT ESTIMATES FOR CANE HAUL ROAD THROUGH THE KUKUIULA BAY PROJECT

A = 4500 ACRES
N = 46 FIELDS

VEHICLE TYPE	OPERATION	OCCURRENCE FACTOR	PASSES PER ACRE PER 24 MONTHS DAY	PASSES PER ACRE PER 24 MONTHS NIGHT	PASSES/24 MO. DAY	PASSES/24 MO. NIGHT	PASSES PER 24 HR.* DAY	PASSES PER 24 HR.* NIGHT	PASSES/HR.* DAY	PASSES/HR.* NIGHT
TYPE 10 AUTOS AND PICKUP TRUCKS	H	1	1.10	.38						
	LP	1/3	.57							
	P	1/3	.77							
	R	2/3	.29							
	TOTALS.		2.73	.38	12,285	1,710	33.7	4.7	2.2	.5
TYPE 20G GASOLINE POWERED TRUCKS	H	1								
	LP	1/3								
	P	1/3								
	R	2/3								
	TOTALS		.19	0	855	0	2.3	0	--	--
TYPE 20D DIESEL TRUCKS (NOT CANE HAUL)	H	1	.10	0						
	LP	1/3	.10	0						
	P	1/3	.36	0						
	R	2/3	.05	0						
	TOTALS.		.61	0	2,745	0				
	EQUIPMENT TRANSPORT	1	(10.5M)	0	483	0				
	TOTALS		--		3,228	0	8.8	0	0.6	0
TYPE 300 (CANE HAUL)	H	1	3.75	2.25	16,875	10,125	46.2	27.7	3.1	3.1

H = HARVESTING
LP = LAND PREPARATION
P = PLANTING
R = RATOONING

A = TOTAL ACRES
N = NUMBER OF FIELDS

* BASED ON 183 OPERATING DAYS PER YEAR

DAY: 7 AM TO 10 PM
NIGHT: 10 PM TO 7 AM

fields.

D. <u>Golf Course Maintenance Noise</u> - Noise from equipment associated with ground maintenance activities, including lawn mowers and leaf blowers, could have an adverse impact on the proposed nearby residential neighborhood particularly when the equipment is near the housing. However, noisy equipment is also incompatible and disruptive with golf play. All equipment powered by internal combustion engines will have exhaust mufflers. Schedules will be developed so noisier maintenance operations do not occur near residences before 7 a.m. The noise from ground maintenance operations will not cause "unreasonable" or "excessive" noise as defined in reference 4.

E. <u>Stationary Equipment and Other Noises from Resort and Commercial Operations</u> - Noise from fans; the trash compactors; and any other stationary equipment in the resort and commercial complexes will not exceed the allowable noise levels in reference 4. Similarly, the design of parking garages will be such that tire squeals and vehicle exhaust noises will not violate the regulations in reference 4. Trash pickup and delivery vehicles will be operated and scheduled to cause minimum disturbance to neighboring residential units if complaints arise. Minimally, these operations will meet the requirements in reference 4.

Property commercial uses also will not cause

TABLE IV

L_{dn} CALCULATIONS FOR CANE HAUL ROAD TRAFFIC, KUKUIULA BAY PROJECT

Vehicle Type	(dB) SEL at 50'	Number of Passes: Day N_d	Night N_n	Day-Night Noise Level (L_{dn}): @50'	@100'	@200'*	@400'*
10	70	33.7	4.7	40			
20G	80	2.3	0	34			
200	86	8.8	0	46			
300	90.2+	46.2	27.7	66			
TOTAL				66	60	54	48

$$L_{dn_i} = SEL_i + 10 \log (N_{d_i} + 10N_{n_i}) - 49.4$$

$$L_{dn_{TOTAL}} = 10 \log \sum_i 10^{\frac{L_{dn_i}}{10}}$$

+ Average of 37 OSC Cane Haul Trucks (21 Trucks loaded, 16 Trucks empty)
SEL = 90.2 $\pm$ 2 dB
dBA_{max} = 83.8 $\pm$ 2 dB

* Sound propagation based on spherical spreading only.

NOTE: At a harvest rate of 40 acres/day (24 hours), it requires 4500 acres ÷ 40 AC/DAY = 113 DAYS/2 YEARS or about 56 DAYS/YR. for harvesting.

"unreasonable" or "excessive" noise as defined in reference 4.

F. <u>Noise Impact from Construction</u> - Development of the project site will involve grubbing, grading, and the construction of infrastructure and buildings. The various construction phases of a development project may generate significant amounts of noise; the actual amounts are dependent upon the methods employed during each stage of the process. Typical construction equipment noise ranges in dB(A) are shown in Figure 2. Earthmoving equipment such as bulldozers and diesel powered trucks will probably be the loudest equipment used during the construction of housing units. Since it is anticipated that noise generated during construction will exceed allowable limits in reference 4, a permit will be obtained from DOH assuming Kauai County adopts the regulations in the future. DOH may grant permits to operate vehicles, construction equipment, power tools, etc. which emit noise levels in excess of the allowable limits. Required permit conditions for construction activities are:

"No permit shall allow construction activities creating excessive noise...before 7:00 a.m. and after 6:00 p.m. of the same day."

"No permit shall allow construction activities which emit noise in excess of ninety-five db(A)...except between 9:00 a.m. and 5:30 p.m. of the same day."

"No permit shall allow construction activities which

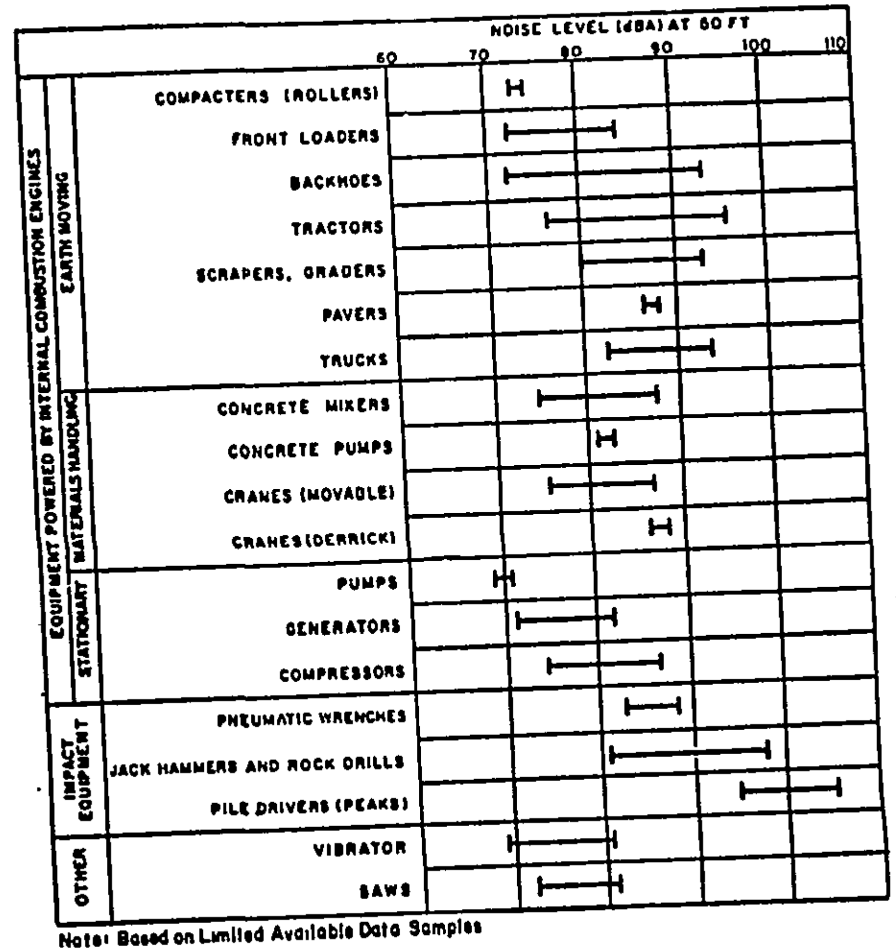

FIG. 2 CONSTRUCTION EQUIPMENT NOISE RANGES.

> exceed the allowable noise levels on Sundays and on... [certain] holidays. Activities exceeding ninety-five dB(A) shall [also] be prohibited on Saturdays."

In addition, construction equipment and on-site vehicles or devices requiring an exhaust of gas or air must be equipped with mufflers. Also, construction vehicles using trafficways will satisfy the noise level requirements defined in reference 5.

G. <u>Blasting In The Marina Harbor Excavation</u> - If blasting is used in the excavation of the harbor for the proposed marina, there are the following considerations concerning potential adverse noise and vibration effects:

(a.) Ground vibrations and/or airblasts from the explosions may cause structural damage or annoyance in nearby residences.

(b.) Possible damage to the existing sea walls, breakwater, and structures at Kukuiula Boat Harbor Park.

(c.) Possible injury to endangered species (namely humpback whales and green sea turtles) or major marine mammals due to overpressure pulses from underwater blasting.

In order to control the blasting operations so the above possible impacts are minimized, special conditions could be utilized in the Technical Specifications for the contract to perform the work. The special conditions could involve the

contractor presenting a blasting program which would include mailing notices to potentially impacted residences and owners of developed property on Lawai Road, stating the overall duration time estimated and the general schedule for blasting. The notices would provide a telephone number for complaints. The program could also include monitoring procedures to determine ground vibrations and air blast levels. .

Blasting would be limited to the period of 9:00 a.m. to 5:30 p.m. and would not occur on Saturdays, Sundays and holidays listed in Reference 4.

A dike between the marina and the ocean would be maintained during the bulk of any blasting activity. When there is no continuous dike above sea level between the blasts and the open sea, no blasting would be done if endangered species or major animals are within view from the shoreline.

A plan to assure that no damage is done to the sea walls and breakwater in Kukuiula Boat Harbor Park would be provided which could include documentation of the existing conditions,eg. elevations and photographs of the existing work. The plan could also include periodic inspections and checking evaluations to assure that no settlement or displacement of rocks has occurred.

H. <u>Noise Mitigation Measures</u> - The design of the facility will include noise mitigation measures in the planning of the location and orientation of the air-conditioning equipment, location and orientation of the air-conditioning equipment, exhaust fans, pool pumps, etc. for the resort and commercial operations such that local noise regulations (Reference 4) will be satisfied.

Sincerely,

Ronald A. Darby, P.E.

RAD:djs

References:

1. "FHWA Highway Traffic Noise Prediction Model", Federal Highway Administration, December 1978.
2. "Environmental Criteria and Standards", Department of Housing & Urban Development, Federal Register, Vol. 44, No. 135, July 12, 1979.
3. "Noise from Sugar Operations in Hawaii - A Study of the Extent and Effect on the Community", - by R.A. Darby, Hawaiian Sugar Planters' Association, Jan. 1971.
4. "Chapter 43 - Community Noise Control for Oahu", Department of Health, State of Hawaii, Administrative Rules, Title 11, 1981.
5. "Chapter 42 - Vehicular Noise Control for Oahu", Department of Health, State of Hawaii, Administrative Rules, Title 11, 1981.

APPENDIX B

AIR QUALITY

AIR QUALITY STUDY
FOR THE PROPOSED
KUKUIULA PLANNED COMMUNITY
KUKUIULA, KAUAI, HAWAII

Prepared for:

Alexander & Baldwin, Inc.

Prepared by:

Barry D. Root & Barry D. Neal

November 1988

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AIR QUALITY STUDY FOR THE PROPOSED KUKUIULA PLANNED COMMUNITY KUKUIULA, KAUAI, HAWAII

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1.0 INTRODUCTION AND PROJECT DESCRIPTION

The Kukuiula Planned Community is proposed for development at Kukuiula Bay, Kauai, Hawaii. As shown in the location map presented in Figure 1, the subject site is located along the southern coast of Kauai in the Koloa District. The proposed project would be developed in two phases on a total of approximately 1000 acres of land that is currently used for agricultural purposes. Phase I would involve an area of 219 acres and would result in the construction of 1738 single- and multi-family housing units and two commercial centers. During Phase II, an additional 800 acres would be developed adjacent to the Phase I area which would provide 2300 additional single- and multi-family housing units, a 500-room hotel with resort facilities, a marina, a golf course, and a sewage treatment plant. Development of the project would begin by the year 1990 and continue for 20 to 25 years until the year 2010 or 2015.

The purpose of this study is to describe existing air quality in the project area and to assess the potential short-term and long-term direct and indirect air quality impacts that could result from construction and use of the proposed project as planned. Measures to mitigate these impacts are suggested where possible and applicable.

2.0 AMBIENT AIR QUALITY STANDARDS (AAQS)

National Ambient Air Quality Standards (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 pollutants. The

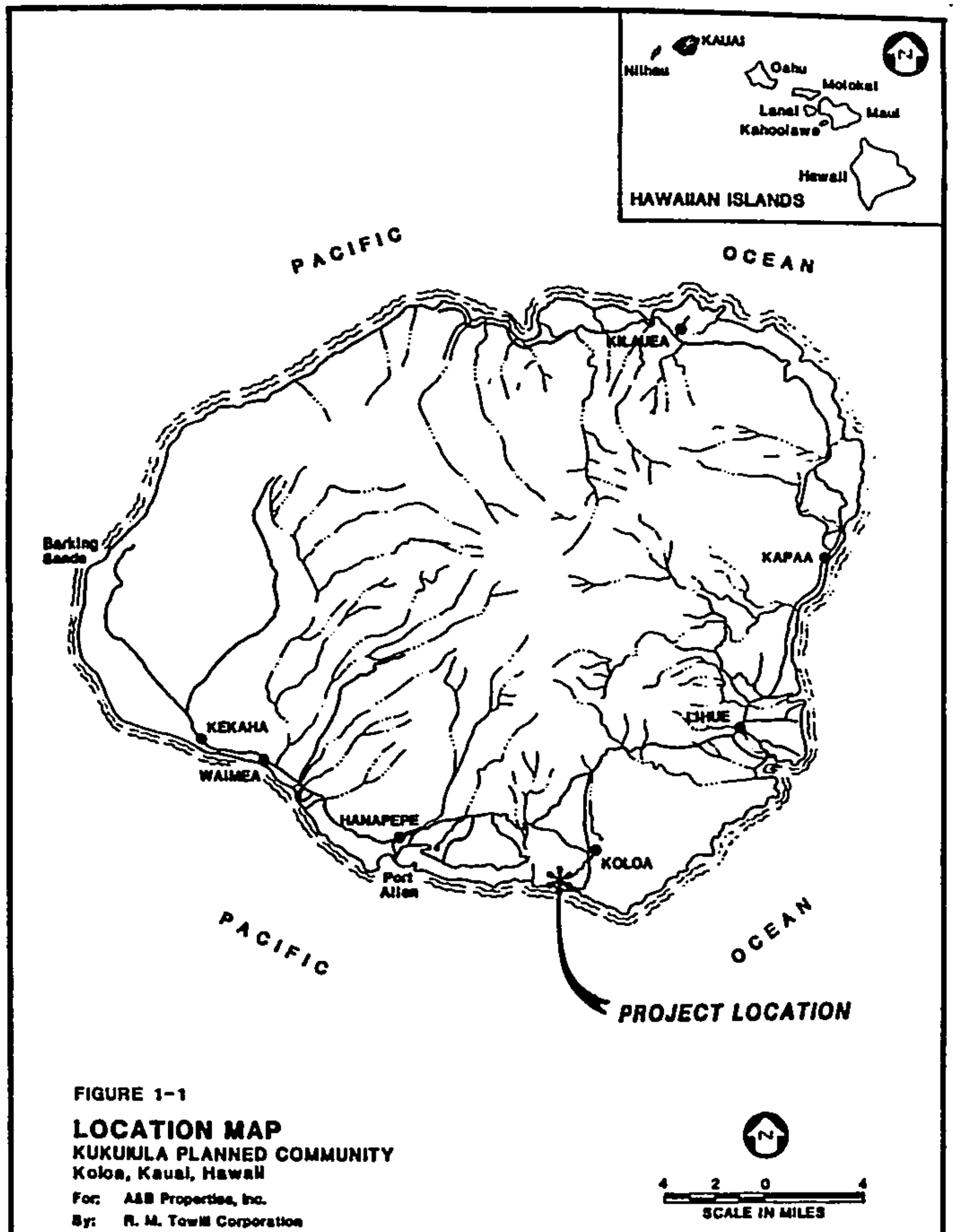

FIGURE 1-1
LOCATION MAP
KUKUIULA PLANNED COMMUNITY
Koloa, Kauai, Hawaii
For: A&B Properties, Inc.
By: R. M. Towill Corporation

Table 1

SUMMARY OF STATE OF HAWAII AND NATIONAL AMBIENT AIR QUALITY STANDARDS (AAQS)

Pollutant (units)	Averaging Time	Maximum Allowable Concentration		
		National Primary	National Secondary	State of Hawaii
Suspended Particulate Matter (ug/m^3)	Annual	-	-	60[a]
	24 Hours	-	-	150[b]
Particulate Matter[c] (ug/m^3)	Annual	50	50	-
	24 Hours	150[b]	150[b]	-
Sulfur Dioxide (ug/m^3)	Annual	80	-	80
	24 Hours	365[b]	-	365[b]
	3 Hours	-	1300[b]	1300[b]
Nitrogen Dioxide (ug/m^3)	Annual	100	100	70
Carbon Monoxide (mg/m^3)	8 Hours	10[b]	-	5[b]
	1 Hour	40[b]	-	10[b]
Ozone (ug/m^3)	1 Hour	235[b]	235[b]	100[b]
Lead (ug/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

pollutants for which AAQS have been established 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 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 pollutant for one or more averaging times to prevent harmful effects. Averaging times vary from one hour to one year depending on the pollutant and type of exposure necessary to cause adverse effects. In the case of the short-term (i.e., 1- to 24-hour) AAQS, both national and state standards allow one exceedance per year.

State of Hawaii AAQS are in some cases considerably more stringent than comparable national AAQS. In particular, the State of Hawaii 1-hour AAQS for carbon monoxide is four times more stringent than the comparable national limit.

Under the provisions of the Federal Clean Air Act [1], the U.S. Environmental Protection Agency (EPA) is required to periodically review and re-evaluate national AAQS in light of research findings more recent than those which were available at the time the standards were originally set. Occasionally new standards are created as well. Most recently, the national standard for particulate matter has been revised to include specific limits for particulates 10 microns or less in diameter (PM-10) [2]. The State of Hawaii has not explicitly addressed the question of whether to set limits for this category of air pollutant, but national AAQS prevail where states have not set their own more stringent levels.

Hawaii AAQS for sulfur dioxide were relaxed in 1986 to make them essentially the same as national limits. It has been proposed in various forums that the state also relax its carbon monoxide standards to the national levels, but at present there are no indications that such a change is being considered.

3.0 PRESENT AIR QUALITY

Present air quality in the Kukuiula area could potentially be affected by air pollutants from four main types of sources: natural, industrial, agricultural and vehicular. Table 2 presents an air pollutant emission summary for Kauai for the latter three source categories which was compiled in 1980.

The only significant fixed-point stack emissions on Kauai are from sugar mills and the electric utility. Sugar mills produce more than 50 percent of the particulates, with cane field burning producing most of the rest. Sulfur dioxide is emitted mainly by the steam electric power plant located near Port Allen with much

Table 2

AIR POLLUTION EMISSIONS INVENTORY FOR
COUNTY OF KAUAI, 1980

Source Category	Percent of Total County Emissions				
	Partic-ulate	Sulfur Oxides	Nitrogen Oxides	Carbon Monoxide	Hydro-carbons
Steam Electric Power Plants	1.9	64.5	25.2	0.4	0.3
Gas Utilities	0.0	0.0	0.0	0.0	0.0
Fuel Combustion in Agricultural Industry	51.3	9.0	8.0	0.0	0.0
Refinery Industry	0.0	0.0	0.0	0.0	0.0
Petroleum Storage	0.0	0.0	0.0	0.0	0.0
Metallurgical Industries	0.0	0.0	0.0	0.0	0.0
Mineral Products Industry	2.4	0.4	1.5	0.0	0.0
Municipal Incineration	0.0	0.0	0.0	0.0	0.0
Motor Vehicles	3.9	12.0	53.8	58.4	50.5
Construction, Farm and Industrial Vehicles	0.5	1.9	6.3	1.5	1.1
Aircraft	0.2	1.4	3.8	3.3	2.7
Vessels	0.2	10.8	1.4	0.1	0.5
Agricultural Field Burning	39.6	0.0	0.0	36.3	44.9
Total in Percent	100.0	100.0	100.0	100.0	100.0
Total in Tons per Year	3129	698	2678	34,179	3773

Source: State of Hawaii, Department of Health

smaller amounts coming from ships using Nawilili Harbor. Most of the nitrogen oxides, carbon monoxide and hydrocarbons emitted on Kauai are generated by motor vehicles.

Natural sources of air pollution emissions which could also affect the project area but cannot be quantified very accurately include the ocean (sea spray), plants (aero-allergens), wind-blown dust, and perhaps distant volcanoes on the Island of Hawaii.

Table 3 is a long-term summary of air pollution measurements collected at the Kauai District Health Office in Lihue, about 10 miles northwest of the project site. Prior to 1978 the State of Hawaii 24-hour particulate standard, which at that time was set at 100 micrograms per cubic meter (ug/m^3), was being exceeded at a rate of about once every other year. After 1978, taller stacks and wet scrubbers were installed at the nearby Lihue Mill; the particulate standard at Lihue has not been exceeded since.

Nitrogen dioxide monitoring was discontinued at the Lihue site in 1976 because of a lack of manpower, an absence of federal requirements for such monitoring, and the generally low levels that had been previously recorded. State of Hawaii Department of Health budget constraints forced a discontinuance of sulfur dioxide monitoring in October 1985, but measurements of long-term concentrations to that date had been minimal in any case. In 1986 particulate monitoring was shifted from total suspended particulates to PM-10 (particles less than 10 microns in diameter) to conform to a change in the national AAQS. The last two years of PM-10 measurements were well within allowable limits.

Table 3

AMBIENT AIR QUALITY MEASUREMENTS
AT KAUAI DISTRICT HEALTH OFFICE, LIHUE[a,b]

Year	Particulates Range	Particulates Mean	Sulfur Dioxide Range	Sulfur Dioxide Mean	Nitrogen Dioxide Range	Nitrogen Dioxide Mean
1973	16-173	39	<5-8	<5	<20-49	<20
1974	13-110	37	<5	<5	<20-86	<20
1975	16-96	40	<5-13	<5	<5-31	7
1976	20-112	37	<5	<5	<5-17	11
1977	12-84	34	<5	<5	discontinued	
1978	22-124	37	<5	<5		
1979	16-86	39	<5	<5		
1980	16-98	38	<5	<5		
1981	18-83	37	<5	<5		
1982	15-87	34	<5	<5		
1983	24-90	39	<5	<5		
1984	13-91	34	<5	<5		
1985[c]	17-76	34	<5-8	<5		
1986[d]	11-42	22	discontinued			
1987[d]	11-42	22				

[a]24-hour averages, micrograms per cubic meter.
[b]Sampling site located about 2 miles west of project site. Frequency of sampling was approximately every six days yielding about 50 samples per year.
[c]Sampling for particulates and sulfur dioxide discontinued in October 1985.
[d]Particulate sampling for 1986 and 1987 are PM-10 only.

Unfortunately, there are no recent long-term measurements of vehicular-related pollutants (i.e., carbon monoxide, nitrogen oxides, ozone or lead) on Kauai, so current levels of these pollutants are difficult to estimate very accurately. However, due to the relatively low level of activity and development in the area and the persistent trade winds from the northeast (where there are few upwind air pollution sources), current air pollution levels are almost certainly low except, perhaps, for a few localized areas where traffic congestion may occur.

4.0 SHORT-TERM DIRECT AND INDIRECT IMPACTS OF PROJECT CONSTRUCTION

For a project of this nature, there are two potential sources of air pollution emissions which could directly result in short-term air quality impacts during project construction: (1) fugitive dust from vehicle movement and soil excavation and (2) exhaust emissions from on-site construction equipment. Indirectly, there 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 grading and dirt-moving activities within the project site. The emission rate for fugitive dust is nearly impossible to estimate accurately because of its elusive nature and because the potential for its generation varies greatly depending upon the type of soil at the construction site, the amount and type of dirt-disturbing activity taking place, the moisture content of exposed soil in work areas, and the wind speed. The EPA [3] has provided a rough estimate for uncontrolled fugitive dust emissions from construction activity of 1.2 tons per acre per month under conditions of "medium" activity, moderate soil silt content (30%), and precipitation/evaporation (P/E) index of 50.

Uncontrolled fugitive dust emissions in the Kukuiula area would probably be somewhere near this level because of the climate and soil type. In any case, State of Hawaii Air Pollution Control Regulations [4] require that visible emissions of fugitive dust from construction activity be essentially nil.

Adequate fugitive dust control can usually be accomplished by establishment of a frequent watering program to keep bare-dirt surfaces in work areas from becoming significant dust generators. Control regulations also require that open-bodied trucks be covered at all times when in motion if they are transporting materials likely to give rise to airborne dust. Paving of parking areas and establishment of landscaping as early in the construction process as possible can also lower the potential for fugitive dust emissions.

On-site mobile and stationary construction equipment will also emit some air pollutants in the form of engine exhausts. The largest of this equipment is usually diesel-powered. Nitrogen oxides emissions from diesel engines can be relatively high compared to gasoline-powered equipment, but the standard for nitrogen dioxide is set on an annual basis and is not likely to be violated by short-term construction equipment emissions. Carbon monoxide emissions from diesel engines, on the other hand, are very 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 are relatively easy to mitigate.

5.0 LONG-TERM DIRECT AND INDIRECT IMPACTS OF PROJECT

5.1 Roadway Traffic

By serving as an attraction for increased motor vehicle traffic on nearby roadways, the proposed project must be considered to be a potential indirect air pollution source. Motor vehicles with gasoline-powered engines are significant sources of carbon monoxide. They also emit nitrogen oxides and those burning leaded gasoline can also 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 Kauai roadways, lead emissions are approaching zero. Nationally, so few vehicles now require leaded gasoline that the EPA is proposing a total ban on leaded gasoline to take effect immediately. Even without such a ban, reported quarterly averages of lead in air samples collected in urban Honolulu have been near zero since early 1986. Thus, lead in the atmosphere is not considered to be a problem anywhere in the state.

Federal air pollution control regulations also call for increased efficiency in removing carbon monoxide and nitrogen oxides from vehicle exhausts. By the year 1995 carbon monoxide emissions are expected to be about one fourth less than the amounts now emitted. At present, however, no further reductions in vehicular emissions have been mandated and increases in traffic levels after 1995 will result in directly proportional increases in vehicle-related pollutant emissions.

To evaluate the potential long-term indirect air quality impact of increased roadway traffic associated with a project such as this, it is standard practice to utilize computerized atmospheric dispersion models 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 motor vehicle generated pollutants. Furthermore, carbon monoxide air pollution is generally considered to be a microscale problem, whereas nitrogen oxides air pollution most often is a regional issue. This is reflected in the fact the AAQS for carbon monoxide are specified on a short-term basis (1-hour and 8-hour averaging times) while the AAQS for nitrogen oxides is set on an annual basis.

Three project scenarios were selected for study: year 1988 with present conditions, year 2000 with Phase I and year 2015 with Phases I and II. To begin the carbon monoxide 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 cycling: decelerating, stopping, queueing and accelerating. For this study, three intersections along Poipu and Koloa Roads were identified for analysis for the year 1988 and year 2000 scenarios. These include the intersections of Poipu Road and Lawai Road, Poipu Road and Koloa Road and Koloa Road and Maluhia Road. For the year 2015 scenario, one additional intersection (which would be constructed and for now called Road B) along Poipu Road between Koloa Road and Lawai Road was identified for examination. At present, none of the intersec-

tions in question is signalized, and all roads are basically two-lane roads. For the future scenarios, signal-controlling of all intersections is planned along with road improvement. The traffic impact assessment report for the project [5] describes the present and future configurations of these intersections and roadways in more detail.

The main objectives of the modeling study were to estimate both current and projected levels of maximum 1-hour average carbon monoxide concentration which could be directly compared to the national and state AAQS. The traffic impact assessment report cited above indicates that current traffic volumes along Poipu and Koloa Roads peak in the morning between 7 and 8 am and again in the afternoon between 3:45 and 4:45. Both current and projected afternoon peak-hour volumes at intersections are higher than the respective morning peak-hour values. Worst-case meteorological dispersion conditions usually occur during the early morning hours. Thus, even though afternoon traffic counts may be higher, the morning peak traffic hour usually can be expected to cause the highest air pollution concentrations along roadways. However, due to possible effects from the queuing of vehicles at intersections, both morning and afternoon peak traffic hours were examined to ensure that worst-case concentrations were identified.

The EPA computer model MOBILE3 [6] was used to calculate vehicular carbon monoxide emission estimates for each of the years studied. 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, 4.2% light-duty gasoline-powered trucks and vans, 0.5% heavy-duty gasoline-powered vehicles, 1% diesel-powered trucks and buses, and 1% motorcycles. It was assumed that about 21 percent of all vehicles would be operating in the cold-start mode and that about 27 percent would be operating in the hot-start mode. These are standard, default values that are used in calculating cold/hot start emissions. National averages for "mis-fueling" were assumed. Ambient temperatures of 59 and 68 degrees F were used for morning and afternoon peak-hour emission computations, respectively. This is a conservative assumption since ambient temperatures will generally be warmer than this and emission estimates given by MOBILE3 are inversely proportional to the ambient temperature.

After computing vehicular carbon monoxide emissions through the use of MOBILE3, these data were then input to the computer model CALINE4 [7]. CALINE4 was developed by the California Transportation Department and the EPA to simulate vehicular movement and atmospheric dispersion of vehicular emissions. It is designed to predict 1-hour average pollutant concentrations along roadways based on input traffic and emission data, roadway/receptor geometry and meteorological conditions.

Input peak-hour traffic data were obtained from the traffic study cited previously. The traffic volumes given in the traffic study for the future scenarios include project traffic as well as traffic from other growth that is expected to occur in the area for the years considered.

Model roadways were set up to reflect actual roadway geometry, physical dimensions and operating characteristics. Model receptor sites were located 10 meters from the edge of the roadways near the subject intersections at a height of 1.5 meters above grade to simulate levels within the normal human breathing zone.

Input meteorological conditions for this study were defined to provide "worst-case" results. One of the key meteorological inputs is atmospheric stability category. For these analyses, atmospheric stability category 6 was assumed for the morning case and stability category 4 was assumed for the afternoon case. These are the most conservative stability categories that can be used for estimating morning and afternoon pollutant dispersion in model calculations. A surface roughness length of 100 cm was assumed with a mixing height of 500 meters. Worst-case wind conditions were defined as a wind speed of 1 meter per second with a wind direction resulting in the highest predicted concentration.

Existing background concentrations of air pollution in the project vicinity are believed to be very low. Hence, background contributions of carbon monoxide from sources or distant roadways not directly considered in the analysis were assumed to be close to zero. A small concentration of 0.1 ppm was added to all predicted concentrations for the 1988 scenario to make allowance for background. For the year 2000 and 2015 scenarios, background concentrations of 0.5 and 1.0 ppm, respectively, were assumed.

Table 4 summarizes the final results of the modeling study in the form of the predicted maximum 1-hour morning and afternoon carbon monoxide concentrations. These results can be compared directly to the state and the national AAQS. Predicted maximum carbon monoxide concentrations are presented in the table for three scenarios: year 1988 with existing traffic, year 2000 traffic with Phase I, and year 2015 traffic with Phases I and II. The locations of these predicted maximum concentrations all occurred at or very near the intersections in question.

Table 4

PREDICTED WORST-CASE 1-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR KUKUIULA PLANNED COMMUNITY (milligrams per cubic meter)

Location	Year/Scenario 1988/ Present	2000/ Phase I	2015/ Phases I & II
Intersection of Koloa Road and Maluhia Road	2.9 (4.1)	3.9 (3.7)	7.4 (6.3)
Intersection of Poipu Road and Koloa Road	6.2 (4.4)	6.5 (4.6)	12.5 (10.3)
Intersection of Poipu Road and Road B	-	-	12.9 (8.4)
Intersection of Poipu Road and Road A/Lawai Road	3.2 (3.1)	10.0 (9.0)	10.8 (8.6)

Hawaii State AAQS: 10
National AAQS: 40

Note: XXX AM Peak Hour
(XXX) PM Peak Hour

The 1-hour values given in the table were obtained directly from the modeling results. As indicated in the table, the estimated present (1988) maximum 1-hour carbon monoxide concentration in the project vicinity was 6.2 mg/m^3. This occurs near the intersection of Poipu and Koloa Roads during the morning peak traffic hour. In the year 2000 with Phase I of the project, a maximum 1-hour concentration of 10.0 mg/m^3 is predicted to occur during the morning peak traffic hour near the intersection of Poipu Road and Lawai Road/Road A. The predicted maximum 1-hour concentration for the year 2015 scenario with Phases I and II is 12.9 mg/m3. This would occur near the intersection of Poipu Road and the new Road B. Maximum predicted concentration near the Poipu/Koloa Road intersection for this scenario is nearly equal in magnitude at 12.5 mg/m^3. Thus, all predicted maximum 1-hour carbon monoxide levels are well within the national AAQS of 40 mg/m^3. It appears possible, however, that the State of Hawaii 1-hour AAQS of 10 mg/m^3 could be exceeded on occasion along Poipu Road if the year 2015 scenario were to evolve.

Worst-case 8-hour carbon monoxide concentrations were estimated by multiplying the worst-case 1-hour values by a "meteorological persistence factor" of 0.6. This procedure is recommended in EPA guidelines [8] to account for two factors: (1) traffic volumes averaged over eight hours are lower than the peak 1-hour value, and (2) meteorological dispersion conditions are more variable (and hence more favorable) over an 8-hour period than they are for a single hour. The resulting estimated maximum 8-hour concentrations are indicated in Table 5. The estimated maximum 8-hour carbon monoxide concentration for 1988 was 3.7 mg/m^3 at the intersection of Poipu and Koloa Roads. The predicted maximum values for the year 2000 and 2015 scenarios were 6.0 mg/m^3 at Poipu Road/Lawai

Table 5

PREDICTED WORST-CASE 8-HOUR CARBON MONOXIDE CONCENTRATIONS ALONG ROADWAYS NEAR KUKUIULA PLANNED COMMUNITY (milligrams per cubic meter)

Location	Year/Scenario 1988/ Present	2000/ Phase I	2015/ Phases I & II
Intersection of Koloa Road and Maluhia Road	2.5	2.3	4.4
Intersection of Poipu Road and Koloa Road	3.7	3.9	7.5
Intersection of Poipu Road and Road B	-	-	7.7
Intersection of Poipu Road and Road A/Lawai Road	1.9	6.0	6.5

Hawaii State AAQS: 5
National AAQS: 10

Road/Road A intersection and 7.7 mg/m^3 at Poipu Road/Road B intersection, respectively. All predicted 8-hour maximum carbon monoxide concentrations are within the 10 mg/m^3 national AAQS. Predicted present levels are within the State of Hawaii AAQS of 5 mg/m^3, but it appears possible that the future scenarios considered here could result in exceedance of the State 8-hour standard.

Out of necessity, many assumptions and estimates must be made in a study of this nature concerning the operational parameters of a signalized intersection to be constructed several years in the future. It should be noted here that the above predictions for the year 2000 and 2015 scenarios assume that all intersections will be designed such that all right-turning traffic will flow with little or no stopping. If right-turning traffic does not flow relatively freely, the predicted concentrations would be correspondingly higher. It should also be mentioned that these predictions for the future scenarios are based on rudimentary signal phasing of the intersections in question. It is likely that the optimized signal phasing resulting from final design would move traffic more effectively and hence reduce the predicted air pollution concentrations.

The results of this study also reflect several assumptions that must be made concerning worst-case meteorological conditions. As mentioned above, a worst-case wind speed of 1 meter per second with a steady direction was assumed. A steady wind of 1 meter per second blowing from a single direction for an hour is not very likely, and may occur only once a year or less. With wind speeds of 2 meters per second, for example, computed carbon monoxide concentrations would be only about half the values given above.

5.2 Electrical Generation

The annual electrical demand of the project when fully developed is not expected to exceed 40 million kilowatt-hours. This power demand would most probably be provided by the steam electric generating facility located near Port Allen and/or by sugar mill co-generation facilities. In order to meet the electrical power needs of the proposed project, the power plant and/or co-generation facilities would be required to burn more fuel and hence more air pollution would be emitted at the power generating facilities. Given in Table 6 are estimates of the indirect air pollution emissions that would result from the project electrical demand assuming all power is provided by burning more fuel oil at the power plant. If power is supplied instead or in part by co-generation facilities, particulate emissions would likely be higher and sulfur dioxide emissions would be lower than the values given in the table.

5.3 Solid Waste Disposal

Solid waste generated by the project when fully occupied is expected to amount to as much as 38 tons of refuse per day. Most if not all of this refuse would be trucked away from the community and either landfilled or burned at another location. Approximately 21 truck trips per day would be required to dispose of the waste. If all refuse is landfilled as presently seems likely, the only air pollution emissions associated with solid waste disposal would be due to exhaust fumes from the 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

Table 6

ESTIMATED INDIRECT AIR POLLUTION EMISSIONS FROM KUKUIULA PROJECT ELECTRICAL DEMAND*

Air Pollutant	Emission Rate (tons/year)
Particulate	3
Sulfur Dioxide	101
Carbon Monoxide	7
Volatile Organics	0.4
Nitrogen Oxides	29

*Based on U.S. EPA emission factors for industrial boilers [9]. Assumes electrical demand of 40 million Kw-hrs per year and low sulfur oil used to generate power.

of solid waste from the project would also result in the emissions of particulate, carbon monoxide and other contaminants from the incineration facility. Table 7 gives emission factors for municipal refuse incinerators (without controls) in terms of pounds of air pollution per ton of refuse material charged. Thus, air pollutant emission rates in terms of pounds per day, for example, can be estimated by multiplying the emission factors given in the table by the number of tons per day of refuse that is burned.

5.4 Golf Course Pesticide Usage

Once the project is completed and the golf course is in use, it will be necessary to regularly apply various chemical fertilizers and pesticides to maintain grass quality. AAQS have not been established for any of the pesticides presently in use, although most of them carry warning or caution labels on their containers. The primary purpose of these labels is to provide occupational safety and health guidance regarding proper handling and application. The primary risk of using these chemicals is to the applicator rather than to individuals at possible receptor sites downwind, since these individuals should encounter airborne concentrations of these chemical substances only in greatly diluted form if at all. There are, however, certain precautions that must be followed by pesticide applicators in order to prevent significant downwind drift when spraying. Primary among these are the use of a coarse rather than a fine spray and application under low wind speed conditions when the wind direction will not contribute to drift towards the clubhouse area or to nearby residences. Provided that proper safety precautions are followed, the potential for serious air quality degradation from chemical spraying for golf course maintenance will likely be minimal.

Table 7

UNCONTROLLED AIR POLLUTION EMISSION FACTORS FOR MUNICIPAL REFUSE INCINERATORS (lb/ton)[a]

Air Pollutant	Emission Factor
Particulate	14
Sulfur Oxides	2.5
Carbon Monoxide	35
Organics	1.6
Nitrogen Oxides	3

[a] Emission factors are given in terms of weight of material emitted per unit weight of refuse material charged.
[b] Assumes incinerator equipped with settling chamber and water spray.

Source: U.S. Environmental Protection Agency [3]

5.5 Boat Operations

The marina associated with the project is expected to accommodate about a 100 to 150 boats ranging in size from about 25 to 60 feet. Some would be sailing vessels, and some would be powered by gasoline or diesel engines. Some of the vessels would be commercial fishing or tour boats while others would be private pleasure craft. Air pollution would be emitted by motor-driven boats entering and leaving their assigned slips. Table 8 gives annual emission estimates for boats that would be operating in the marina area. These estimates assume that there would be 75 inboards and 75 outboards and that each boat would operate an average of 500 hours per year.

6.0 IMPACTS OF SUGARCANE OPERATIONS ON PROJECT

In addition to assessing the impact of the project on the surrounding areas, it is also of interest to investigate the reverse problem. That is, what would be the impacts of air pollution sources in the surrounding area on the residents of the project. For the Kukuiula Planned Community Project, the issue of primary concern is the ongoing sugarcane operations in the fields encompassing the project. Insofar as air quality is concerned, sugarcane burning and cane haul road usage present the two greatest problems.

6.1 Sugarcane Burning

Sugarcane fields are harvested every two years. Prior to harvesting, sugar cane is burned in the field to remove unwanted foliage as well as to control rodents and insects. Burning of the sugar cane results in emissions of particulate, carbon monoxide and volatile organic compounds.

Table 8

ESTIMATED AIR POLLUTION EMISSIONS FROM BOATS OPERATING AT KUKUIULA MARINA[a]

Air Pollutant	Emission Rate (tons/year)
Sulfur Oxides	1
Carbon Monoxide	420
Hydrocarbons	125
Nitrogen Oxides	8

[a]Based on U.S. EPA emission factors [9]. Assumes 75 inboards and 75 outboards each operating 500 hours per year.

There are 25 sugarcane fields within a 1-mile radius of the development. Seven of these will be replaced by the proposed project. The remaining 18 fields would continue to produce sugar cane after the project is built. Thus, there are two air quality issues to be considered: (1) what are the emissions that would be eliminated by removing the land to be developed from sugar cane, and (2) what would be the impacts on the residents of the new community from the surrounding sugarcane burning operations.

Insofar as the first issue is concerned, the seven fields that would be removed from sugar cane total about 600 acres. Table 9 shows the estimated emissions in tons per year that would be eliminated by the proposed development. Values given in the table represent 300 acres per year harvested (reflecting the biennial harvesting procedure for sugar cane) and are mid-range estimates.

In regard to the second issue, the question of impacts on residents of the new community from nearby sugarcane burning, about eight of the remaining 18 fields would be located to the west of the project where the usual prevailing northeast trade winds would move the smoke away from the development. There are three fields totaling about 330 acres just north of and adjacent to the project. These fields would have the greatest impact on the development. The three fields are harvested one to two months apart with the next harvesting scheduled to occur in July, September and October 1989. The remaining seven fields are located to the north of the development and are shielded from the project site by a high ridge. Emissions from the three fields that could most likely affect the development would be similar in magnitude to the emission estimates given in Table 9. If it is assumed that 30 to 40 acres per day are

Table 9

ESTIMATED AIR POLLUTION EMISSIONS ELIMINATED BY WITHDRAWING FIELDS FROM SUGAR CANE AT KUKUIULA[a]

Air Pollutant	Emission Rate (tons/year)
Particulate	15
Carbon Monoxide	147
Volatile Organics	22

[a]Based on mid-range of U.S. EPA emission factors [3]. Assumes 300 acres per year harvested.

burned, there would be about ten days during a three or four month period every other year when burning would take place on the three adjacent fields. Depending on field and meteorological conditions, smoke from the fires may impact the project area.

6.2 Cane Haul Road Usage

A major cane haul road servicing approximately 50 fields from Poipu Road to Hanapepe traverses the length of the project site. Trucks use the dirt road approximately 56 days per year to travel to and from the Koloa Sugar Mill. The haul road runs in an east-west direction dividing the proposed development area into north and south sections. Approximately 2/3 of the project area lies to the south of the haul road in the prevailing downwind direction; this portion of the development will be most exposed to dust generated by trucks traveling back and forth between the fields and the mill.

Fugitive dust emissions from dirt haul roads are primarily a function of road silt content, vehicle speed, weight and number of wheels, and local climate. Much of the dust generated will be in the form of larger particles that will settle to the surface within a short distance of the roadway. Larger dust particles do not generally constitute a health hazard anyway but mainly are a nuisance. However, dust particles smaller than 10 microns in diameter can remain suspended indefinitely and inhaled rather readily. Thus, it is the smaller particles that are of most concern.

Based on the U.S. EPA emission factor for unpaved roads [3], it is estimated that the cane haul road traffic would generate an average of about 15 pounds of dust smaller than 10 microns in diameter per

vehicle mile of travel, assuming no control measures are practiced. In the vicinity of the proposed development, this translates to about 110 tons of uncontrolled dust emanating from the haul road each year (based on 13,500 truck passes per year and 1.1 mile of travel across the site). In a 24-hour period, it is estimated that about 3 tons of the smaller particle dust could be generated in the worst case. Most of this dust will be carried over and through the portion of the development lying to the south of the haul road by the prevailing winds. Preliminary calculations indicate that 24-hour air quality standards for particulate matter could be exceeded at locations within a few hundred feet of the haul road during persistent adverse meteorological conditions if haul road dust is not controlled effectively.

7.0 SUMMARY OF IMPACTS AND MITIGATIVE CONSIDERATIONS

7.1 Impacts Summary

The major short-term air quality impact of the project will be project construction and the potential emission of significant quantities of fugitive dust. Uncontrolled fugitive dust emissions from construction activities are estimated to amount to about 1.2 tons per acre per month. During construction phases, emissions from engine exhausts (primarily consisting of carbon monoxide and nitrogen oxides) will also occur both from on-site construction equipment and from vehicles used by construction workers traveling to and from the project.

All long-term air quality impacts associated with the proposed project are indirect. The primary long-term air pollution impact from the project will arise from the increased motor vehicle traffic associated with the project. Increased levels of carbon monoxide concentrations along roadways leading to and from the proposed development will be the main problem, especially near intersections along Poipu Road and Koloa Road. Based on mathematical modeling of projected vehicular traffic and atmospheric dispersion calculations, it is predicted that carbon monoxide concentrations in the vicinity of the project will unavoidably increase, but the predicted highest concentrations should remain within the national ambient air quality standards set by the U.S. Environmental Protection Agency. During later phases of the project, however, the more stringent State of Hawaii ambient air quality standards for carbon monoxide may be exceeded. This is not unusual. Because the state standard is so low, it is probably exceeded at nearly any intersection in the state that has 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.

Another potential long-term, indirect air quality impact of the project will be the increase in air pollution emissions at power generating facilities due to the increase in power that will have to be generated to meet the electrical power demand of the development. Assuming low-sulfur fuel oil is used to generate the required power, it is estimated that power plant emissions of sulfur dioxide would increase by about 100 tons per year, nitrogen oxides emissions would increase by about 30 tons per year, and emissions of particulate matter, carbon monoxide and volatile organics would increase by less than 10 tons per year each.

Solid waste generated by the project could also potentially result in indirect long-term air quality impacts if the refuse is

incinerated rather than landfilled. The present practice on Kauai is to landfill solid waste, and this appears to be the most likely scenario for the future. If all refuse from the project were to be incinerated rather than landfilled, carbon monoxide and particulate matter would be the two primary air pollution byproducts. It is estimated that carbon monoxide emissions would amount to 243 tons per year, and emissions of particulate matter would amount to about 97 tons per year or less depending on the emission control equipment.

Exhaust emissions from boats operating at the project marina will also constitute a long-term, indirect air quality impact. These emissions will be similar to automobile exhausts with carbon monoxide being the primary air pollution constituent. Carbon monoxide emissions from boat operations at the marina are estimated to amount to about 420 tons per year.

Pesticides will be used on the project golf course to maintain grass quality. During high wind conditions and/or if improper application techniques are employed, airborne drift could potentially contaminate nearby, downwind areas.

One long-term, direct benefit of the project to the air quality of the area will be the elimination of emissions from sugarcane burning. Removal of the project site from sugarcane production will result in the following estimated reductions in emissions: carbon monoxide - 147 tons per year, particulate matter - 15 tons per year, volatile organics - 22 tons per year.

Fields adjacent to the project site will remain in sugar cane with burning and harvesting occurring every two years. Residents of the proposed development may be exposed to smoke and other contaminants from nearby fires on a few days each year.

Fugitive dust from cane haul road usage may also impact the proposed new community. It is estimated that uncontrolled fugitive dust emissions from trucks traversing the project site on the cane haul road could amount to about 110 tons per year. Preliminary calculations indicate that air quality standards for particulate matter could be exceeded at locations within a few hundred feet of the haul road during persistent adverse meteorological conditions if some type of dust control is not implemented.

7.2 Mitigative Considerations

Strict compliance with State of Hawaii Air Pollution Control Regulations regarding establishment of a regular dust-watering program and covering of dirt-hauling trucks will be required to effectively mitigate fugitive dust emissions from construction activities. Twice daily watering is estimated to reduce dust emissions by up to 50 percent. Paving of parking areas and establishment of landscaping early in the construction schedule will also help to control dust. Increased vehicular emissions due to disruption of traffic by construction equipment and/or commuting construction workers can be alleviated by moving equipment and personnel to the site during off-peak traffic hours.

The long-term projected impacts of carbon monoxide emissions from vehicular traffic associated with the completed development assume widening of Poipu and Koloa Roads and improvement of intersections

along these roads in the vicinity of the new community and Koloa Town. Intersection improvements will include signalization and provision for dedicated turning lanes. Optimization of signal phasing during final design will likely reduce the predicted air quality impacts. The proposed Koloa bypass road planned by the County and/or a new north-south road parallel to Poipu Road would also reduce the predicted impacts. Carpooling and/or bus service is another possibility for lessening traffic-related air pollution. Further, as this project will be completed some years hence, it is conceivable that the efficiency of motor vehicle engines and/or emission control equipment will be improved or that vehicles will be developed which burn cleaner fuels before project completion. With regard to the latter, vehicles burning methanol or compressed natural gas or powered by electrical motors are some of the possibilities for technological development that are currently being contemplated. Lastly, even without technological breakthroughs, it is also possible that at some point in the future the State may decide to adopt a motor vehicle inspection and maintenance program which would ensure that emission control devices are properly maintained, and thereby reduce emissions.

Indirect emissions from project electrical demand could be reduced somewhat by utilizing solar energy design features to the maximum extent possible. This might include installing solar water heaters on all new homes, designing homes so that window positions maximize indoor light without unduly increasing indoor heat, and using landscaping to provide afternoon shade to cut down on the use of air conditioning. Use of wind power generating units by the utility instead of fuel-burning facilities would also lessen indirect emissions from project electrical demand.

Solid waste from the project will probably be landfilled, and thus any related air quality emissions would be minimal. If it were to be burned in a municipal incinerator, particulate emissions resulting therefrom could be reduced substantially if the incinerator is fitted with pollution control equipment, i.e., electrostatic precipitators or fabric filters. Conservation and recycling programs could also reduce solid waste which would reduce any related air pollution emissions proportionately. Another possibility for the future is that a garbage-to-energy facility similar to the one currently being built on Oahu might be developed on Kauai. Although this would result in air pollution emissions, the emissions would be offset by the reduced fuel oil that would need to be burned to meet project electrical demand.

Emissions from boat operations at the project marina will be relatively minimal, and thus no specific mitigative measures are suggested. The emissions eliminated by the project (i.e., reduced burning of sugarcane) could be considered to offset these emissions to some extent.

Compliance with existing safety guidelines for the spraying of chemicals for golf course maintenance should mitigate potential air quality impacts from this activity.

Prospective residents of the new community should be advised of the potential air pollution from burning cane. Enforcement of the State's agricultural burning regulations will help to minimize impacts.

A landscape buffer along both sides of the cane haul road will be planted to reduce fugitive dust impacts from the cane haul road. Also, the location of the golf course generally along both sides of the haul road will increase the distance to nearby residences and thereby lessen impacts. Truck speeds should be regulated within the project boundaries, and an effective road watering program should be implemented. To further mitigate impacts, the road could be oiled or paved to control dust.

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APPENDIX C

BOTANICAL REPORT

BOTANICAL SURVEY
KUKUI'ULA BAY PROJECT
KOLOA DISTRICT, ISLAND OF KAUA'I

by

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BOTANICAL SURVEY
KUKUI'ULA BAY PROJECT
KOLOA DISTRICT, ISLAND OF KAUA'I

INTRODUCTION

The Kukui'ula Bay Project site consists of approximately 1,000 acres of land in the Kukui'ula area, Koloa District. At present, most of the project site is actively under sugar cane cultivation or used for pasture. The property is located between Lawa'i Valley and Po'ipu Road. Slopes on most of the property are gentle and rolling except for the northern most section which has some steep unbuildable slopes. Elevation ranges from near sea-level by the proposed ±2.3-acre marina to about 275 ft. along the steeper northern boundary.

Sugar cane fields are found on most of the well-drained, deeper soils. The grassy, open pasture lands on the northern section were once used for pineapple cultivation and the pattern of the old fields can still be seen on recent aerial photographs of the site. Eroded areas on the steeper slopes are also visible in the photos. On the southeast portion of the property, the soil is stony and generally shallow with numerous rock outcrops. A scrub vegetation composed of various shrub and grass species as well as scattered trees occurs on this substrate. These scrub areas are used for grazing cattle.

A survey to inventory and assess the botanical resources on the project site was conducted in March 1988. The primary objectives of the survey were to 1) provide a general description of the major vegetation types; 2) inventory the terrestrial, vascular plant species; and 3) search for rare, threatened or endangered plants on the project site.

SURVEY METHODS

Prior to undertaking the field studies, a search was made of the pertinent literature to familiarize the investigators with other biological studies conducted in the general area. Existing topographic maps as well as aerial photographs were examined to determine access, boundaries, reference points, terrain characteristics, and vegetation patterns.

Access onto the site was primarily by the main canehaul road which runs the length of the property, starting at Po'ipu Road and running westwardly towards the Allerton Estate (Lawa'i Valley). From this main access road, a number of smaller canehaul roads branch off and cross and define the fields. The survey focused on the less disturbed areas within the project site such as gulches, drainages, scrub-covered areas, rock piles, steep slopes, etc., as native species or native plant communities are more likely to occur in such places.

Tentative vegetation types, delineated from the recent aerial photographs, were ground checked. Notes were made on plant associations and distribution, substrate types, topography, exposure, etc. Species identification was made in the field; plants which could not be positively determined were collected for later determination in the herbarium (Univ. of Hawaii, Manoa) and comparison with the botanical literature. The species recorded are indicative of the season ("rainy" vs. "dry") and the environmental conditions under which this survey was made. Surveys taken at different times and under varying environmental conditions would no doubt yield slight variations in the species list, especially of the weedy, annual taxa.

DESCRIPTION OF THE VEGETATION

A previous botanical survey by Earthwatch (1984) included a 235-acre portion of the project site along the southeast corner. Vegetation cover types composed of various scrub communities covered most of the 235-acre study area; a few sugar cane fields occurred on a portion of the site.

A recent flora study by Char and Linney (1988) was conducted for a nearby ±490-acre parcel between Keoniloa Bay and Kamala Point, Maha'ulepu. Sugar cane fields covered the major portion of the site; scrub vegetation occurred on stony soil or low-lying drainage areas; and pockets of native coastal scrub vegetation were found on lithified and unconsolidated sand dunes.

No officially listed, proposed or candidate threatened or endangered plant species were encountered during these two studies. A few plants considered rare or depleted (Fosberg and Herbst 1975) were listed from the areas supporting native coastal scrub.

In this report four broad vegetation types are recognized on the project site. Sugar cane fields cover the majority of the property (>60%). Scrub pastureland composed of various shrub and grass species with scattered trees is found on the southeast section of the property. Open, grassy pastureland with scattered pockets of scrub occurs on land formerly used to grow pineapple. Coastal scrub covers only a small portion of the site along the steep cliffs from Lawa'i Valley to Spouting Horn Park and on the narrow sand and rock frontage along Kukui'ula Bay. A total of 202 plant species were inventoried on the site (see Appendix A). The majority, 182 plants or 90%, are introduced species. None of the native plants (indigenous and endemic) are threatened or endangered species.

1. Cane Fields

The cane fields along with their associated network of irrigation and drainage ditches, canehaul roads, and rock piles covers the

major portion of the property. The fields are found on deep, well-drained soils largely of the Lihue series (Foote *et al.*) Soils of the Puhi, Ioleau, and Koloa series are also cultivated. Sugar cane (*Saccharum officinale*) grows rapidly, forming monodominant stands and quickly shades out many of the weedy species associated with cultivated lands. Thus, weedy species such as finger grass (*Chloris barabata*), nutgrass (*Cyperus rotundus*), brachiaria (*Brachiaria subquadripara*), Bermuda grass (*Cynodon dactylon*), and sleepinggrass (*Mimosa pudica*) are largely confined to the margins of fields.

Drainageways and old irrigation ditches may be overgrown with vegetation and support dense mats of California grass (*Brachiaria mutica*). Natal redtop (*Rhynchelytrum repens*), various weedy, annual species, and scattered clumps of amaryllis (*Hippeastrum puniceum*) are also found in such areas.

Scattered through the cane fields are a few boulder and rock piles some of which were placed there when the fields were first cultivated. Most support a koa-haole scrub (*Leucaena leucocephala*) with Guinea grass (*Panicum maximum*) ground cover. On the western section of the property in the middle of cane fields, a cluster of large Chinese banyan (*Ficus microcarpa*) and Java plum (*Syzygium cumini*) trees can be found growing on a large stone platform, a part of a heiau (see Archaeology Section).

Where the fields abut the Allerton Estate (Lawa'i Valley), a number of ornamental species have spread into the weedy scrub bordering the margins of the cane fields. These include golden pothos (*Epipremnum pinnatum*), philodendron (*Philodendron* sp.), and montbretia (*Crocosmia X crocosmiflora*).

2. Coastal Scrub

A rocky coast with precipitous cliffs stretches from Lawa'i Valley to Spouting Horn Park. Vegetation along this coastline is composed of common ironwood (*Casuarina equisetifolia*) trees with a more or less dense koa-haole shrub layer bordering the Lawa'i Beach Road. Low, wind-pruned koa-haole shrubs hug the seaward facing slopes. Mats of wind-swept 'ilima (Sida falla), pa'u-o-Hi'i'aka (Jacquemontia ovalifolia), and 'aki'aki (Sporobolus virginicus) are found in open, rocky areas with thin soil. Patches of Guinea grass and finger grass are also found on the seaward facing slopes.

Along Kukui'ula Bay, in the area proposed for the marina, are found several homes. The landscaped areas around these homes are not included in the plant inventory. On the beach area fronting the homes, pockets of sand and coralline rubble among boulders supports plants of pohuehue (Ipomoea brasiliensis), Australian saltbush (Atriplex semibaccata), tree heliotrope (Tournefortia argentea), naupaka kahakai (Scaevola taccada), and 'akulikuli (Sesuvium portulacastrum).

3. Scrub Pasture

The scrub pasture occupies roughly 25% of the proposed Kukui'ula Bay Project site and lies on the southeast corner. The soil has been classified as "Wt", Waikomo very rocky, silty clay (Foote et al. 1972). The thin soil is stony with rock outcrops frequent. It overlays pahoehoe lava flows of the Koloa series although small areas of 'a'a are also present. Macdonald and Abbott in their Volcanoes in the Sea, the Geology of Hawaii (1970) note that flows of the Koloa series are found throughout the eastern half of the island, from Waimea to Hanalei.

In their survey of this portion of the project site in 1984, Earthwatch recognized four vegetation cover types. These were koa-haole thicket, lantana scrub, open mixed scrub, and California grass pond association. The boundaries of the first three cover types are usually not distinct or sharp and they tend to grade one into the other. The California grass pond association forms a distinct but limited, narrow band along the edges of a large pond mauka of the old railroad bed.

All four cover types have been "lumped" into our more generalized scrub pasture vegetation type and the variations are noted and discussed below.

A dense mixed scrub with various, scattered tree species borders edges of most of the pastureland. Shrubs of koa-haole (Leucaena leucocephala) and kolomona (Senna surattensis) are abundant and may form thickets up to 18 ft. tall in places. Scattered trees of 'opiuma (Pithecellobium dulce), Javaplum (Syzygium cumini), silk oak (Grevillea robusta), Chinese banyan (Ficus microcarpa), and monkey pod (Samanea saman) occur throughout the scrub pastureland. Where the scrub and trees are especially dense, rouge plant (Rivinia humilis) is especially abundant.

On rock outcrops and particularly on sites supporting archaeological features, koa-haole forms a dense thicket. The native peperomia or 'ala'ala-wai-nui (Peperomia leptostachya) is abundant on the large rocks.

The more open, grassy areas support scattered shrubs or clumps of the shrub species mentioned previously; a few plants of lantana can also be found in these more open areas. Various grass species such as Guinea grass (Panicum maximum), buffel grass (Cenchrus ciliaris), and sour grass (Digitaria insularis) form somewhat dense ground cover. Hurricane grass (Bothriochloa pertusa) is locally abundant along old jeep trails. Weedy annuals such as spiny pigweed or spiny amaranth (Amaranthus spinosus), Spanish needle (Bidens pilosa), and finger grass (Chloris barbata) are abundant along the old railroad bed.

The pond which receives most of the drainage from the upper areas supports dense California grass (Brachiaria mutica) along its edges; this is heavily grazed by cattle in places. The California grass quickly grades into an assortment of weedy species such as spiny pigweed, malvastrum (Malvastrum coromandelianum), and cheeseweed (Malva parviflora) along its outer margins.

4. Pasture

On soils of the Puhi series (Foote et al. 1972) formerly used for growing pineapple, can be found a mixed grass pasture. This vegetation type is found on the northern boundary of the property.

Species commonly found here include California grass (especially in small gullies and around the reservoirs), buffel grass, golden beardgrass (*Chrysopogon aciculatis*), Bermuda grass (*Cynodon dactylon*), Pangola grass (*Digitaria decumbens*), and Guinea grass. Scattered clumps of Javaplum, guava (*Psidium guajava*), lantana (*Lantana camara*), and koa-haole are found throughout the pasture especially the areas bordering the reservoirs.

On steeper slopes, pili grass (*Heteropogon contortus*) forms small clumps. The native 'akia (*Wikstroemia uva-ursi*) may also occasionally be found on such steep slopes.

THREATENED AND ENDANGERED PLANT SPECIES

Of the 202 plant species found on the property (see Appendix A), 182 or 90% are introduced. Native species, both indigenous and endemic), number 14. None of these native species is considered threatened or endangered (listed, proposed or candidate) by the federal and/or state governments (Herbst 1987; Federal Register 1985). Nor are any of these plants considered rare (Fosberg and Herbst 1975). Some of the native taxa such as the 'uhaloa (*Waltheria inica*), popolo (*Solanum nigrum*), and koali awahi'a (*Ipomoea indica*) are considered "weedy" natives as they prefer the more disturbed habitats.

DISCUSSION AND RECOMMEDATIONS

Vegetation on the proposed project site is composed largely of

sugar cane fields. Weedy species associated with cultivated areas are found along the irrigation and drainageways, canehaul roads, and margins of fields. Uncultivated areas support pasture lands of scrub or mixed grass species, the majority of them introduced. Likewise, the rocky gulches and steep slopes are also vegetated primarily by introduced species. Such species account for 90% of the 202 species inventoried on the project site. Endemic species, i.e., native only to the Hawaiian Islands number 2 or 1%; indigenous species number 12 or 6%; and plants originally of Polynesian introduction number 6 or 3%.

The proposed project is not expected to have a significant negative impact on the total island populations of the species involved as the majority are introduced. The native species occur in similiar environmental conditions throughout the islands; none are considered rare, threatened or endangered.

Of some concern are the steeper areas on the northern portion of the property, these areas should be revegetated as soon as possible after clearing activities to prevent soil loss through wind and water erosion.

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APPENDIX A. PLANT SPECIES LIST.
KUKUI'ULA BAY PROJECT, KOLOA DISTRICT, KAUA'I

A list of the vascular plant species inventoried on the project site during this survey follows. Plants are divided into three groups -- Ferns, Monocots, and Dicots. Within each of these groups, the taxa are arranged alphabetically by family, genus, and species. For each species, the scientific name with author citation is provided; an accepted English or Hawaiian name, when known, is given; and the biogeographic status of a species is indicated by a letter code. The presence (+) or absence (-) of a particular species within each of four vegetation types on the project site is also provided.

Taxonomy and nomenclature of the ferns follow Wagner and Wagner (1987); taxonomy and nomenclature of the flowering plants (Monocots and Dicots) follow Wagner _et al_. (in prep.). Common English or Hawaiian names, when provided, are in accordance with St. John (1973) or Porter (1972).

An explanation of the abbreviations used, other than author citation, is provided below:

SCIENTIFIC NAME
cf. = similiar to a certain taxa
indet. = indeterminate
s. l. = in the broad sense (_sensu lato_)
sp. = correct species name not determined due to insufficient material (flowers and/or fruit)
subsp. = subspecific level, subspecies
var. = variety

BIOGEOGRAPHIC STATUS
E = endemic, native _only_ to the Hawaiian Islands
I = indigenous, considered native to the islands but also found elsewhere naturally in one or more other geographic area(s)

P = Polynesian introduction, not native, thought to have been introduced prior to Cook's discovery of the islands in 1778
X = introduced or exotic, not native, brought to the islands after Western contact either intentionally or accidentally

VEGETATION TYPE (see text for discussion)
cf = cane field
cs = coastal scrub
sp = scrub pasture
p = pasture

SPECIES LIST

SCIENTIFIC NAME	COMMON NAME	BIOGEOGRAPHIC STATUS	VEGETATION TYPE cf	cs	sp	p
FERNS						
Aspleniaceae						
Nephrolepis multiflora (Roxb.) Jarret ex Morton	sword fern	X	+	-	+	-
Thelypteris parasitica (L.) Iwatsuki	wood fern	X	+	-	+	-
Polypodiaceae						
Phymatosorus scolopendria (Burm.) Pichi Sermolli	laua'e	X	-	-	+	+
MONOCOTS						
Araceae						
Epipremnum pinnatum (L.) Engl.	golden pothos	X	+	-	-	-
Philodendron sp.	philodendron	X	+	-	-	-
Commelinaceae						
Commelina benghalensis L.	purple day flower	X	-	-	+	-
Commelina diffusa N.L. Burm.	blue day flower	X	+	-	+	-
Cyperaceae						
Cyperus rotundus L.	nut sedge, nutgrass	X	+	-	+	-
Kyllinga brevifolia Rottb.	green kyllinga	X	+	-	-	-

SCIENTIFIC NAME	COMMON NAME	STATUS	cf	cs	sp	p
Gramineae						
Bothriochloa pertusa (L.) A. Camus	hurricane grass	X	-	-	+	-
Brachiaria mutica (Forsk.) Stapf	California grass	X	+	-	+	+
Brachiaria subquadripara (Trin.) Hitchc.	brachiaria	X	+	-	+	+
Cenchrus ciliaris L.	buffel grass	X	+	+	+	+
Cenchrus echinatus L.	sandbur	X	+	-	+	-
Chloris barbata (L.) Sw.	finger grass	X	+	+	+	+
Chloris divaricata R. Br.	star grass	X	-	-	+	-
Chloris radiata (L.) Sw.	plush grass	X	+	-	+	-
Chrysopogon acicularis (Retz.) Trin.	golden beard-grass	X	-	-	+	+
Coix lachryma-jobi L.	Job's tears	X	+	-	+	+
Cynodon dactylon (L.) Pers.	Bermuda grass	X	+	+	+	+
Digitaria ciliaris (Retz.) Koeler	Henry's crab grass	X	-	-	+	-
Digitaria insularis (L.) Mez ex Ekman	sour grass	X	+	+	+	+
Digitaria decumbens Stent	Pangola grass	X	-	-	-	+
Digitaria sp.	crab grass	X	+	-	+	+
Echinochloa colonum (L.) Link	jungle rice	X	+	-	+	-
Echinochloa crus-galli (L.) Beauv.	barnyard grass	X	+	-	+	-
Eleusine indica (L.) Gaertn.	goose grass	X	+	+	+	+
Eragrostis tenella (L.) Beauv. ex R. & S.	Japanese love-grass	X	+	+	+	+
Heteropogon contortus (L.) Beauv. ex R. & S.	pili	P	-	-	-	+
Panicum maximum Jacq.	Guinea grass	X	+	+	+	+
Panicum maximum Jacq. var. *trichoglume* Eyles ex Robyns	green panic grass	X	+	-	+	-
Paspalum conjugatum Berg.	Hilo grass	X	+	-	+	-
Paspalum dilatatum Poir.	Johnson grass	X	-	-	+	-
Paspalum urvillei Steud.	Vasey grass	X	+	-	+	-

SCIENTIFIC NAME	COMMON NAME	STATUS	cf	cs	sp	p
Pennisetum clandestinum Hochst ex Chiov.	kikuyu grass	X	-	-	-	+
Pennisetum purpureum Schumach.	elephant grass	X	-	-	+	-
Rhynchelytrum repens (Willd.) C. E. Hubb.	Natal redtop	X	+	-	+	-
Saccharum officinale L.	sugar cane	P/X	+	-	+	-
Setaria verticillata (L.) Beauv.	bristly foxtail	X	-	-	+	-
Sporobolus diander (Retz.) Beauv.	Indian dropseed	X	-	-	+	-
Sporobolus virginicus (L.) Kunth.	'aki'aki	I	-	+	-	+
Sporobolus sp.	dropseed	X	-	-	-	+
Iridaceae						
Crocosmia x *crocosmiflora* (Lemoine ex Morren) N. E. Brown	montbretia	X	+	-	-	-
Liliaceae s.l.						
Agave americana L.	century plant	X	+	+	+	-
Furcraea foetida (L.) Haw.	Mauritius hemp	X	+	-	+	-
Hippeastrum puniceum (Lam.) Voss	amaryllis	X	+	-	-	-
Sansevieria trifasciate Prain	snake plant	X	-	-	+	-
Musaceae						
Musa x *paradisiaca* L.	banana, mai'a	P	+	-	+	-
Palmae						
Cocos nucifera L.	coconut, niu	P	-	-	+	-

SCIENTIFIC NAME	COMMON NAME	STATUS	cf	cs	sp	p
DICOTS						
Acanthaceae						
Asystasia gangetica (L.) T. Anderson	Chinese violet	X	-	+	+	-
Barleria cristata L.	Philippine violet	X	-	-	+	-
Justicia betonica L.	white shrimp plant	X	-	-	+	-
Thunbergia fragrans Roxb.	white thunbergia	X	+	+	+	+
Aizoaceae						
Sesuvium portulacastrum (L.) L.	'akulikuli	I	+	-	+	-
Amaranthaceae						
Amaranthus spinosus L.	spiny pigweed	X	+	-	+	+
Amaranthus viridis L.	slender amaranth	X	+	-	+	+
Anacardiaceae						
Mangifera indica L.	mango	X	-	-	+	-
Schinus terebinthifolius Raddi	Christmas berry	X	+	-	+	+
Apocynaceae						
Catharanthus roseus (L.) G. Don	Madagascar periwinkel	X	-	-	+	-
Cascabela thevetia (L.) Lippold	be-still	X	-	-	+	-
Araliaceae						
Schefflera actinophylla (Endl.) Harms	octopus tree	X	-	-	+	+
Polyscias guilfoylei (Bull) L. H. Bailey	panax	X	-	-	+	-

SCIENTIFIC NAME	COMMON NAME	STATUS	cf	cs	sp	p
Bignoniaceae						
Spathodea campanulata Beauv.	African tulip tree	X	+	-	-	-
Boraginaceae						
Heliotropium curassavicum L.	seaside heliotrope	I	-	-	+	-
Tournefortia argentea L. f.	tree heliotrope	X	-	-	-	-
Cactaceae						
Cereus uruguayensis Ritter ex Kiesling	cactus	X	+	-	+	-
Harrisia martinii (Labouret) Britton	harrisia	X	+	-	-	-
Hylocereus undatus (Haw.) Britton & Rose	night-blooming cereus	X	-	+	-	-
Opuntia cochenillifera (L.) Mill.	cochineal cactus	X	+	-	+	-
Opuntia ficus-indica (L.) Mill.	panini	X	-	-	+	-
indet. cactus		X	-	-	-	-
Capparaceae						
Cleome gynandra L.	wild spider-flower	X	+	-	+	-
Caricaceae						
Carica papaya L.	papaya	X	-	-	+	-
Casuarinaceae						
Casuarina equisetifolia Stickm.	common ironwood	X	-	+	+	-
Casuarina stricta Dry. in Ait.	ironwood	X	+	-	-	-

SCIENTIFIC NAME	COMMON NAME	STATUS	cf	cs	sp	p
Chenopodiaceae						
Atriplex semibaccata R. Br.	Australian saltbush	X	-	+	+	-
Chenopodium murale L.	chenopodium	X	+	+	+	-
Chenopodium cf. carinatum R. Br.	chenopodium	X	-	-	+	-
Compositae						
Acanthospermum australe (Loefl.) Kuntze	Paraguay bur	X	+	-	+	+
Ageratum conyzoides L.	ageratum	X	+	-	-	-
Bidens pilosa L.	Spanish needle	X	+	-	+	+
Conyza canadensis (L.) Cronq.	horseweed	X	+	-	+	+
Crassocephalum crepidiodes (Benth.) S. Moore	crassocephalum	X	+	-	+	-
Eclipta alba (L.) Hassk.	eclipta	X	+	-	+	-
Elephantopus mollis H.B.K.	elephantopus	X	+	-	+	-
Emilia coccinea (Sims) G. Don	emilia	X	+	-	+	+
Emilia fosbergii D.H. Nicolson	emilia	X	+	-	-	-
Emilia sp. ?	emilia	X	+	-	-	-
Erechtites hieracifolia (L.) Raf.	fireweed	X	+	-	+	-
Pluchea indica (L.) Less.	pluchea	X	-	+	+	-
Pluchea symphytifolia (Miller) Gillis	pluchea	X	+	-	+	+
Sigesbeckia orientalis L.	sigesbeckia	X	+	-	+	-
Sonchus asper (L.) Hill	spiny sowthistle	X	+	+	+	+
Sonchus oleraceus L.	common sowthistle	X	+	+	+	+
Synedrella nodiflora (L.) Gaertn.	synedrella	X	-	-	+	-
Verbesina encelioides (Cav.) B. & H.	golden crownbeard	X	+	-	+	+
Vernonia cinerea (L.) Less.	ironweed	X	+	-	-	-
Wedelia trilobata (L.) A. S. Hitchc.	wedelia	X	-	+	+	-

SCIENTIFIC NAME	COMMON NAME	STATUS	cf	cs	sp	p
Xanthium strumarium L.	cocklebur	X	-	-	+	-
Convolvulaceae						
Ipomoea indica (J. Burm.) Merr.	koali awahi'a	I	-	-	+	+
Ipomoea obscura (L.) Ker-Gawl.	yellow bindweed	X	+	-	+	-
Ipomoea triloba L.	pink bindweed	X	+	-	+	-
Jacquemontia ovalifolia (Choisy) H. Hallier	pa'u-o-Hi'i'aka	I	-	+	+	-
Merremia aegyptia (L.) Urban	hairy merremia	P?	+	-	+	-
Merremia tuberosa (L.) Rendle	woodrose	X	-	+	+	-
Crassulaceae						
Kalanchoe pinnata (Lam.) Pers.	air plant	X	+	-	+	-
Kalanchoe tubiflora (Harv.) Hamet	kalanchoe	X	-	-	+	-
Kalanchoe sp.	vining kalanchoe	X	-	+	+	-
Cucurbitaceae						
Cucumis dipsaceus Ehrenb. ex Spach	spiny cucumber	X	-	-	+	-
Momordica charantia L.	bittermelon	X	+	+	+	-
Euphorbiaceae						
Chamaesyce hirta (L.) Millsp.	spurge	X	+	-	+	-
Chamaesyce hypericifolia (L.) Millsp.	spurge	X	+	-	+	-
Chamaesyce prostrata (Ait.) Small	spurge	X	-	-	+	-
Chamaesyce thymifolia (L.) Millsp.	spurge	X	+	-	+	-
Euphorbia lactea Haw.	milk bush	X	-	+	+	-
Euphorbia tirucalli L.	pencil plant	X	-	+	+	-

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SCIENTIFIC NAME	COMMON NAME	STATUS	cf	cs	sp	p
Phyllanthus debilis Klein ex Willd.	phyllanthus	X	+	-	+	-
Phyllanthus tenellus Roxb.	phyllanthus	X	-	-	+	-
Ricinus communis L.	castorbean	X	+	+	+	+
Goodeniaceae						
Scaevola taccada Gaertn.	naupaka kahakai	I	-	+	-	-
Guttiferae						
Clusia rosea Jacq.	autograph tree	X	-	-	+	-
Labiatae						
Leonotis nepetaefolia (L.) R. Br.	lion's ear	X	+	-	+	+
Leguminosae						
Acacia farnesiana (L.) Willd.	klu	X	-	-	+	+
Albizia lebbeck L.	mother-in-law's tongue	X	-	-	+	+
Alysicarpus vaginalis (L.) DC.	alysicarpus	X	-	-	-	+
Bauhinia monandra Kurz	pink bauhinia	X	-	-	+	-
Caesalpinia bonduc (L.) Roxb.	gray nickers	X	-	-	+	-
cf. Calopogonium coeruleum (Benth.) Hemsl.	calopogonium	X	-	-	-	+
Canavalia cathartica Thouars	maunaloa	X	+	-	+	-
Chamaecrista nictitans (L.) Moench	partridge pea	X	+	-	+	+
Crotalaria incana L.	rattlepod	X	+	-	+	+
Crotalaria pallida Ait.	rattlepod	X	-	-	+	-
Desmanthus virgatus (L.) Willd.	virgate mimosa	X	+	-	+	-
Desmodium incanum DC.	beggar's tick	X	+	-	+	-

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SCIENTIFIC NAME	COMMON NAME	STATUS	cf	cs	sp	p
Desmodium triflorum (L.) DC.	beggarweed	X	-	-	-	-
Indigofera suffruticosa Mill.	indigo	X	+	-	+	-
Lablab purpureus (L.) Sweet	hyacinth bean	X	+	-	-	-
Leucaena leucocephala (Lam.) deWit	koa-haole	X	+	+	+	-
Lotus uliginosus Schkuhr	lotus	X	+	-	-	-
Macroptilium atropurpureum (DC.) Urb.	wild bush-bean	X	+	-	+	-
Macroptilium lathyroides (L.) Urb.	wild bush-bean	X	+	+	+	-
Mimosa pudica L.	sleepinggrass	X	+	+	+	-
Peltophorum cf. pterocarpum (DC.) Bak. ex K. Heyne	peltophorum	X	+	-	-	+
Phaseolus sp.	bean	X	+	-	-	-
Pithecellobium dulce (Roxb.) Benth.	'opiuma	X	-	-	+	-
Pithecellobium cf. unguis-cati (L.) Benth.	pink-flowered 'opiuma	X	-	-	+	-
Prosopis pallida (Humb. & Bonpl. ex Willd.) H.B.K.	kiawe	X	-	-	-	+
Samanea saman (Jacq.) Merr.	monkey pod	X	-	-	-	-
Senna occidentalis (L.) Link	coffee senna	X	+	-	+	-
Senna surratensis (N.L. Burm.) Irwin & Barneby	kolomona	X	+	+	+	-
Senna pendula (Humb. & Bonpl. ex Willd.) Irwin & Barneby	cassia	X	-	-	+	-
Vigna unguiculata (L.) Walp. subsp. sesquipedalis (L.) Verdc.	asparagus bean	X	+	-	-	-
Lythraceae						
Cuphea carthaginensis (Jacq.) Macbr.	cuphea	X	-	-	+	-
Malvaceae						
Abutilon grandifolium (Willd.) Sweet	ma'o	X	+	+	+	+
Hibiscus tiliaceus L.	hau	I?	-	-	-	+
Malva parviflora L.	cheeseweed	X	+	+	+	+

SCIENTIFIC NAME	COMMON NAME	STATUS	cf	cs	sp	p
Malvastrum coromandelianum (L.) Garcke	malvastrum	X	+	+	+	+
Malvaviscus arboreus Cav.	turk's cap	X	-	-	+	-
Sida fallax Walp.	'ilima	I	-	+	+	+
Sida rhombifolia L.	sida	X	+	-	+	+
Thespesia populnea (L.) Soland. ex Correa	milo	I?	-	+	+	-
Meliaceae						
Melia azedarach L.	Chinaberry	X	-	-	+	+
Moraceae						
Artocarpus altilis (Parkins) Fosb.	breadfruit, 'ulu	P	-	-	+	-
Ficus microcarpa L. f.	Chinese banyan	X	+	-	+	-
Myrtaceae						
Psidium guajava L.	guava	X	+	-	+	-
Syzygium cumini (L.) Skeels	Javaplum	X	-	-	+	+
Nyctaginaceae						
Bougainvillea spectabilis Willd.	bougainvillea	X	-	+	+	-
Mirabilis jalapa L.	four-o'clock	X	+	-	+	-
Onagraceae						
Ludwigia octovalvis (Jacq.) Raven	ludwigia	X	+	-	+	-
Oxalidaceae						
Oxalis corniculata L.	yellow wood-sorrel	X	+	-	+	-

SCIENTIFIC NAME	COMMON NAME	STATUS	cf cs sp p
Oxalis corymbosa DC.	pink wood-sorrel	X	+ - + -
Papaveraceae			
Argemone mexicana L.	yellow prickly-poppy	X	+ - + -
Passifloraceae			
Passiflora edulis Sims	passion fruit	X	+ - + -
Phytolaccaceae			
Rivina humilis L.	rouge plant	X	- - + -
Piperaceae			
Peperomia leptostachya Hooker & Arnott	'ala'ala-wai-nui	E	- - + -
Plantaginaceae			
Plantago major L.	common plantain	X	+ - - -
Plumbaginaceae			
Plumbago zeylanica L.	'ilie'e	I	+ - + -
Polygonaceae			
Antigonon leptopus Hooker & Arnott	coral vine	X	+ + + -
Coccoloba uvifera (L.) L.	sea grape	X	- + - -
Portulacaceae			
Portulaca oleracea L.	common purslane	X	+ + + -

SCIENTIFIC NAME	COMMON NAME	STATUS	cf cs sp p
Portulaca pilosa L.	portulaca	X	- - + -
Talinum paniculata (Jacq.) Gaertn.	pink baby's-breath	X	- - + -
Primulaceae			
Anagallis arvensis L.	scarlet pimpernel	X	- - + +
Proteaceae			
Grevillea robusta A. Cunn. ex R. Br.	silk-oak	X	- - + +
Rubiaceae			
Paederia scandens (Lour.) Merr.	maile pilau	X	+ + + +
Richardia brasiliensis Gomes	richardia	X	+ - + -
Spermacoce assurgens Ruiz & Pavon	borreria	X	+ - + -
Rutaceae			
Citrus cf. reticulata Blanco	tangerine	X	- - + -
Murraya paniculata (L.) Jack	mock orange	X	- - + -
Sapindaceae			
Cardiospermum halicacabum L.	balloon vine	X	+ + + +
Solanaceae			
Lycopersicon pimpinellifolium Mill.	currant tomato	X	+ + + +
Physalis sp.	physalis	X	- - + -
Solanum americanum Mill.	popolo	I?	+ - + -
Solanum seaforthianum Andr.	solanum	X	- + + -

SCIENTIFIC NAME	COMMON NAME	STATUS	[illegible]
Sterculiaceae			
Waltheria indica L. var. americana (L.) R. Br. ex Hosaka	'uhaloa, ni'aloa	I?	- - - -
Thymelaeaceae			
Wikstroemia uva-ursi A. Gray	'akia	E	- - - -
Tiliaceae			
Triumfetta semitriloba Jacq.	Sacromento bur	X	- - - -
Umbelliferae			
Centella asiatica (L.) Urban	asian pennywort	X	- - - -
Ciclospermum leptophyllum (Pers.) Sprague	ciclospermum	X	- - - -
Verbenaceae			
Lantana camara L.	lantana	X	- - - -
Stachytarpheta urticifolia (Salisb.) Sims	stachytarpheta	X	- - - -
Vitex trifolius L.	vitex	X	- - - -
Addendum			
Convolvulaceae			
Ipomoea brasiliensis (L.) Sweet.	pohuehue	I	- - -

APPENDIX D

TERRESTRIAL VERTEBRATE ANIMALS REPORT

TERRESTRIAL VERTEBRATE ANIMALS

OF THE

KUKUIULA PROJECT SITE

Island of Kauai, Hawaii

PREPARED FOR:

Alexander & Baldwin, Inc.
Honolulu, Hawaii

AUGUST 1988

PREPARED BY:

Dr. Andrew J. Berger, Ph.D

TERRESTRIAL VERTEBRATE ANIMALS OF THE KUKUIULA PROJECT SITE

This report was prepared at the request of Mr. Bruce T. Tsuchida of the R. M. Towill Corporation, who will be the Project Manager for the project. Mr. William H. Campbell, Manager, Planning and Property Development, of Alexander & Baldwin, Inc., in a letter dated February 24, 1988, approved my proposal as sent to Mr. Tsuchida in a letter dated December 7, 1987. My field studies were conducted on March 16 and 17, 1988.

THE HABITAT

The expanded project site has been devoted to pasture and sugarcane production. I assume that this has been marginal pastureland because the region is a relatively dry one. According to Price (in Armstrong, 1983), the rainfall during April, May, and June averages less than 5 inches per month. And, the pastureland was very dry during March 16 and 17, 1988, and I saw no cattle, horses, or other grazing animals in the pasture; there were no functional and operating water troughs in the pasture. Most of the grass tussocks were dead and dry, as was a large part of the introduced dominant vegetation: koa haole (Leucaena glauca) and kiawe or mesquite (Prosopis pallida). Both living and dead koa haole showed evidence of heavy grazing in the past.

There are a few Indian banyon trees (Ficus benghalensis) in the pasture (especially along old fence rows), and at least two species of conspicuous cacti: prickly pear cactus (Opuntia sp.) and a cereus cactus (Cereus peruvianus). According to Benson (1982:544), the cereus cactus apparently was introduced to Kauai "by the Moir family." Sisal (Agave sisalana) grows inside the lower fence. Lava boulders of many sizes are scattered throughout the pastureland. The pasture upslope of the cane haul road is badly eroded. Without a regular water supply, the entire project site would be considered a real "wasteland." I saw no endemic or endangered plants or animals during my two days of field work.

AMPHIBIANS AND REPTILES

There are no native or endemic amphibians or land reptiles in the Hawaiian Islands. All on Kauai, therefore, have been introduced by man. None is an endangered or threatened species in their native habitat and none is of any significance for an environmental impact statement.

I. CLASS AMPHIBIA

A. Family Ranidae, True Frogs

(1) Bullfrog (Rana catesbeiana). Oliver and Shaw (1953) wrote that "this was probably one of the first species of amphibians to be introduced to the Hawaiian Islands, and may have been one of the frogs that was imported prior to 1867." McKeown (1978) said that the bullfrog "was purposely introduced in 1867 and again in 1879 from California as an additional food source." It now is found on all of the main islands. Bullfrogs are active primarily at night, and I did not happen to see or hear any during my two days at the project site in 1988. Bullfrogs are serious predators on small ducklings and I have found the remains of Koloa (the endemic endangered Hawaiian duck) in the stomach of a bullfrog. Two small ducklings also were taken from the stomach of a bullfrog at Waimea Falls Park, Oahu, in 1982.

(2) Wrinkled Frog (Rana rugosa). This frog is native to Japan. It was introduced to Hawaii in 1896 for insect control. "It has since become established in most mountain streams which offer both abundant shade and year-round clear, cool running water ... It co-inhabits some streams with the bullfrog, the latter living in the broad deeper sections, while the wrinkled frog is found in shallow pools" (McKeown, 1978).

B. Family Buffonidae, True Toads

(3) Giant Neotropical Toad (Bufo marinus). This toad was first introduced to the islands in 1932 "when Dr. C. E. Pemberton brought 148 adult toads from Puerto Rico. Eighty of these were

liberated in a taro patch near Waipio, Oahu, and 69 were released in a swampy part of Manoa Valley" (Oliver and Shaw, 1953:77). The toads were very successful and "in a little over two years more than 100,000 descendants of the original stock were distributed through Dr. Pemberton's activities throughout the islands." Hunsaker and Breese (1967) wrote that this toad was "the commonest species of amphibian" in Hawaii. These toads are active primarily at night and I did not happen to see any during my daytime field studies. The pastureland may now be too dry for these toads even though they require water only for their breeding activities. According to McKeown (1978) these toads eat "large quantities of cockroaches, beetles, grubs, crickets, grasshoppers, other insects, spiders, and centipedes."

II. CLASS REPTILIA

A. Suborder Lacertilia, Geckos and Skinks

1. Family Gekkonidae, Geckos

Mourning gecko (Lepidodactylus lugubris)
Stump-toed gecko (Gehyra mutilata)
Tree gecko (Hemiphyllodactylus typus)
Indo-Pacific gecko (Hemidactylus garnoti)
House gecko (Hemidactylus frenatus)

2. Family Scincidae, Skinks

Metallic skink (Leiolopisma metallicum)
Snake-eyed skink (Cryptoblephanus boutoni)
Azuretailed skink (Emoia cyanura)

All of these small geckos and skinks are irrelevant to an impact assessment, in part, because they adapt well to both urban and rural habitats and because all are introduced species.

B. Suborder Serpentes, Snakes

1. Family Typhlopidae, Blind Snakes

(1) Blind Snakes (*Typhlinia bramina*). "This small, secretive snake was apparently introduced from the Philippines in the dirt surrounding plants that were brought in for landscaping the campus of the Kamehameha Boys School in Honolulu. It was first found there in January of 1930" (Oliver and Shaw, 1953). These blind, worm-like snakes are rarely seen until they are flooded from underground burrows by heavy rains or unless one looks for them under branches and other debris on the ground. These small, harmless snakes are of no significance for an environmental impact statement and I did not look for them. They are found on all of the main islands in the Hawaiian chain (McKeown, 1978).

C. Order Chelonia, Turtles

1. Family Trionychidae, Softshell Turtles

(2) Chinese Softshell Turtle (*Trionyx s. sinensis*). This turtle is native to China, Formosa, Japan, and Southeast Asia. They now are found on Kauai and Oahu, although there appears to be no habitat for these turtles in the project area.

THE BIRDS

Three different groups of birds are found in the Hawaiian Islands: Introduced, Indigenous or Native, and Endemic or Unique.

I. INTRODUCED BIRDS

More than 170 species of exotic or alien bird species have been introduced to the Hawaiian Islands since 1796 (Berger, 1981). Approximately 50 species have established breeding populations in the islands. The following species have been recorded on the project site or on lands surrounding the site. I include birds seen on "lands surrounding the site" for several reasons: first, the site lies adjacent to other land uses; secondly, my field studies were confined to only two days in May of 1988; and thirdly, some of the species seen in surrounding areas certainly pass through or over the project site at times, and others certainly would move in when residential areas and a golf course replace the present pasture and sugarcane fields.

A. Order Ciconiiformes

1. Family Ardeidae, Herons and Egrets

(1) Cattle Egret (*Bubulcus ibis*). This species was imported to Hawaii from Florida to aid "in the battle to control house flies, horn flies, and other flies that damage hides and cause lower weight gains in cattle" (Breese, 1959). This egret is native to Spain, Africa, and Asia. The birds appeared in British Guiana about 1930, apparently being wind-borne from Africa, a natural colonization of the New World. By 1965, the birds had reached California (Peterson, 1954; Van Tyne and Berger, 1976). A total of 105 birds were released on five islands between July 17 and August 24, 1959. During the 1983 annual Christmas Count of the Hawaii Audubon Society, 2,381 egrets were counted on Kauai (Sears, 1984) but Byrd, et al, (1980) thought that the total Kauai population was at least 6,800 birds. Some 2,725 cattle egrets were counted on the Kauai Christmas Count on December 21, 1985 (Sears, 1986).

I saw several cattle egrets in the pasture, along the cane haul road, and in several surrounding areas (e.g., Kiahuna Golf Course).

B. Order Galliformes

1. Family Phasianidae, Pheasants, Quails, Francolins

(2) Ring-Necked Pheasant (*Phasianus colchicus*). This pheasant has a wide distribution in temperate Asia. It is a highly variable species, and as many as 40 separate subspecies have been described by taxonomists. *Phasianus colchicus torquatus*, a native of eastern China, was introduced to Hawaii at an unknown date, but perhaps as early as 1865 (Caum, 1933). Other races and mutants were obtained from mainland game farms during the period of 1959 to 1962. This pheasant is a popular game bird in Hawaii, and the 10-year average (1977-1986) for pheasants killed by hunters was 327 birds, with annual bags varying from 263 birds (1985) to 454 birds (1983) (Telfer and Walker, 1986). The project site does not provide good habitat for the pheasant, and I flushed only one bird in the pasture and I saw another at the Kiahuna Golf Course.

(3) Red Jungle Fowl (*Gallus gallus*). This is the ancestor of all domestic chickens. The native range is from Sri Lanka and India eastward to Java and the area formerly called Indochina. I saw a cock bird along the road to the Kiahuna Golf Course that looked like a true jungle fowl, which I have seen often in the Kokee area. If it was a domestic rooster, it was a remarkable bird. In any event, its presence is irrelevant to an impact statement.

C. Order Columbiformes

1. Family Columbidae, Pigeons and Doves

(4) Rock Dove or Feral Pigeon (*Columba livia*). The pigeon probably was the first exotic bird to be introduced to the Hawaiian Islands; their importation has been traced back to

1796. Schwartz and Schwartz (1949) wrote that the feral pigeon roosts and nests the year around in sheltered portions of cliffs along the sea coast, in rocky gulches, and in collapsed lava tubes up to 10,000 feet on Mauna Kea. These authors found heavy parasitism of feral pigeons by tapeworms, and they stated that the tapeworm infestation retards proper nutrition and "occludes the intestine, produces undesirable toxins, and hinders breeding." Navvab Gojrati (1970) reported infection by bird malaria, *Haemaproteus*, and *Leucocytozoon* in birds at the Honolulu Zoo. Kishimoto and Baker (1969) reported finding the fungus *Cyptococcus neoformans* in 13 out of 17 samples of pigeon droppings in Oahu. The full significance of their findings was never determined, but, in man, this fungus causes a chronic cerebrospinal meningitis and Hull (1963) remarked that "in all but the cutaneous forms the prognosis is very grave."

The feral pigeon apparently is quite rare on Kauai, so that free flying pigeons may well be those of pigeon fanciers on the island.

(5) Spotted or Lace-Necked Dove (*Streptopelia chinensis*). Also called the Chinese dove, this Asian species was released at an early date; the exact date appears to be unknown, but the birds are said to have been very common on Oahu by 1879. Although this species does occur where the annual rainfall exceeds 100 inches, the highest densities are found in drier areas where the alien kiawe or mesquite is one of the dominant plants. Schwartz and Schwartz (1949) reported densities as great as 100 birds per square mile in dry areas on Molokai. This dove is classified as a game bird in Hawaii and the 10-year average kill on Kauai was 61 birds (Telfer and Walker, 1986). The spotted dove is common in the pastureland as well as along the cane haul roads.

(6) Barred Dove or Zebra Dove (Geopelia striata). This dove is native to Australia and the Orient. The species is said to have been introduced to Hawaii some time after 1922 (Bryan, 1958). It now is an abundant species on all of he islands. This dove also prefers the drier areas, and Schwartz and Schwartz (1949) reported densities as great as 400 to 800 birds per square mile in some areas on Oahu, for example, Barbers Point to Makaha. The barred dove is also classified as a game bird in Hawaii and the 10-year average kill on Kauai was 53 birds (Telfer and Walker, 1986). One study of the food habits in Hawaii revealed that the diet consists of 97 percent seeds and other plant materials; the 3 percent animal matter included several species of beetles, weevils, and wireworm larvae. Kocan and Banko (1974) reported on barred doves from the Big Island that were infected with trichomonas; this parasite was "catastropic" effects on doves in North America. The barred dove is very common throughout the project region, including the pasture and the cane haul road.

D. Order Strigiformes

1. Family Tytonidae, Barn Owls

(7) Barn Own (Tyto alba pratincola). Barn owls differ from other owls in that they have a facial disc of feathers, hence the name of monkey-faced owl. Barn owls were first released on Kauai between April 1959 and June 1963 (Berger, 1981). Au and Swedberg (1966) summarized the status of barn owls that were first released at Kilohana. Many owls were found dead later, but recoveries of dead birds showed that the species had spread nearly around the entire island. Tom C. Telfer, District Wildlife Biologist of the State Division of Forestry and Wildlife in Lihue, wrote to me (letter dated March 22, 1988), "We have had a mysterious 'owl disease' during the past year and have lost over 75 owls (both barn owls and pueo). We have recovered some from the Lawai area,

and some from Poipu." Barn owls are nocturnal in habits and I did not see one during my stay in the project area, but, as Telfer wrote, they do occur in the area. Byrd and Telfer (1980) reported that barn owls had killed more than 100 seabirds and their chicks on Kauai and on Kaula Island.

E. Order Passeriformes

1. Family Timaliidae, Babblers and Their Allies

(8) Melodious Laughing-Thrush (Garrulax canorus). Although it has long been called the Chinese Thrush in Hawaii, this bird is a member of the babbler family. The Chinese name is Hwa-mei. The species is native to the Yangtze Valley in China and southward into Laos, and it occurs in Formosa. The birds were brought to Hawaii as cage birds. "A number obtained their freedom at the time of the great fire in the Oriental quarter of Honolulu in 1900, and took to the hills behind the city" (Caum, 1933). Birds later were imported and released on other islands. Birds from Oahu were released on Kauai in 1918. Richardson and Bowles (1946) reported that this babbler was a common resident on Kauai. They wrote that "the species was present from the coast to the highest forests (over 4,500 feet), and from humid forested valleys to dry, barren canyons of the southern Na Pali Coast." I saw and heard this laughing-thrush in the pasture as well as in surrounding areas.

2. Family Mimidae, Mockingbirds and Thrashers

(9) Mockingbird (Mimus polyglottos). The mockingbird has a wide distribution from southern Canada throughout the mainland United States and into southern Mexico. The Hui Manu released birds on Oahu in 1931 and later on Maui in 1933 (Elepaio, 21:81). There seem to be no further records of introductions, but the mockingbird is now well established on

Kauai. In the past, I have seen mockingbirds at Kalalau Lookout and in the Barking Sands area. In 1984 and 1988, I found the mockingbird in the pastureland as well as in other habitats near the project area.

3. Family Turdidae, Thrushes

(10) Shama (Copsychus malabaricus). Shama is the Hindi name for this thrush, which is native to India, Nepal, Burma, Malaysia, and throughout Indonesia. It was released on Kauai in in 1931 (Berger, 1983). Richardson and Bowles (1964) found the Shama a "moderately common resident locally, usually in inhabited lowland areas" on Kauai. The shama is interesting because typically it nests in holes in trees, but Mr. Richard C. Tongg told me several years ago that some shamas on Kauai had nested in a pair of shoes on an outside shelf at a home in Waialua Homesteads, and of another pair that built a nest in a woman's purse hung open under the eaves and over a door of a house. The shama is noted for its loud and attractive song. I found shamas near the west end of the project area, as well as in other adjacent areas.

4. Family Zosteropidae, White-eyes and Silver-eyes

(11) Japanese White-eye (Zosterops j. japonicus). The Japanese name for this bird is mejiro. It was first imported from Japan by the Territorial Board of Agriculture and Forestry in 1929. There was later importation by the Hui Manu and by private individuals, and Caum (1933) said that the bird was known to be established on Oahu by 1933 and "possibly on Kauai." The white-eye has been a remarkably successful species, and I believe it to be the most abundant song bird in the Hawaiian Islands today. It occurs from sea level to tree line on Maui and Hawaii and it is found in the wettest and the driest habitats. It is common in all habitats adjacent to and including the pasture and cane land of the

project area. White-eyes are pests at times and the California Department of Food and Agriculture recommended that their importation, transportation, or possession be prohibited in that state (Keffer, et al, 1976). Two pairs of a related species (gray-backed white-eye) escaped in San Diego in 1973 or 1974; 150 offspring had been captured in less than 10 years. "Estimates of the potential loss in soft-fruit crops, should white-eyes even begin to multiply rapidly and establish large populations, run as high as $2 million a year" (Audubon Magazine, September 1982).

5. Family Sturnidae, Starlings and Mynas

(12) Common Indian Myna (Acridotheres tristis). The common myna, which is native to Sri Lanka, India, Nepal, and adjacent areas, "was introduced from India in 1865 by Dr. William Hillebrand to combat the plague of army worms that was ravaging the pasturelands of the islands" (Caum, 1933). The myna is an abundant and familiar species, being found in both residential and urban areas, as well as in the vicinity of human habitation in rural areas and even in the mountains (e.g., Kokee State Park). The myna is very common in the entire Spouting Horn -- Poipu Beach region.

6. Family Icteridae, Blackbirds, Orioles, and Meadowlarks

(13) Western Meadowlark (Sturnella neglecta). This species is native to Western North America, from British Columbia southward into Mexico and eastward to Michigan and northeastern Ohio. Meadowlarks were released on Oahu and Kauai in 1931; the birds did not survive on Oahu. On Kauai the birds are fairly common but localized in distribution, being found in Kilauea, Kapaa, and Kekaha. Meadowlarks are birds of open fields, alfalfa fields, and golf courses. The only place where I have seen this bird in the vicinity of the project site is at the Kiahuna Plantation Golf Course.

7. Family Ploceidae, Weaverbirds and Their Allies

a. Subfamily Estrildinae, Waxbills

(14) Ricebird or Nutmeg Mannikin (*Lonchura punctulata*). Also called the spotted munia, this species has a wide distribution in Asia and the Philippines. It was introduced into Hawaii about 1865 by Dr. William Hillebrand. Caum (1933) wrote that the species "feeds on the seeds of weeds and grasses and does considerable damage to green rice." Rice is no longer grown in Hawaii, but the ricebird is now very common on all islands (see house finch regarding the destruction to sorghum crops by these two species). Ricebirds are highly gregarious and it is not uncommon to see flocks of a hundred or more at certain times of the year. It is a prolific species that nests throughout the year. Ricebirds are not inhabitants of dense forests or thickets but they occur wherever there are roads, trails, or open spaces, and I found them throughout the Spouting Horn -- Poipu Beach region.

(15) Black-headed Munia (*Lonchura malacca atricapilla*). Also called the chestnut mannikin, this species was first reported near Pearl Harbor in 1959 (Udvardy, 1960). They were first reported on Kauai in 1976 (Pratt, 1977), when H. Douglas Pratt saw between 40 and 50 birds in the Poipu Beach area. This munia frequents golf courses, grassy roadsides, weedy margins of cane fields, and nearly any open area where there are weed seeds. I saw flocks of from seven birds to 50 or more in and adjacent to the project site.

b. Subfamily Passerinae, Sparrow Weavers

(16) House Sparrow (*Passer domesticus*). Also incorrectly called the English sparrow, nine birds were first imported to Honolulu from New Zealand in 1871. Caum (1933) wrote

that "whether or not there were further importations is not known, but the species was reported to be numerous in Honolulu in 1879." The house sparrow is now an abundant species on all of the islands, typically being found in the vicinity of man and his buildings. They occur throughout the Spouting Horn -- Poipu Beach region. In North American, the house sparrow (first released in Brooklyn, New York in 1852) became a serious pest and tens of thousands of dollars were spent in attempting to control the population (Dearborn, 1912). In India, was well, the house sparrow causes "colossal damage to the food-grains in standing crops and storages" (Rana and Idris, 1986). The sparrow apparently never became a pest in Hawaii. It is omnivorous in diet, eating weed seeds as well as insects and their larvae.

8. Family Fringillidae, Cardinals, Buntings, and New World Sparrows

a. Subfamily Emberizinae

(17) Red-crested Cardinal (*Paroaria coronata*). This bird traditionally has been called the Brazilian cardinal in Hawaii, but the native range includes Uruguay, Paraguay, Brazil, and parts of Bolivia and Argentina. Richardson and Bowles (1964) did not see this cardinal on Kauai, but the species has become established there. It has been reported in Lihue, Poipu Beach, Wailua Valley, and the Hanapepe salt pond area. I saw these cardinals in the partureland, along the cane haul road in many other adjacent lands.

b. Subfamily Cardinalinae, Cardinals and Grobeaks

(18) Cardinal (*Cardinalis cardinalis*). Also called the Virginia cardinal, Kentucky cardinal, and Kentucky redbird, this species was released several times in Hawaii

between 1929 and 1931 (Caum, 1933). Richardson and Bowles (1964) found cardinals near sea level, in the very dry regions of the Na Pali coast, at Kokee State Park, and in the exceedingly wet forest of the Alakai Swamp at an elevation of 4,000 feet. These cardinals are at home in the kiawe/koa haole habitat of the pastureland as well as in the vegetation along the shore, homes and hotels; they also visit the edges of cane fields. The cardinal is common throughout the entire region.

c. Subfamily Carduelinae, Goldfinches and Allies

(19) House Fince (*Carpodacus mexicanus frontalis*). The house finch was introduced to the islands from California "prior to 1870, probably from San Francisco" (Caum, 1933). It also is called the papayabird in Hawaii, even though it is primarily a seed-eater. The house finch is now an abundant bird in both urban and rural areas of all islands, and probably is the second most common song bird in the islands. House finches are inhabitants of open forest, scrub land, and residential area, wherever seeds are common. I found them throughout the region, including the pastureland and along cane haul roads.

House finches and ricebirds caused considerable damage to experimental sorghum crops planted on Kauai and Hawaii during 1971 and 1972. "A report by the Senate Committee on Ecology, Environment and Recreation says ricebirds and linnets [equals house finch] caused a 30 to 50 percent loss in the sorghum fields at Kilauea on Kauai last year ... seed-eating birds at Kohala ate about 50 tons of sorghum grain in a 30-acre experimental field that was expected to produce 60 tons" (Honolulu Advertiser, March 14, 1972, page B-2). The seriousness of this problem is because of the "implications it holds for the establishment of a major

grain production industry in Hawaii. If the grain production is successful in Hawaii, it will help expand the livestock industries and eventually result in greater agricultural sufficiency for the State." However, the recent establishment of a large population of black-headed munias on Kauai and of the warbling silverbird (*Lonchura malabarica cantans*) and of the Java sparrow (*Padda oryzivora*) on the Big Island will intensify this problem.

II. INDIGENOUS OR NATIVE BIRDS

These are birds that occur in Hawaii but also in other parts of the Pacific Basin or in North America. They are native to the Hawaiian Islands but are not unique to them; none is classified as threatened or endangered. In this category are 22 species of seabirds, the Hawaiian black-crowned night heron or Aukuu, and a number of migratory birds that nest in Alaska or Siberia and which spend the winter season on the Hawaiian and other islands in the Pacific Ocean. There are no seabirds that nest in or near the project site.

A. Order Ciconiiformes

1. Family Ardeidae, Herons and Egrets

(1) Black-crowned Night Heron (*Nycticorax c. hoactli*). Herons are long-necked, long-winged, and long-legged birds that inhabit marshes, swamps, lakes, rivers, and ponds. They eat fish, frogs, snakes, mice, insects, crayfish, and a wide variety of aquatic life. In Hawaii they also are known to eat the downy young of seabirds and probably the downy young of the endangered Hawaiian waterbirds. They also relish prawns, and the State Land Board gave prawn producers a "120-day permit to destroy black-crowned night herons which have been causing economic havoc at Oahu's Kahuku prawn farm as well as other aquaculture farms statewide" (Honolulu Star Bulletin, October 26, page A-8, and October 30, 1985, front page).

The Hawaiian birds have not been recognized as subspecifically distinct from the populations that live in North and South America. Therefore, they are not classified as threatened or endangered, even though their future in Hawaii depends on the preservation of the wetlands on which the endangered Hawaiian waterbirds depend. The black-crowned night heron is not a common species on Kauai; only 35 birds were counted by personnel of the State Division of Forestry and Wildlife during their semi-annual count during January 1986 (Telfer and Walker, 1986). I saw only one heron in the lower pond makai of the cane haul road.

b. Migratory Birds

(2) Golden Plover (Pluvialis dominica fulva). The most conspicuous of the migratory species is the lesser golden plover, which occurs from sea level to elevations of nearly 10,000 feet on Maui and Hawaii during the winter season. This plover frequents lawns in residential areas, golf courses, weedy pastures, open areas in the mountains, mud flats, cane haul roads, and grassy areas around air fields. Several plovers were foraging along the cane haul road and they were especially numerous at the Kiahuna Golf Course.

(3) Wandering Tattler or 'Ulili (Heteroscelus incanus). The other migratory species (other shorebirds, ducks) are restricted to tidepools, mud flats, ponds, and mountain streams. I did not see any of these species, but Mr. Tom Telfer wrote to me (letter March 22, 1988) stating that he had seen the wandering tattler or 'Ulili in tidepools along the shore. He added that "that is probably the only regular shorebird in the area besides the plover."

III. ENDEMIC BIRDS

These are birds that are unique to the Hawaiian Islands; they do not occur naturally in any other parts of the world. At least 40 percent of these unique birds are extinct and another 40 percent are now classified as endangered or threatened with extinction. Most of these endangered species are forest birds and there is no native forest anywhere near the project area. There is one endemic bird that occurs in the region.

A. Order Strigiformes

1. Family Strigidae, Typical Owls

(1) Hawaiian Owl or Pueo (Asio flammeus sandwichensis). The pueo is a subspecies of the North American short-eared owl. It is a permanent resident on all of the main islands. The species is not classified as an endangered species on Kauai. On Kauai they occur from sea level to the forest areas at Kokee State Park and the Alakai Swamp. This owl differs from most other owls in that it is diurnal in habits, typically being seen soaring either high or low over pastures and brushland looking for prey, which consists largely of mice and rats. I did not see any pueo during my field work, but Telfer reports that they do pass through this region (see barn owl, above). Nevertheless, the change in land use should have no adverse effect on the pueo.

THE MAMMALS

I. ENDEMIC MAMMALS

The only endemic land mammal in the Hawaiian Islands is the Hawaiian bat (Lasiurus cinerus semotus), a subspecies of the North American hoary bat. This bat occurs primarily on the islands of Hawaii and Kauai. It was long thought that the only breeding population of this bat was confined to the Big Island, but there is a breeding population of unknown size on Kauai. The full extent of its range there has not been determined. It occurs in the Kokee region, and Thomas C. Telfer, District Biologist on Kauai, told me that he had seen this bat along the shoreline in the Poipu and, especially, just west of Lawai Bay. The bats are nocturnal in habits, catching their insect food while in flight. I did not see any bats during my daytime field work, nor after dark at the Sheraton Kauai Hotel at Poipu, where I stayed. Nevertheless, any bats that occur in the region would continue to feed at night whether over the cane fields and pasture or over the lawns of a golf course and residential areas.

II. INTRODUCED MAMMALS

All of the introduced mammals have proven highly detrimental to man, his buildings, products, and agricultural crops and/or to the native forests and their animal life. None of these alien animals is an endangered species and none is of concern as far as detrimental effects on them of any change in the land use activities in the project area. It would, in fact, be a great boon to the islands if it were possible to eliminate all of them, which it is not.

Some of these mammals were first introduced by Captains Cook and Vancouver. Feral cattle (Bos taurus), goats (Capra hircus), sheep (Ovis aries), pigs (Sus scrofa) have been destroying the Hawaiian native forests since 1800, and they continue to do so today. Fortunately, none of these destructive mammals occur in the project area.

With the possible exception of the house mouse (Mus musculus), all of the smaller alien mammals prey on birds, their eggs, and nestlings. These small mammals include the roof rat (Rattus rattus), the Norway rat (Rattus norvegicus), the Polynesian rat (Rattus exulans), small Indian mongoose (Herpestes auropunctatus), feral cat (Felis catus), and feral dog (Canis familiaris). The birds that serve as prey for these small mammals include the endangered forest birds, the endangered Hawaiian waterbirds, and domestic poultry and other domestic birds.

I did not attempt to trap the nocturnal rodents because their presence is irrelevant to an impact statement and because all are alien and pestiferous species. It is certain that all of them occur in the project area (Kramer, 1971; Tomich, 1986).

SUMMARY AND CONCLUSIONS

1. The proposed project site contains sugarcane fields and marginal pastureland. The dominant plants in the pasture are the alien kiawe, koa haole, and grasses, plus cactus, sissal, and banyon trees. There is no endemic ecosystem anywhere near the project site.

2. Because there are no endemic amphibians or land reptiles in the Hawaiian Islands, all of those that are present were introduced by man and are, therefore, alien species. All are insignificant for an environmental impact statement.

3. The presence of the 18 species of introduced bird species in the project area is irrelevant to an impact assessment for the following reasons. An example of the destructiveness of small grain crops by the ricebird and the house finch already has been discussed. The doves and the myna have been implicated in the spread of the seeds of such noxious plants as Lantana camara. The Japanese white-eye is a serious pest to fruit farmers (see Keffer, et al., 1976). The barn owl is known to kill seabirds on Kauai. It seems reasonable to conclude, therefore, that the presence of these alien bird species is irrelevant to an environmental impact statement. To be sure, some of the introduced birds apparently cause no damage to crops or to endemic bird species and their presence gives pleasure to many people. But, development, including landscaping, actually would provide new habitat for more of the introduced bird species than does the sugarcane fields and the relatively barren pastures.

4. The black-crowned night heron is an uncommon species on Kauai. Change in the land use pattern will not have an adverse effect on the heron nor on the golden plover or other migratory birds that are confined to the seashore.

5. The non-endangered pueo or Hawaiian owl has a large home range and the proposed changes in the use of the land of the project area would have no adverse effect on this owl.

6. The only endemic land mammal in the Hawaiian Islands is the Hawaiian hoary bat, now classified as an endangered species. The nocturnal, insect-eating bat inhabits urban areas as well as rural areas and they will continue to do so if the present cane field and pasture are removed and replaced by a golf course and residential units. The bat roosts in caves, trees, and lava tubes, and there is no evidence that the bats roost in the region of the project site.

7. All of the remaining mammals in the project area are introduced species and all are serious pests to man, his buildings, products, agriculture and to the native flora and fauna. The three species of rats prey on the nests of ground-nesting and even some tree-nesting birds, and the mouse and rats cause considerable damage to agriculture and to homes and businesses. If it were possible to exterminate all of these mammals, it would be a great benefit to the Hawaiian Islands. Their presence, therefore, is irrelevant to this environmental impact assessment.

8. Finally, I can see no biological reason for opposing any change in the land use for the project area.

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APPENDIX E

MARINE ENVIRONMENTAL SURVEY REPORT

William A. Brewer & Associates
Environmental Scientists and Aquaculture Consultants
for
Hawaii and the Pacific Basin

BASELINE MARINE ENVIRONMENTAL SURVEYS, KUKUIULA BAY, KAUAI, HAWAII

prepared for

R.M. Towill Corporation

May 23, 1988

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P H O T O G R A P H S

SECTION 1.0 INTRODUCTION

This report presents the results of water quality, limited water current, and biological surveys conducted in Kukuiula Bay, Kauai, Hawaii, on May 11, 1988. The purpose of the study was to define baseline environmental conditions that occur within the bay and to gain an understanding of the marine resources and water quality conditions that could potentially be affected by construction of a marina and channel on mauka lands bordering the east side of Kukuiula Bay.

Kukuiula Bay and smallcraft harbor encompasses approximately 7 acres and is located due east and approximately 1,200 feet from Spouting Horn on Kauai's southern coast (Figure 1). The harbor is roughly rectangular in dimension and has been extensively modified from its natural condition. A roughly 400-foot-long manmade jetty and parking/boat loading area borders the southern sector of the harbor. Approximately 200 feet of concrete bulkhead and a 100-foot-wide draglined channel extend from the toe of the jetty to a narrow boat launching ramp on the east (and makai) side of the harbor. Portions of the harbor were reconstructed in 1984 following a destructive hurricane.

The north and east sides of the harbor have been extensively modified by rock seawalls and rock revetments designed to protect shoreline homes and the coastal (Lawai) road from storm wave attack.

One perennial and two intermittent stormwater or irrigation tail water channels discharge directly into the harbor on its northern (mauka) margin. Waters in the northern third of the harbor were discolored during the May 11, 1988 survey period, an apparently chronic condition.

The results of the field surveys reported herein should be interpreted as a "snapshot" reflecting physical and chemical measurements and biological observations made during the aforementioned survey period and do not necessarily reflect conditions that may be encountered during other times of the year.

SECTION 2.0 METHODS

2.1 Physical-Chemical Measurements

Salinity and temperature measurements were made with a Yellow Springs Instrument Company (YSI) Salinity-Conductivity-Temperature meter equipped with a YSI Model 3300 nickel-platinum conductivity/temperature probe. Dissolved oxygen measurements were obtained utilizing a YSI Model 51B Dissolved Oxygen Meter equipped with a membrane-covered polarographic sensor. The dissolved oxygen meter was calibrated according to factory guidelines in a water vapor-saturated chamber. All measurements were based on *in situ* sampling.

Based on manufacturer-supplied specifications, maximum worst-case instrument/probe errors are as follows: temperature, ±0.7 degrees Centigrade (C.); salinity, ±0.2 parts per thousand (ppt); dissolved oxygen, ±0.2 parts per million (ppm). However, as a result of the efflux of freshwater into the harbor in certain locations, salinity readings were often made by "averaging" meter oscillations at any given station. Such variability in conditions undoubtedly influenced other instrument readings, thus actual instrument/probe error was probably higher than suggested by the above specifications.

2.2 Water Current Measurements

Water currents were analyzed utilizing biologically inert fluorescein dye. Surface (wind-dominated) currents were determined by mixing approximately 10 grams of fluorescein into one quart of seawater within a small plastic bag. These bags were tossed into various locations within the harbor at various tidal periods; upon hitting the water the bag ruptures, releasing a concentrated plume of bright green dye.

Midwater currents were measured by a similar mixture of dye which was dispensed by the diver from a one-quart Nalgene squeeze bottle at approximately mid-depth in various locations around the harbor at different tidal periods.

The tracks of surface and mid-water dye plumes were monitored by estimating distance traveled and dispersion rates over time.

Wind velocity measurements were made with a Florite air velocity meter (Bacharach Instrument Company) with a 0-3,000 feet/minute scale.

2.3 Marine Biological Surveys

Underwater biological surveys were conducted to qualitatively assess the major physiographic features, biological zonation patterns, and to develop a checklist of represented algae, coral, invertebrates and fish. Surveys were conducted with mask and snorkel, which necessarily limited dives to waters less than 5 meters in depth. Kukuiula Bay waters rarely exceeded this depth.

Benthic invertebrate identification and enumeration was generally

limited to specimens exceeding 2.0 cm. in longest dimension (macroinvertebrates), though certain especially numerous, albeit smaller, invertebrates were occasionally recorded. Where appropriate, counts of estimates of population density were made with an aluminum meter stick which was utilized to lay out crude one-square meter or 0.25 square meter quadrats. Particular attention was focused on rock outcroppings, mooring anchors, coral heads, and other types of subsurface structure which offerred a foothold or habitat for epibenthic organisms.

Fish identification and estimates of abundance were made by the diver recording all species sighted during the underwater surveys. Data were recorded on Polypaper sheets upon which a list of the most common fishes expected to be observed was previously printed. This permitted more time for observations and less time for writing. Notes were taken to indicate population densities, habitat features, and the most numerous species characterizing a given zone or habitat.

Corals and algae were inventoried by systematically recording all species sighted along defined compass bearing transects and, in areas of limited underwater visibilty, by random surveys perpendicular to the compass transect. Percent coverage data were developed by visual estimates and, occasionally, by localized measurements with an aluminum meter stick.

A total of 3.0 hours, encompassing six separate dives, were required to survey the major physical and biological features of Kukuiula Harbor. A Nikonos II underwater camera was utilized to document subtidal physiographic features and representative marine flora and fauna.

Surveys of intertidal flora and fauna were conducted on foot around both the developed and undeveloped portions of the harbor during an early morning, +0.1 foot, low tide. A meter stick was occasionally used to quantitate population densities of certain invertebrates. These same areas were later censused via mask and snorkel during the mid-day high tide.

SECTION 3.0 RESULTS

3.1 Water Quality Analyses

The results of temperature, salinity, and dissolved oxygen measurements in Kukuiula Bay are shown in Table 1. Sampling station locations are depicted in Figure 2.

Weather conditions experienced during the survey period varied from sunny in the early morning hours to overcast with light showers characterizing the late morning through late afternoon hours. Winds were variable, ranging from 5-11 miles per hour (mph) during early morning hours (0730-0900 hrs), increasing in velocity by 1000 hours to 10-20 mph, with an average velocity of 14 mph throughout the duration of the survey period.

Water quality data were indicative of the influence of moderate winds on harbor mixing and the influence of surface water runoff (and possible subtidal spring discharges) on the physical and chemical composition of the harbor waters.

The mean temperature of harbor waters was 25.3 degrees C. with a range of 24.2-26.2 degrees C. A slight warming trend was evident between early morning and late afternoon hours. Because of the prevailing winds and relatively shallow waters there was no thermal gradient detected. Harbor waters influenced by the surface water discharge eminating from a drainage ditch on the north side of the harbor (Table 1, Station 2) demonstrated somewhat cooler waters throughout the day than other nearshore sites within the harbor. The surface water discharge demonstrated a mean temperature of 23.8 degrees C., or approximately 1.5 degrees C. cooler than the mean harbor water temperature. This discharge produced a noticeable plume of turbid water which was detectable in the northern third of the harbor throughout the day.

No significant density stratification was evident in the harbor salinity data. This is not unusual, considering the prevailing moderate tradewinds (and resultant water mixing) which characterized the survey period. Salinities demonstrated the influence of surface freshwater (and perhaps subtidal freshets) and ranged from 18.4-27.4 ppt and were variable at each sampling station over time. Normal oceanic salinity would be approximately 34.0 ppt. The highest salinity reading, 31.2 ppt, was recorded on the ocean side of the jetty during afternoon hours, indicating the influence of freshwater discharges even along the wave-exposed coastline. The lowest salinity readings were located in the vicinity of the surface water discharge on the extreme north side of the harbor.

Dissolved oxygen values ranged from 6.25-8.25 ppm. The highest readings were associated with a zone of moderate wave action on the north side of the harbor (Table 1, Station 2). These waters averaged approximately 98 percent of saturation. With the exception of Station 2, dissolved oxygen values throughout the remainder of the harbor averaged approximately 80 percent of saturation. These data indicate that dissolved oxygen is not a limiting factor to marine organisms at any location within the

harbor under existing conditions.

3.2 Water Current Analyses

The results of limited water current analyses conducted on May 11, 1988 indicated that the overall influence of tides on water circulation within the harbor is minimal; wind effects predominate regardless of tidal period. The results of water current analyses are depicted in Figure 3. A tide chart for the May 11, 1988 survey period is shown in Table 2.

During the early morning rising tide, light but persistent winds (5-11 mph) resulted in a westerly (seaward) surface water flow at a velocity of approximately 3.6-4.2 cm./sec. on the south, jetty side, of the harbor. Midwater currents were barely perceptible, averaging less than 0.3 cm./sec. in a westerly direction, with plume dispersion in a north and south direction averaging somewhat less than the westerly flow. The position of the jetty in relation to the prevailing northeasterly winds (230 degree bearing) appears to block the surface current, resulting in a surface flow that moves westerly, parallel with and offshore of the jetty, eventually discharging into the open ocean.

On the opposite side of the harbor, surface currents recorded during a rising morning tide averaged approximately 12.7 cm./sec., versus 4.0 cm./sec. for the midwater plume. Unimpeded by the jetty, these surface waters move relatively rapidly in a southwesterly direction, roughly parallel to the mauka (north) shore, and exit the harbor basin. Plume dispersion to the north and south of the main dye plume is less apparent on the north side of the harbor than on the south (jetty) side because of the limited wind fetch on the north side. As would be expected, surface currents on the northern side of the harbor were found to closely follow the plume of turbid water generated by the drainage ditch discharge.

Water currents on the south (jetty) side of the harbor followed a nearly identical pattern as that previously described during the afternoon receding tide; however, reflecting the overall increase in tradewind velocity, surface current velocities significantly increased. Surface current velocities of 6.8-10.2 cm./sec. characterized the afternoon survey period. These values are approximately 1.1-1.6 percent, respectively, of the surface wind velocity. Midwater velocities were essentially identical to those reported in the aforementioned morning (rising tide) survey. Tradewinds during this period ranged from 10-20 mph with an average of 14 mph. In contrast to the morning hours, however, the surface dye plume was rendered stationary approximately 15 meters from the harbor-side terminus of the jetty. Wave action and strong surges effectively "piled up" the wind driven surface waters at this location and no further seaward progress of the dye plume was detectable. These waters presumably exit the harbor toward the north (mauka) side of the harbor where wave and surge action is less severe.

Water currents observed during the afternoon receding tide on the north side of the harbor followed a track identical to that described during the morning hours; only the velocities were different. Corresponding to the increase in afternoon tradewind velocity, surface currents averaged approximately 14.6 cm./sec.; midwater currents averaged approximately 5.0 cm./sec. As in the morning water current study, the track of both the surface and midwater dye plume followed the same course as the turbid waters eminating from the drainage ditch discharge.

3.3 Marine Biological Surveys

3.3.1 Corals

The coral community was found to be widely distributed throughout all subtidal areas within Kukuiula Harbor. A total of five (5) species were represented: *Pocillopora damicornis* (represented by several growth forms), *Pocillopora meandrina*, *Porites lobata* (represented by two growth forms), *Porites compressa*, and *Montipora* sp. (Table 3).

The common shallow water coral *P. damicornis* dominated the harbor in terms of total number of colonies; *P. lobata* dominated in terms of total percent coverage for a single species; *P. compressa* formed dense, localized assemblages in deeper sections of the main harbor basin; and *P. meandrina* was rather infrequently recorded in shallow waters on the north side of the harbor and less frequently in the main harbor basin. *Montipora* was limited to 7 colonies, most of which were found in the main harbor basin.

P. damicornis was widespread throughout the harbor but was most conspicuous as the principal shallow water coral occurring in a distinct zone immediately below the intertidal zone. This coral was represented by small cespitose (hemispherical) colonies ranging between 3.5-14.0 cm. in diameter. Despite their relatively large numbers, percent coverage in shallow waters around the perimeter of the harbor averaged less than 0.1 percent.

P. lobata dominated the deeper waters of the harbor and was generally found below a depth of approximately 2 meters. This

species was represented by both massive encrusting and columnar growth forms. Colony diameters ranged from small vegetative growth forms (living corals broken or damaged by storm wave action) less than 10 cm. in diameter, to massive coral heads exceeding 3 square meters in surface area and often rising as much as two meters above the substratum. This species could pose as a navigation hazard in certain locations within the harbor during extremely low tides.

Percent coverage of live *P. lobata* ranged from approximately 5 percent around the perimeter of the harbor to 10 percent in the main harbor basin. With the exception of a 200-foot-long by 50-foot-wide section of the harbor fronting the boat loading zone (which appeared to have been draglined at some time in the past), this species dominated the harbor basin. Large expanses of dead colonies, often partially overgrown by living coral, occurred throughout the harbor. The distribution of dead coral did not appear to be a function of the proximity of the coral to the drainage ditch discharge. At any given site within the harbor, as much as 30-60 percent of the *P. lobata* was dead.

The "finger coral", *P. compressa*, was of secondary importance to *P. lobata* throughout the deeper portions of the harbor basin. This species was generally restricted to water depths in excess of 3 meters and was often observed growing on dead colonies of *P. lobata*. Total percent coverage of this species in the main harbor basin was approximately 2 percent, though localized patches occasionally produced colonies exceeding 2 meters in diameter.

P. meandrina had a patchy distribution in shallow waters around the north side of the harbor and was always found seaward of the *P. damicornis* zone. Widely scattered colonies of this species were occasionally observed in the main harbor basin, often growing atop large live and dead colonies of *P. lobata* and *P. compressa*. Overall coverage by this species was less than 0.1 percent.

3.3.2 Algae

A total of 23 species of algae were identified in the intertidal and subtidal reaches of the harbor, though the total number of species is probably somewhat higher (Table 4). Fish grazing or wave disturbance reduced many macrothallic algae to simple holdfasts (attachment organs) which made identification, with any degree of certainty, impossible. However, with the exception of certain red calcareous algae, the overall density and abundance of algae was low compared to other similar locations in Hawaii.

The intertidal flora in wave-dominated areas consisted of encrusting calcareous forms such as *Porolithon onkodes*, *Porolithon gardineri*, and *Sporolithon erythraeum*; low-cropped macroalgal turfs dominated by *Acanthophora spicifera* and *Chlorodesmis hildenbrandtii*; occasional foliaceous patches of the brown alga *Padina japonica*; and often dense, carpet-like stands of blue-green algae (*Hormothamnion* and *Lyngbya*) intermixed with stands of cropped *Enteromorpha*. The cropped, turf-like appearance of some algal species is the result of grazing by herbivorous fish.

The flora of the shallow, subtidal areas around the north and east sides of the harbor consisted of occasional stands of *Ulva fasciata*, various species of *Dictyota*, and foliaceous calcareous algae such as *Amphiroa fragilissima*, *Corallina* sp., *Galaxaura fastigiata*, and *Jania*.

The macroalgal diversity on the manmade rock jetty was exceptionally low in what otherwise would appear to represent ideal habitat for intertidal and subtidal algae. There is no readily apparent explanation for the meager assemblage of algae that was present. *A. spicifera* dominated the flora of the jetty's intertidal and subtidal zones, often forming nearly monotypic, well-cropped mats along most of the length of the jetty. Other less common species occurring on the jetty included *U. fasciata*, *P. japonica*, and *Dictyota*.

3.3.3 Fishes

A total of only 20 species of fish were recorded within Kukuiula Harbor (Table 5). More surprising than their extremely low diversity was their prevailing low population densities. Nearly one-third of the total fish checklist was made up of only one or two individual sightings.

Blennies, wrasses, surgeonfishes, and damselfishes dominated all areas surveyed.

The most numerous species in the intertidal zone (and the most frequently recorded species throughout the harbor) was an unidentified blenny (probably *Istiblennius zebra*). Populations of 20+ individuals frequented the small tidepools on the north side of the harbor during low tide periods. These same tide pools often harbored small schools of juvenile (2.0-3.5 cm.) manini (*Acanthurus triostegus*).

Schools of juvenile mullet (*Mugil cephalus*) were frequently seen well up into the intertidal zone on the north side of the harbor where they appeared to be grazing upon particulate matter

being discharged from the drainage ditch. They were not seen elsewhere in the harbor.

Below the intertidal zone, on the north and east sides of the harbor, saddle wrasses (*Thalassoma duperrey*), manini (*A. triostegus*), *Plectroglyphidodon sindonis*, and an occasional spotted trunkfish (*Ostracion meleagris*) dominated the fish fauna. Single individuals of the acanthurids *Acanthurus achilles* and *Acanthurus olivaceus*, the pearl wrass (*Anampses cuvier*), and the butterflyfish, *Chaetodon quadrimaculatus*, were seen near the mouth of the drainage channel. A single Moorish Idol (*Zanclus cornutus*) was observed near the boat ramp.

The harbor side of the jetty, like other areas within the harbor, hosted relatively few fishes. The territorial pomacentrids *Plectroglyphidodon johnstonianus*, *Plectroglyphidodon sindonis* and *Stegastes fasciolatus*, and a few widely scattered acanthurids (*A. triostegus*, *A. dussumieri*) comprised the limited fish fauna. The paucity of fishes along the subtidal reaches of the jetty may in part be the result of the absence of any significant coral habitat.

Widely scattered acanthurids and pomacentrids were the representative fishes of the main harbor basin. Population densities of both of these families were extremely low, despite the presence of well developed live and dead coral heads which should otherwise have offerred excellent habitat for far more families and species of fishes than were observed.

3.3.4 Macroinvertebrates

With the exception of the intertidal zone on the north side of the harbor, which hosted a relatively diverse invertebrate community, the invertebrate population of the harbor basin and jetty was low (Table 3).

Intertidal boulders and benches on the north and east sides of the harbor provided supratidal (splash-zone) and intertidal habitat for the rock crabs *Grapsus grapsus* and *Grapsus tenuicrustatus*, the largest and most conspicuous species, and an assortment of common nerites and littorines, including *Nerita picea* (pipipi), *Littorina pintado* (pupu kolea), and *Littorina scabra*. Population densities of *N. picea* on one large rock outcrop on the north side of the harbor averaged in excess of 600/sq. meter.

The false opihi, *Siphonaria normalis*, was also a common component of the mid- to upper-intertidal community with population densities on one large boulder averaging approximately 240/sq. meter. On most intertidal rocks the densities averaged less than 20/sq. meter.

Exceedingly large populations of the rock boring urchins *Echinometra oblonga* and *Echinometra mathaei* (ina) dominated the mid- to lower-intertidal zones along the north (mauka) side of the harbor, with densities averaging approximately 75/sq. meter. Urchins play a major role in the geological processes underway in the harbor as a result of their rock-grinding mouthparts which form large fissures and cracks in intertidal and subtidal boulders. They are literally "eating up" much of the intertidal and subtidal rock bench.

Other relatively common species occurring in the subtidal reaches of the harbor included two species of unidentified polychaete worms, several large specimens of the xanthid crab *Carpilius maculatus*, the mollusks *Cypraea caputserpentis* and *Drupa morum*, and at least two species of small, brightly colored encrusting sponges. The collector urchin, *Tripneustes gratilla*, was locally abundant (9 recorded) in shallow water areas influenced by moderate wave action on the north side of the harbor. The ophiuroid (brittle star) *Ophiocoma pica* was noticed on several occasions in the mid-harbor area, but was not especially numerous.

The most abundant and widespread invertebrate throughout the subtidal reaches of the harbor was the delicate octocoral (anthozoan/soft coral) *Anthelia edmondsoni*. This species often formed a bluish-purple carpet across larger rocks and limestone.

Holothurians (sea cucumbers) were conspicuous in their absence from appropriate sand and rubble habitat within the harbor.

SECTION 4.0 DISCUSSION

4.1 Water Quality

Temperature, salinity and dissolved oxygen data obtained in Kukuiula Harbor were within the range normally associated with nearshore marine waters in Hawaii that are subject to surface or subsurface fresh or brackish water discharges. No single water quality parameter evaluated would pose as a limiting factor for any marine or intertidal organism within the harbor under the conditions encountered on May 11, 1988.

The presence of one surface water discharge and two intermittent

mauka drainage systems (the latter two were not flowing during the survey period) would, however, appear to pose as a significant exogenous environmental stress, particularly during periods of heavy stormwater (or irrigation tailwater) runoff. Turbid waters eminating from the main discharge channel created a seaward-flowing silt plume which reduced underwater visibility to less than a meter along most of the northern shoreline and appeared to be responsible for the pronounced turbidity which characterized much of the harbor basin during the survey period (note photograph 3). By contrast, waters on the seaward side of the jetty could be classed as "pristine" on the basis of the absence of any discernible turbidity or discoloration.

The presence of this turbid plume originating from the drainage ditch discharge did not appear to have adversely affected coral distribution or abundance inasmuch as percent coral coverage in areas affected by the turbid waters was comparable to locations outside the influence of the plume. This observation suggests that much of the larger sedimentary material is deposited in the stream bed before reaching the harbor and that suspended materials (silt or "fines") may be carried in the lower density freshwater plume, away from shore, where they are dispersed over a wide area, posing little harm from the standpoint of environmental significance. These discharges are likely to contribute important inorganic and organic nutrients to the nearshore marine ecosystem.

Significant amounts of silt or sedimentary materials were not observed on any live coral, even upon those living beneath the turbid plume. Live corals, particularly species of *Porites* associated with nearshore waters, are known to be able to accomodate significant silting without detrimental effects. From an energy standpoint, however, this is an expensive process, since much of the energy expended by the coral is utilized for transfering particulate material off the colony. Reduced light transmission may also reduce photosynthesis in the symbiotic zooxanthellae (algae) which reside within the coral tissues.

Conversely, the turbid water discharge appeared to constitute a popular feeding zone for certain species of fish, several of which were only observed within these near-zero visibility waters. The acanthurids *Acanthurus triostegus* and *A. olivaceus* demonstrated greater population densities in areas subject to the plume than in other locations within the harbor; the butterflyfish *Chaetodon quadrimaculatus* and several schools of mullet (*Mugil cephalus*) were only observed within areas influenced by the discolored discharge waters. These species may be grazing on particulate organic matter suspended in the discharge water.

Although macrothallic (fleshy) algae were poorly represented throughout the harbor, densities of *Ulva fasciata* were greatest on the north side of the harbor in areas subject to freshwater discharges. The calcareous alga *Padina japonica* was only observed on subtidal rocks in the vicinity of the runoff waters.

No single water quality parameter or observation explains the prevailing low diversity and density of fishes associated with Kukuiula Harbor. Along heavily fished shorelines, or reef areas subject to commercial or recreational aquarium fish collecting, it is not unusual to observe reduced numbers of certain popular food or aquarium fishes. The presence of only eight families of fishes within the entire harbor is exceptionally low, as was the number of individual species observed. Ample coral reef, rock and sand habitats for various fishes were available throughout both inshore and harbor basin waters; they were simply not occupied.

4.2 Water Currents

The results of water current surveys conducted on May 11, 1988 in Kukuiula Harbor demonstrated the influence of the prevailing tradewinds on water circulation; tidal effects were minimal during all tidal periods evaluated. The prevailing currents produce a west and southwesterly flow during all tidal periods. The results of these preliminary surveys should be interpreted as reflecting circulation patterns under tradewind conditions with average tides and moderate surf/surge conditions. Circulation patterns would likely differ under other tidal or weather regimes.

Water circulation is an important consideration when construction is anticipated in marine waters, inasmuch as these data provide an indication of the direction and fate of silt and sediments generated by construction and related activities. Such information is important because of the known adverse impacts on marine biota and marine habitat associated with silt and sediment deposition and scouring.

Construction of a smallcraft marina and access channel on mauka lands on the east side of the existing harbor has been proposed as one component of a major development project in the vicinity of Kukuiula Bay. Preliminary design plans indicate that a marina would be excavated entirely mauka of the existing shoreline. To reduce silt and sediment impacts, the natural beach/backbeach

area would remain intact until all mauka excavation to the design depth is completed. Only then would the existing beach/backbeach area be breeched, allowing immediate and direct exchange between Kukuiula Harbor waters and the excavated marina.

This action would produce a major "one-shot" silt and sediment load which would affect water quality within the harbor and, in all likelihood, in the immediate offshore waters fronting Kukuiula Harbor. An additional period of time would be required for the newly excavated marina to flush and bottom conditions to stabilize, presumably resulting in the efflux of silt-laden water (wind or tidal-driven) into Kukuiula Harbor and adjacent nearshore waters over some period of time.

The results of limited water current studies indicate that silt-laden waters generated by breeching the beach would create a plume which would be directed immediately west and parallel to the existing jetty. During periods of moderate trade winds and low wave and surge action, surface waters would discharge into the open ocean beyond the terminus of the jetty and be widely dispersed. Midwater currents would carry suspended silt and suspended particulate matter in the same (westerly) direction but with some deposition occurring in the main harbor basin.

During periods of moderate trade winds and moderate to heavy wave and surge action dispersal would be less efficient because of the demonstrated "pile up" of surface waters near the terminus of the breakwater. These silt-laden waters would likely exit the harbor at some point between the north (mauka) shore and the terminus of the jetty, and be widely dispersed and diluted in the offshore waters.

4.3 Marine Biology

The results of marine biological surveys indicate that Kukuiula Harbor supports a modestly diverse coral community, a diverse intertidal fauna on undeveloped sections along the north side of the harbor, a rather meager macroalgae community, and an unusually low diversity and abundance of fishes.

Perennial and intermittent flows of silt- and sediment-laden mauka drainage waters appear to be exerting the singlemost (or at least the most readily detectable) adverse influence on the water quality and biota of harbor waters and may, in part, account for the low diversity and density of the macroalgae and fish community.

Future mauka development plans, which include a major golf course, have the potential to significantly improve water quality conditions and increase biological diversity within the harbor by provision of ponds and other water features which could reduce silt and sediment loads that are presently discharged, largely uncontrolled, into nearshore waters within the harbor. Present discharges not only adversely impact Kukuiula Harbor, but adjacent shoreline and offshore areas to the west as well.

The breaching of the beach and backbeach areas following marina construction would, as previously described, create a "one shot" plume of silt- and sediment-laden waters which would have a limited, short-term impact on marine biota in the vicinity of the existing launching ramp. Organisms occurring within the path of such waters could be covered with silt and sediment and suffocate.

Increased silt loading to harbor and nearshore waters outside the harbor basin may also be anticipated until such time that physical and biological processes flush out or stabilize marina and channel sediments. Such longer term events may be expected to stress corals and other benthic organisms to some degree. However, given the existing nature of the discharges which chronically affect the harbor under present conditions, it is unlikely that small, incremental additions of silt resulting from marina and channel sediment stabilization would adversely affect the biota over that presently experienced during heavy runoff conditions.

An estimated two hundred-foot-long section of the harbor basin fronting the existing boat loading and launching ramp appears to have been previously draglined, as coral heads are absent from this zone. This zone is dominated by sand, rubble and low-relief rock outcrops which offer little in the way of habitat for marine organisms. In the absence of coral habitat and significant bottom relief, this area supports an extremely limited flora and fauna. Thus, impacts to marine organisms in this area are expected to be inconsequential.

A limited quantity of intertidal and subtidal boulders and rocks would be removed to create an access channel to the marina. This would destroy the organisms inhabiting these areas, as well as a small amount of intertidal and subtidal habitat for benthic organisms within the harbor. However, this zone has been previously disturbed by seawall, boat ramp, and loading pier construction and represented intertidal and subtidal organisms found on the east side of the harbor are limited in comparison with the relatively undisturbed shoreline on the north side of the harbor which is subject to moderate wave action.

Given the existing baseline environmental conditions occurring in

Kukuiula Harbor, it unlikely that the proposed marina and channel construction activities would result in any significant or long-term environmental impacts. Any such future impacts are unlikely to significantly exceed those presently experienced within the harbor in its present state during heavy runoff conditions.

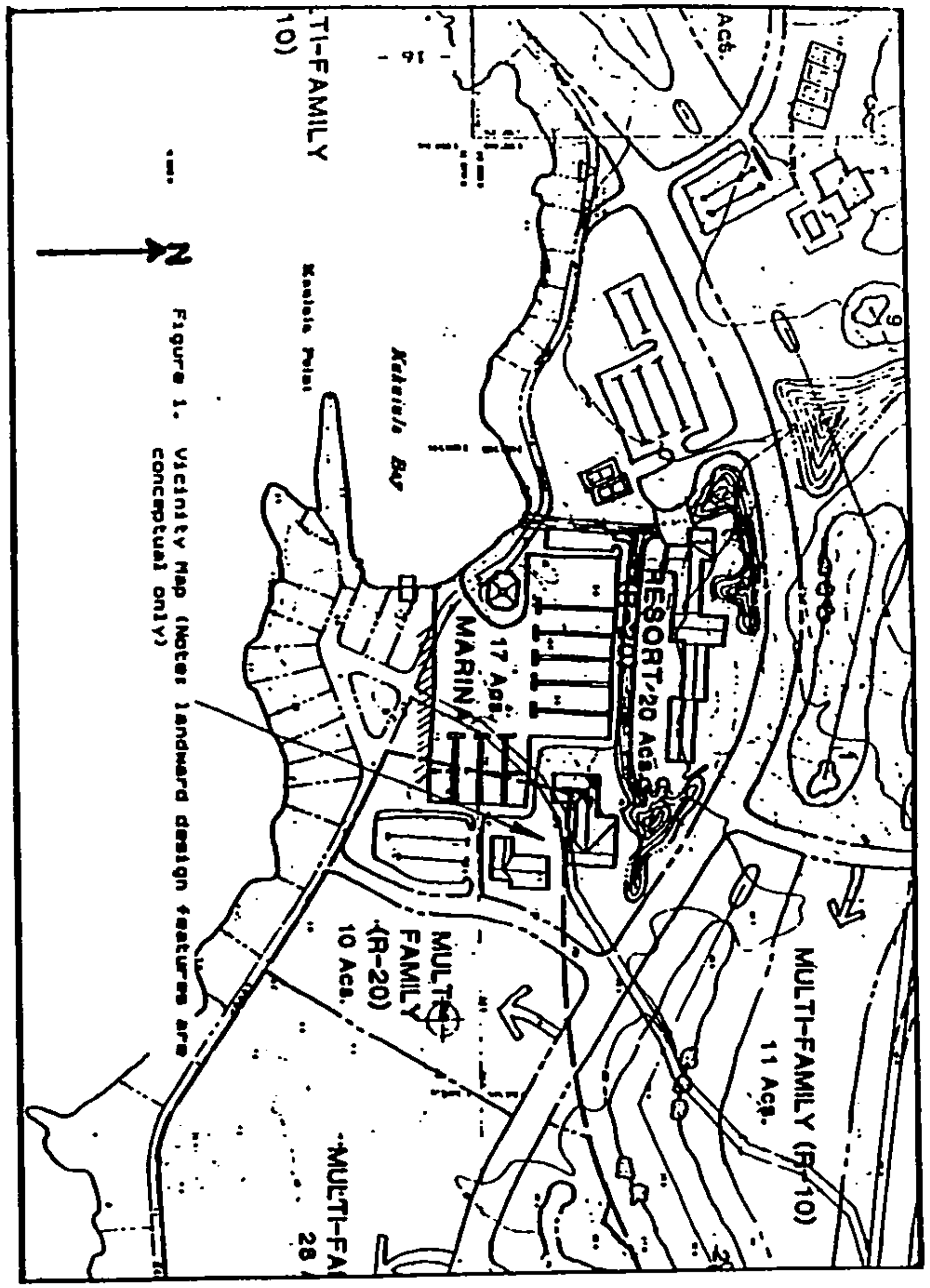


Figure 1. Vicinity Map (Note: landward design features are conceptual only)

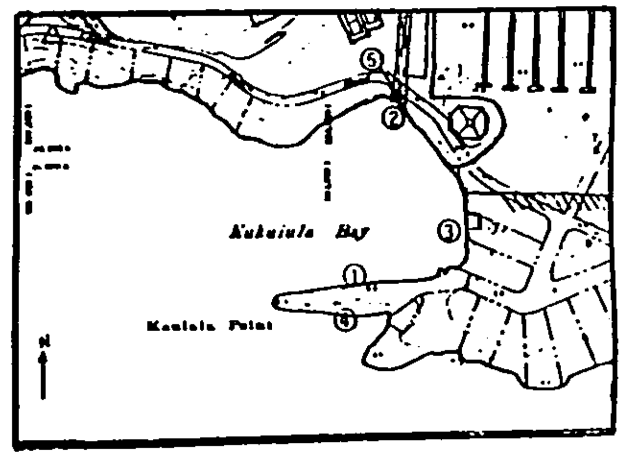


Figure 2. Water Quality Sampling Stations 1-5, Kukuiula Harbor.

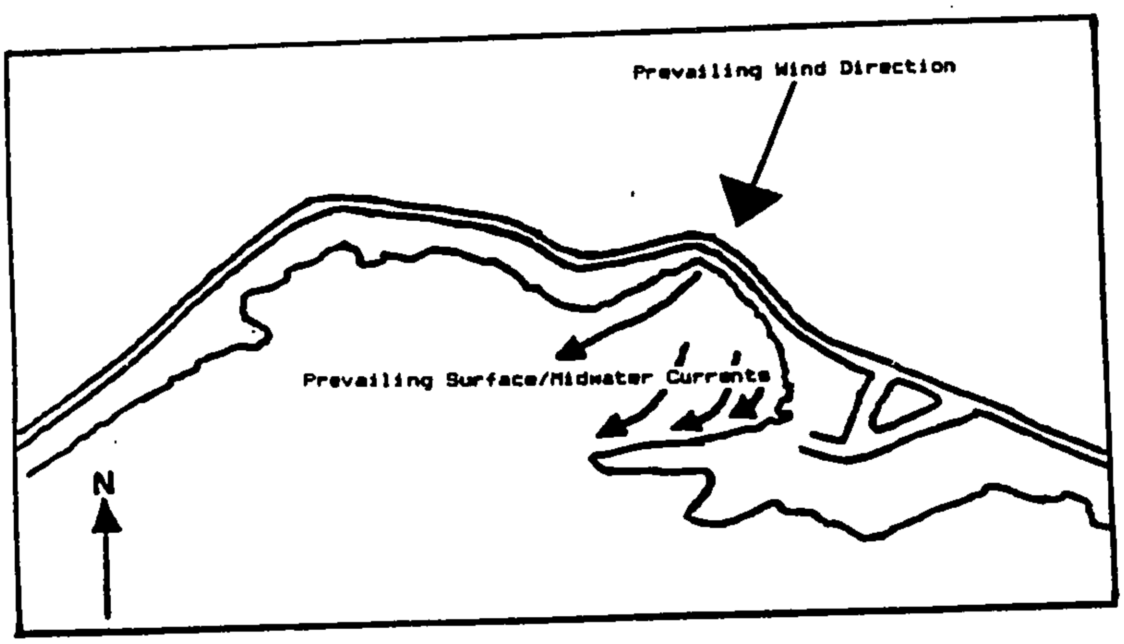


Figure 3. Surface and Midwater Currents, Kukuiula Harbor, May 11, 1988.

TABLE 1

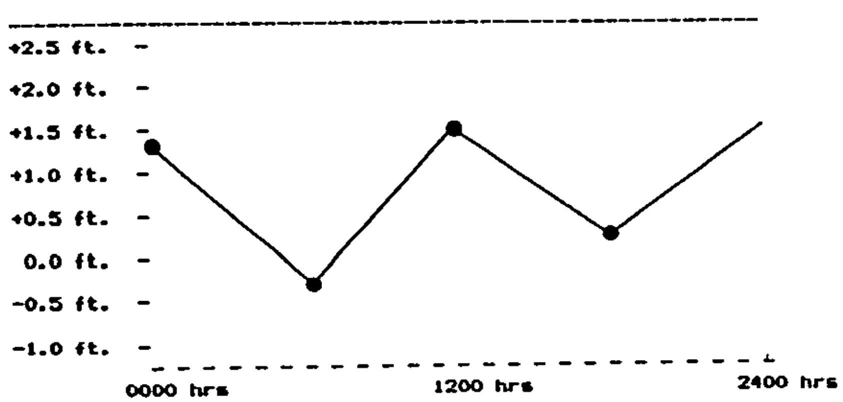
WATER QUALITY DATA - KUKUIULA BAY, KAUAI
MAY 11, 1988

Station No.	Time (hrs.)	Depth (m.)	Temp. (C.)	Salinity (ppt)	Dis. Oxygen (ppm)
1	0825	0.5	24.2	19.0	6.41
	0825	2.0	24.3	19.0	6.44
	1015	0.5	25.2	22.9	6.42
	1015	2.0	24.9	24.2	6.80
	1400	0.5	26.2	26.9	6.81
	1400	2.0	26.0	26.8	6.85
	1708	0.5	25.8	27.4	6.80
	1708	2.0	25.7	27.2	6.83
2	0837	1.0	24.6	18.4	8.25
	1020	1.0	25.0	21.0	8.05
	1410	1.0	25.3	23.8	8.10
	1717	1.0	25.4	20.4	8.15
3	0840	1.3	24.8	24.7	6.25
	1024	1.3	25.0	24.3	6.52
	1414	1.3	25.8	26.4	6.74
	1721	1.3	25.9	27.0	6.88
4	1025	2.0	25.0	30.5	7.80
	1430	2.0	25.1	31.2	7.75
5	0827	0.1	23.7	0	7.82
	1710	0.1	23.9	0	7.74

Legend:
Station 1 = toe of jetty, harbor side, 1 m. from shore
2 = 15 m. off drainage channel, N. side of bay
3 = 10 m. from shore, 10 m. N. of boat ramp
4 = toe of jetty, ocean side, 2 m. from shore
5 = in drain channel cascade, 3 m. mauka of shore

TABLE 2

TIDE CHART, MAY 11, 1988*



* for Port Allen, Kauai

TABLE 3

CHECKLIST OF CORALS AND INVERTEBRATES, KUKUIULA BAY, KAUAI

PHYLUM/CLASS/FAMILY/SPECIES	SUBTIDAL	INTERTIDAL
SCLERACTINIAN (HARD CORALS)		
PORITIDAE		
Porites lobata	X	
Porites compressa	X	
POCILLOPORIDAE		
Pocillopora meandrina	X	
Pocillopora damicornis	X	
ACROPORIDAE		
Montipora sp.	X	
ANTHOZOA		
OCTOCORALLIA		
Anthelia edmondsoni	X	
PORIFERA (SPONGES)		
Demospongiae sp. (red)	X	
Spirastrella sp.	X	
ANNELIDA (SEGMENTED WORMS)		
unident. tube worm 1	X	
unident. tube worm 2		X
CRUSTACEA (CRUSTACEANS)		
GRAPSIDAE		
Grapsus grapsus		X
Grapsus tenuicrustatus		X
XANTHIDAE		
Carpilius maculatus		X
MOLLUSCA (MOLLUSKS)		
NERITIDAE		
Nerita picea		X
CYPRAEIDAE		
Cypraea caputserpentis		X
MURICIDAE		
Drupa morum		X

LITTORINIDAE		
Littorina pintado		x
Littorina scabra		x
PATELLIDAE		
Siphonaria normalis		x
VERMETIDAE		
Serpulorbis variabilis		x
ECHINODERMATA (ECHINODERMS)		
ECHINOIDEA (SEA URCHINS)		
Echinometra mathaei	x	x
Echinometra oblonga	x	x
Tripneustes gratilla	x	
OPHIUROIDEA (BRITTLE STARS)		
Ophiocoma pica	x	

TABLE 4

CHECKLIST OF ALGAE, KUKUIULA BAY, KAUAI

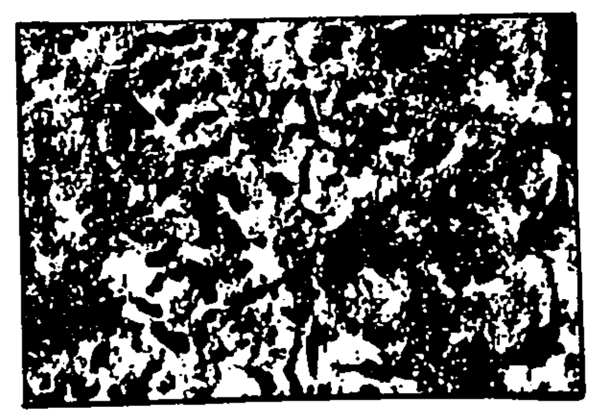
DIVISION	GENUS/SPECIES
CYANOPHYTA (BLUE-GREEN ALGAE)	
	Hormothamnion sp.
	Lyngbya sp.
PHAEOPHYTA (BROWN ALGAE)	
	Dictyota acutiloba
	Dictyota bartayresii
	Dictyota sandvicensis
	Padina japonica
	Sphacelaria furcigera
CHLOROPHYTA (GREEN ALGAE)	
	Chaetomorpha antennina
	Chlorodesmis hildenbrandtii
	Chladophora sp.?
	Enteromorpha sp.
	Ulva fasciata
RHODOPHYTA (RED ALGAE)	
	Acanthophora spicifera
	Amphiroa fragilissima
	Corallina sp.
	Galaxaura fastigiata
	Grateloupia sp.
	Hydrolithon breviclavium
	Hydrolithon reinboldii
	Jania sp.
	Porolithon onkodes
	Porolithon gardineri
	Sporolithon erythraeum

TABLE 5

CHECKLIST OF FISHES, KUKUIULA BAY, KAUAI

FAMILY/GENUS SPECIES/COMMON NAME
CHAETODONTIDAE (BUTTERFLYFISHES)
Chaetodon lineolatus (kikakapu)
Chaetodon lunula (kikakapu)
Chaetodon quadrimaculatus (lauhau
POMACENTRIDAE (DAMSELFISHES)
Plectroglyphidodon johnstonianus
Plectroglyphidodon sindonis
Stegastes fasciolatus
MUGILIDAE (MULLETS)
Mugil cephalus
LABRIDAE (WRASSES)
Anampses cuvier ('opule)
Anampses sp. (juveniles)
Halichoeres ornatissimus ('ohua)
Thalassoma duperrey (hinalea lau-wili)
BLENNIIDAE (BLENNIES)
Cirripectes variolosus
Unident. blenny
ZANCLIDAE (MOORISH IDOLS)
Zanclus cornutus (kihikihi)
ACANTHURIDAE (SURGEONFISHES)
Acanthurus achilles (paku'iku'i)
Acanthurus dussumieri (palani)
Acanthurus olivaceus (na'ena'e)
Acanthurus nigrorius (maiko)
Acanthurus triostegus (manini)
OSTRACIONTIDAE (BOXFISHES, COWFISHES)
Ostracion meleagris (moa)

Photograph 1. Intertidal Bench, North Side of Kukuiula Harbor.



Photograph 2. Boring Urchins in Lower Intertidal Zone.

Photograph 3. Massive *Porites* Bed in Harbor Basin.

APPENDIX F

SUPPLEMENTAL BASELINE MARINE ENVIRONMENTAL SURVEYS

Brewer Brandman Associates

Environmental Research • Planning and Processing • Resource Management

BASELINE MARINE ENVIRONMENTAL SURVEYS

KUKUIULA BAY, KAUAI, HAWAII

SUPPLEMENTAL SURVEY OF APRIL 1989

prepared for

Alexander & Baldwin, Inc.
Honolulu, Hawaii

April 17, 1989

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FIGURES

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BASELINE MARINE ENVIRONMENTAL SURVEYS, KUKUIULA BAY, KAUAI, HAWAII SUPPLEMENTAL SURVEY OF APRIL 1989

SECTION 1.0 INTRODUCTION

This report presents the results of a second marine environmental survey conducted in Kukuiula Bay, Kauai, on April 13-14, 1989, in support of the Kukuiula Bay Master Plan. Earlier surveys, prepared for the R.M. Towill Corporation (reported in *Baseline Marine Environmental Surveys, Kukuiula Bay, Kauai, Hawaii*, May 23, 1988), reported that the bay supported an exceptionally low diversity and density of fishes and macroalgae and a "modestly diverse" coral community. Chronic high levels of silt and sediment from upland runoff were identified as possible causative factors for the prevailing low biological diversity and density that were observed.

This supplemental study was undertaken to ascertain whether the water quality measurements and biological observations made during the May 1988 surveys represented the normal condition for this manmade harbor or were the result of other environmental factors.

Kukuiula Bay and smallcraft harbor encompasses approximately seven acres and is located due east of Spouting Horn on Kauai's southern coast. The harbor is roughly rectangular in dimension and has been extensively modified from its natural condition. A roughly 400-foot-long manmade jetty and parking/boat loading area borders the southern sector of the harbor. Approximately 200 feet of concrete bulkhead and a 100+-foot-wide draglined channel extend from the toe of the jetty to a narrow boat launching ramp on the east side of the harbor. Portions of the harbor were reconstructed in 1984 following a destructive hurricane.

The north and east sides of the harbor have been extensively modified by rock seawalls and rock revetments. One perennial and two intermittent stormwater or irrigation tail water channels discharge directly into the harbor on its northern margin.

SECTION 2.0 METHODS

2.1 Physical-Chemical Measurements

Salinity and temperature measurements were made with a Yellow Springs Instrument Company (YSI) salinity-conductivity-temperature meter equipped with a YSI Model 3300 nickel-platinum conductivity/temperature probe. Dissolved oxygen measurements were made with a YSI Model 51B dissolved oxygen meter equipped with a membrane-covered polarographic sensor. The dissolved oxygen meter was calibrated according to factory guidelines in a water vapor-saturated chamber. All measurements were based on *in situ* sampling.

Based on manufacturer-supplied specifications, maximum worst-case instrument/probe error is as follows: temperature, ± 0.7 degrees Centigrade (C.); salinity, ± 0.2 parts per thousand (ppt); and dissolved oxygen, ±0.2 parts per million (ppm). However, as a result of the efflux of freshwater into the harbor in certain locations, salinity readings were often made by "averaging" meter oscillations. Such variability in conditions undoubtedly influenced other instrument readings, thus actual instrument and probe error is probably higher than suggested by the above specifications.

2.2 Marine Biological Surveys

Underwater biological surveys were conducted to qualitatively assess the major physiographic features, biological zonation patterns, and to develop a checklist of represented algae, coral invertebrates and fish. Surveys were conducted with mask and snorkel.

Invertebrate identification and enumeration was generally limited to specimens exceeding 2.0 centimeters (cm.) in longest dimension (macroinvertebrates), though certain especially numerous, albeit smaller, invertebrates were occasionally recorded. Where appropriate, population density estimates were made with an aluminum meter stick which was utilized to lay out crude 0.25 square meter or one-square meter quadrats.

Fish identification and abundance estimates were made by recording all species sighted during the underwater surveys. Data were recorded on Polypaper sheets. Notes were taken to indicate population densities, habitat features, and the most numerous species characterizing a given zone or habitat. Fish transect surveys were not conducted because of the prevailing currents which tended to result in the transect line being lodged against rock or coral (or other debris), thus skewing the data toward fishes normally associated with coral reefs or other submerged structures.

Corals and algae were inventoried by systematically recording all species sighted along defined compass bearing transects and by random surveys (Figure 1). Percent coverage data were developed

by visual estimates and, occasionally, by localized measurements with an aluminum meter stick.

Intertidal flora and fauna surveys were conducted on foot along both the developed and undeveloped portions of the harbor during two low-tide periods.

A total of four 30-minute dives were conducted on April 13 and 14, 1989 in Kukuiula Bay. Underwater visibility was limited to between 1 to 2 meters throughout the harbor. This was about one-half to one-third the visibility of the May 1988 surveys. This factor undoubtedly resulted in many species being omitted from the data record. Limited underwater visibility also posed a problem during the May 1988 surveys at Kukuiula.

2.3 Freshwater Surveys

Freshwater surveys were limited to a single pool at the makai side of the box culvert under Lawai Road. Heavy vegetation growth along the upstream segment of the drainage channel prevented an analysis of mauka conditions. Clear water and the use of a nylon dip-net provided the opportunity to identify represented freshwater macroscopic biota.

SECTION 3.0 RESULTS

3.1 Water Quality Analyses

The results of temperature, salinity, and dissolved oxygen measurements in Kukuiula Bay are shown in Table 1. Sampling station locations are depicted in Figure 2.

Table 1. Water Quality Parameters, Kukuiula Bay, Kauai, 4/13/89

Station No.	Time (hrs)	Depth (m.)	Temp. (C.)	Salinity (ppt)	Diss. Oxygen (ppm)
1	0940	0.5	25.2	18.9	6.62
	0942	1.0	25.3	19.0	6.84
2	0948	0.1	22.2	0	7.95
3	0955	0.2	24.5	24.1	8.10
4	0959	0.5	23.8	25.2	7.62
5	1029	0.5	24.0	23.9	7.41
	1029	2.5	24.4	26.8	7.32

Water quality data are indicative of the influence of surface water runoff and likely subtidal spring discharges on the physical and chemical composition of the harbor waters. The drainage ditch at the head of the harbor was discharging about 1-2 cubic feet/second of generally clear, tea-colored, water during the survey period.

The mean temperature of harbor waters was 24.5 degrees C. with a range of 23.8 to 25.3 degrees C. Cooler waters were associated with the northerly (mauka) side of the harbor in areas under the influence of the drainage ditch discharge. Drainage ditch water demonstrated a temperature of 22.2 degrees C., the coolest water temperature recorded during the survey. Harbor salinity values ranged from 18.9 to 26.8 ppt with a mean value of 23.3 ppt. This suggests that certain portions of the harbor are more estuarine than marine in character. Dissolved oxygen values ranged from 6.62 to 8.10 ppm with a mean value of 7.32 ppm. Based on the mean dissolved oxygen value, harbor waters were about 96 percent of oxygen saturation with respect to prevailing temperatures and salinities.

Weather conditions experienced during the survey period included sunny to partly cloudy skies with northeasterly tradewinds during the morning and early afternoon of April 13th. Light showers characterized the southern coast of Kauai during the late afternoon and early evening of April 13th. Conditions on April 14th were sunny to partly cloudy with typical northeasterly trades.

According to a recently prepared circulation study (*Nearshore Circulation Study, Kukuiula Bay Master Plan, Kauai, Hawaii* prepared by Sea Engineering, Inc.), on March 2 and 3, 1989, Kauai experienced the most severe Kona storm of the winter. A low pressure system over the islands resulted in strong southwest winds and heavy rainfall. During this period winds gusted to 55 knots at Barking Sands and 40 to 50 knots at Lihue. During this period the small stream at the head of Kukuiula Bay was discharging highly turbid water and the bay and nearshore waters were "chocolate brown" out to at least the 18-foot contour. A winter storm also influenced the area during the period April 7 and 8, 1989 and several inches of rain were recorded in the area during this period. These events are mentioned, inasmuch as they may have influenced the conditions observed during the April 13-14, 1989 survey period.

3.2. Biological Surveys

3.2.1 Marine Biological Surveys

Corals

A total of five species of corals were represented in Kukuiula Bay: *Pocillopora damicornis, Pocillopora meandrina. Porites lobata, Porites compressa* and *Montipora*. These same species were recorded during the May 1988 surveys.

Algae

Thirteen species of algae were recorded during the April 13 and 14, 1989 surveys. Cyanophytes (blue-green algae) were dominated by *Hormothamnion* and *Lyngbya*. Chlorophytes (green algae) included *Chaetomorpha antennina, Dictyosphaeria versluysii*, expansive, carpet-like growths of *Enteromorpha* sp., and on flat to gently sloping intertidal and subtidal rocks, *Ulva fasciata*. Phaeophytes (brown algae) were represented by *Dictyota friabilis, Ralfsia pangoensis, Padina australis*, and three small (6-7 cm. tall) stands of *Sargassum echinocarpum*. Rhodophytes (red algae) were poorly represented, consisting of dense intertidal stands of *Acanthophora spicifera*, scattered stands of *Galaxaura fastigiata* and occasional patchy growths of *Jania*. Red coralline algae were composed of scattered encrusting growths (often on dead coral or coral rubble) of *Hydrolithon breviclavium, H. reinboldii. Porolithon onkodes, P. gardineri*, and *Sporolithon erythraeum*.

Eighteen species of algae were recorded in Kukuiula Harbor during the 1989 surveys as contrasted with the 23 species recorded during the 1988 surveys. This difference is probably not significant and is probably the result of the restricted visibility encountered during the most recent surveys. However, several new species were observed in the 1989 surveys that were not recorded during the 1988 surveys. They included the green alga *D. versluysii* and the brown algae *D. friabilis, R. pangoensis*, and *S. echinocarpum*.

Many of the algal stands, particularly in the intertidal and adjacent subtidal zones, demonstrated evidence of the effects of recent storm damage. In contrast to fish grazing, which tends to produce a mowed or evenly cropped appearance, storm wave damage tends to "uproot" and damage the entire plant. These possible storm wave effects included damaged holdfasts, broken rhizoids and crushed blades. In addition, several pocket-like depressions in the mid-harbor basin contained "pools" of decomposing intertidal algae.

Macroinvertebrates

Because of the prevailing poor underwater visibility, few benthic invertebrates, other than sea urchins (*Echinometra mathaei* and *E. oblonga*), were recorded in the harbor basin surveys. Conspicuous, however, was the absence of the delicate octocoral (anthozoan/soft coral) *Anthelia edmonsoni*. In the May 1988 surveys this species was reported as "... the most abundant and widespread invertebrate..." throughout the subtidal reaches of the harbor. Holothurians (sea cucumbers) were also conspicuous in their absence from appropriate sand and rubble habitat within the harbor. Holothurians were not recorded during the 1988 surveys.

There was little change in represented intertidal invertebrates as compared to the 1988 surveys. The ghost crab, *Ocypode ceratopthalmus*, was not recorded during the 1988 surveys but juveniles were common on the sandy beaches during the 1989 surveys. Similarly, *Serpulorbis variabilis*, a vermetid (tube-building) snail was not recorded in 1988 but six specimens were sighted in the low intertidal zone on April 14, 1989.

Fishes

The fish fauna recorded during the April 1989 survey was limited to only 13 species. This contrasts with the 1988 survey which yielded a total of 20 identified species. As in the 1988 survey, the fish fauna was characterized by both extremely low diversity and density. A total of only 156 individuals of all species were recorded within the entire harbor basin during the 1989 surveys. Although the prevailing high turbidity undoubtedly influenced this tally, these numbers are exceptionally low, given the size and habitat diversity of this embayment. Four of the 13 species recorded in April 1989 represented single individuals.

The most common family of fishes were the acanthurids (surgeonfishes). Manini (*Acanthurus triostegus*), represented by both juveniles and adults, was the numerically dominant species from the intertidal zone to the harbor basin. An unidentified blenny (probably *Istiblennius zebra*) was second in abundance but was restricted largely to the intertidal pools and rock-strewn areas within the nearshore subtidal zone. The territorial pomacentrids *Plectroglyphidodon johnstonianus*, *P. sindonis* and *Stegastes fasciolatus* were found around all larger coral outcrops, though their numbers were low. Other less common species included the Moorish Idol, *Zanclus cornutus* (kihikihi); the acanthurids, *Acanthurus achilles* (paku'iku'i)

and *A. olivaceus* (na'ena'e); and the butterflyfish, *Chaetodon quadrimaculatus* (lau hau).

The remaining four species recorded consisted of single individuals. They included: the goatfish, *Mulloides flavolineatus* (weke); the acanthurid, *Acanthurus nigrofuscus*; the trunkfish, *Ostracion meleagris* (moa); and the saddle wrass, *Thalassoma duperrey* (hinalea lau-wili).

3.2.2 Stream Fauna

A brief examination of a small pool directly located between the mouth of the discharge channel and the box culvert showed the presence of three non-indigenous aquatic organisms: the common tilapia (*Oreochromis mossambicus*); the Louisiana crayfish (*Procambarus clarkii*); and unidentified guppies (*Poecilia* sp.). Turbidity levels were too high to permit this pool to be examined during the May 1988 survey.

SECTION 4.0 DISCUSSION

The results of the April 13-14, 1989 supplemental survey confirm the physical-chemical and biological conditions previously reported in a survey conducted on May 11, 1988 at Kukuiula Bay.

4.1 Water Quality Parameters

Temperature, salinity and dissolved oxygen data obtained in the April 1989 surveys were within the range normally associated with nearshore marine waters that are subject to surface or subsurface fresh or brackish water discharges and were comparable to conditions encountered on May 11, 1988 (Table 2).

Table 2. Range of Water Quality Parameters, Kukuiula Bay

Date	May 11, 1988	April 13, 1989
Temperature (C.)	24.2 - 26.2	23.8 - 25.3
Salinity (ppt)	18.4 - 27.4	18.9 - 26.8
Diss. Oxygen (ppm)	6.25 - 8.25	6.62 - 8.10

No single water quality parameter or observation explains the prevailing low diversity and density of fishes associated with Kukuiula Bay during both the 1988 and 1989 surveys. However, as suggested in the 1988 surveys, chronic silt and sediment loading may be ultimately responsible for the paucity of fishes within the bay.

4.2 Marine Biological Surveys

The results of the April 13-14, 1989 surveys show that Kukuiula Bay continues to support a modestly diverse coral community, a diverse (and unchanged) intertidal fauna on undeveloped sections along the north side of the harbor, a rather meager macroalgae community, and an unusually low diversity and density of fishes.

As was previously stated, perennial and intermittent silt- and sediment-laden mauka drainage waters appear to be exerting the singlemost (or at least the most readily detectable) adverse influence on harbor water quality and biota. Sediment loading and reworking of deposited sediments by wave and current action may account for the low diversity and density of the macroalgae and fish community reported in surveys conducted in May 1988 and April 1989. Further evidence of heavy terrigenous sediment loading is suggested by the mud-stained appearance of all intertidal rocks on the northwest side of the Kukuiula Harbor. Water currents appear to sweep the majority of this material into the open ocean, as similar mud-stained rocks are not found in the vicinity of Spouting Horn or in the adjacent small embayment to the east of Kukuiula.

The storm damaged appearance of the subtidal and intertidal macroalgae and the absence of the anthozoan *Anthelia edmondsoni* suggest that recent storm wave damage (probably the March 2-3, 1989 Kona Storm) has exerted a significant influence on the biota of the bay. These observations suggest that the biota of Kukuiula Bay (as is the case with most exposed coastlines in Hawaii) is subject to a very fugitive existence. By contrast, the finding of three new species of macroalgae during the latest survey (under conditions far less favorable, visibility-wise, than during the 1988 surveys) and the identification of two invertebrates not observed during 1988 suggest that conditions are not totally unfavorable to all species at all times.

In summary, Kukuiula Bay appears to be chronically influenced by terrigenous silt and sediment; an influence that appears to pose as a limiting factor to many species of fish. Silt and sediment deposition, and reworking by wave and current action, may also be detrimental to the algal community, accounting for its generally low diversity, distribution and abundance. Aside from the drag-lined corridor fronting the dock, which provides little in the way of habitat for marine organisms, the coral community of Kukuiula continues to provide ample habitat and important niches

for marine organisms, but as reported in the May 1988 survey results, and confirmed in the April 1989 surveys, these habitats and niches remain largely unoccupied.

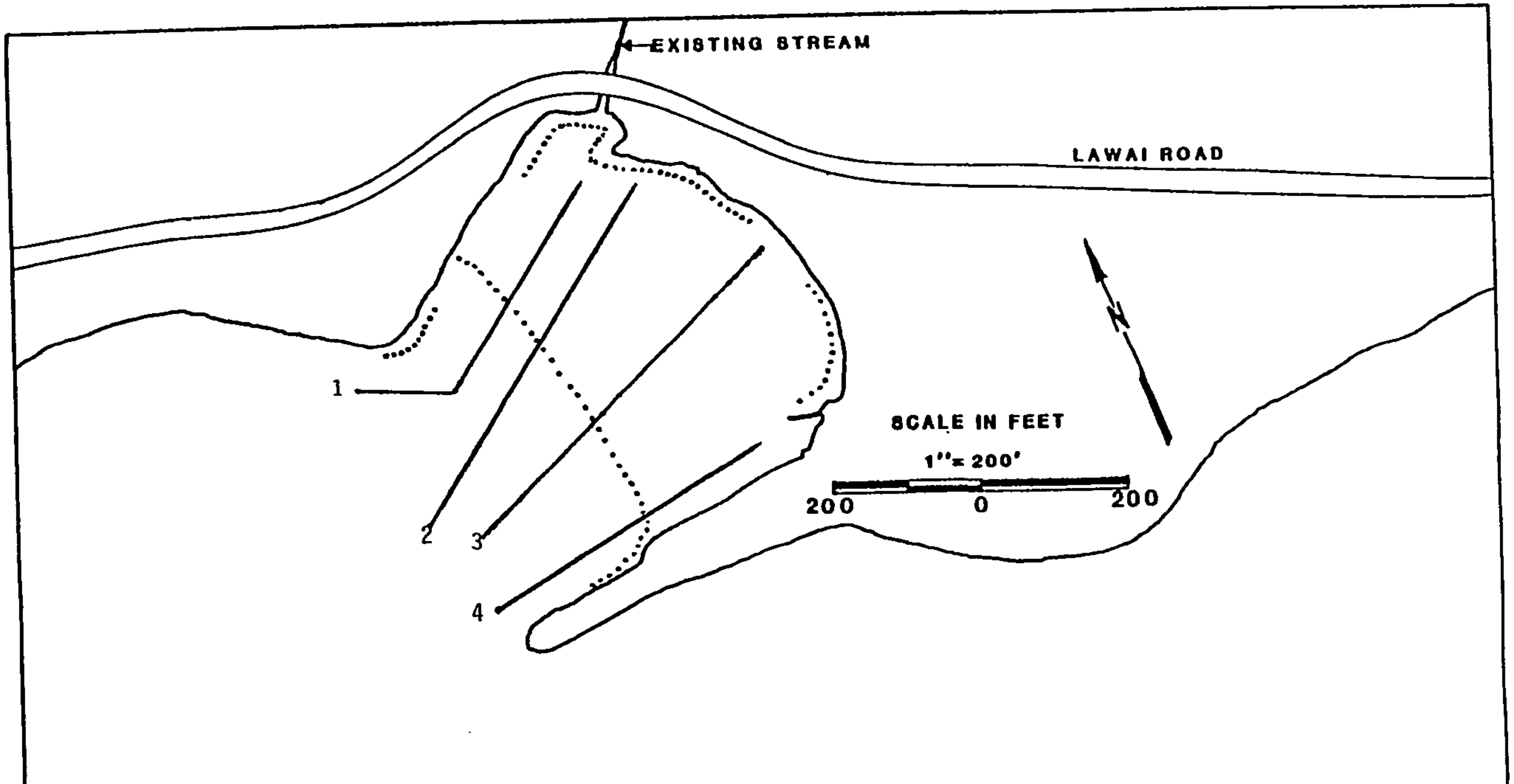

Figure 1. Approximate Transect Locations
(dotted areas denote areas of random surveys)

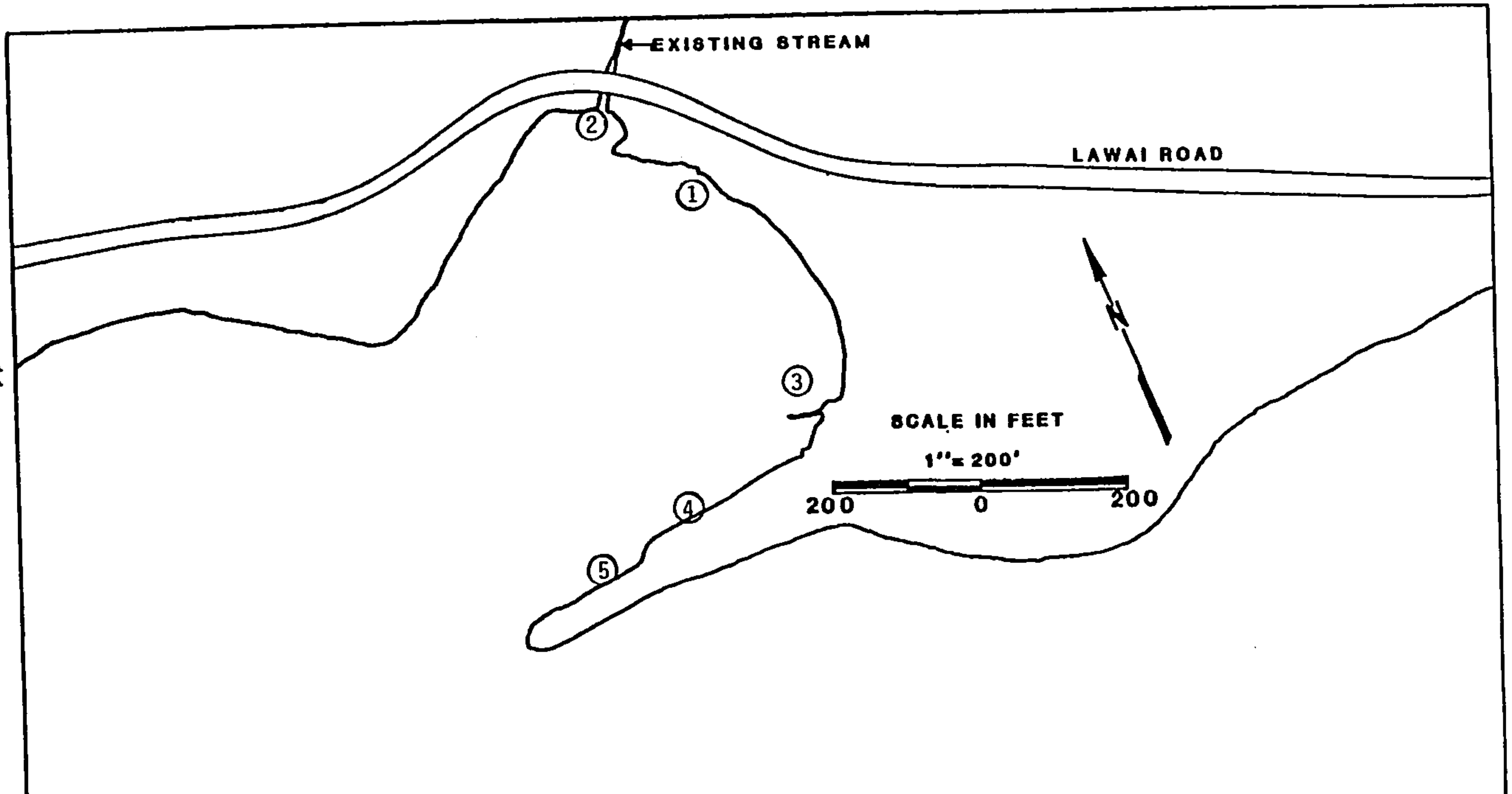

Figure 2. Water Quality Sampling Stations

APPENDIX G

NEARSHORE CIRCULATION STUDY

NEARSHORE CIRCULATION STUDY

KUKUIULA BAY MASTER PLAN,

KAUAI, HAWAII

Prepared For:

Alexander & Baldwin, Inc.
822 Bishop Street
Honolulu, Hawaii

Prepared By:

Sea Engineering, Inc.
Makai Research Pier
Waimanalo, Hawaii

April 1989

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INTRODUCTION

A & B Properties, Inc. has proposed a combined resort/residential development in the vicinity of Kukuiula Bay on the south coast of Kauai. The development is located mauka of Lawai Road, except for a proposed marina at Kukuiula Bay. The project area extends from Koloa landing on the east to Lawai Bay on the west (Figure 1). A preliminary master plan for the development has been prepared by the R.M. Towill Corporation, and shows single family lots, commercial space, multi-family units, a resort area, park, sewage treatment plant, a golf course, and the marina at Kukuiula Bay. The total area is 1,020 acres.

The drainage plan for the development specifies that runoff from the development be channeled to two discharges, one on the west side of the small peninsula at Kolopa, and the other to an existing intermittent stream outlet at the head of Kukuiula Bay.

Storm water discharge at the two sites is expected to be intermittent, occurring only during periods of moderate to heavy rainfall. At present, the runoff is channeled primarily to the intermittent stream discharging into Kukuiula Bay and to Waikomo Stream, which discharges into the ocean at Koloa landing. A relatively small amount discharges through an 18-inch culvert on the west side of Kolopa.

The objective of this study was to describe the circulation patterns in the vicinity of the two drainage channels in particular, and of the area in general. Knowledge of the nearshore circulation patterns was required to assess the impacts of the storm water discharges upon the water quality and benthic communities of the area. This study was undertaken concurrently with other marine environmental studies in order to provide the information necessary to address the environmental concerns associated with the project.

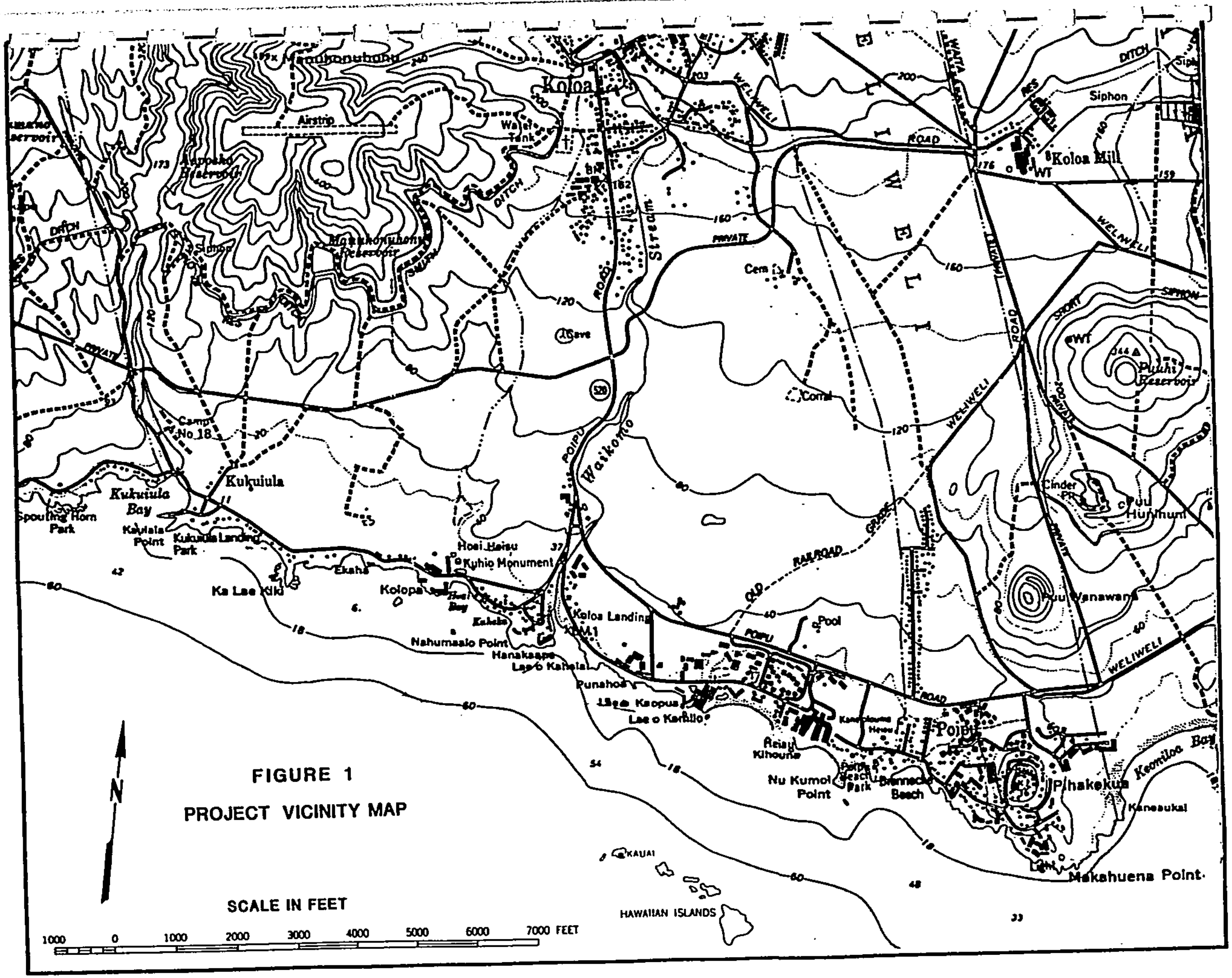

FIGURE 1

PROJECT VICINITY MAP

SUMMARY

The circulation in Kukuiula Bay is influenced primarily by the wind, with relatively little influence from the tide or waves. Given the small tidal range in Hawaii, and the large opening of the bay relative to the surface area, the resultant tidal currents are weak. During tradewind conditions, the wind stress on the surface layers results in a seaward flow of water. Simultaneously, there must be a weak shoreward counter current along the bottom to balance the seaward flow at the surface.

The exception to the wind driven circulation pattern occurs when there are large waves. At such times, the waves break all along the north side of the bay, and a counter current in the center of bay forms to release the water transported shoreward by the waves. This counter current was observed during the severe Kona storm of March 2-3, 1989. In spite of strong onshore winds, the curface water in the center of the bay was moving seaward.

Fresh water discharged by the stream at the head of the bay will therefore be carried seaward during almost all tide, wind and wave conditions. During storm conditions there is a high degree of wave induced mixing in the bay. Once seaward of the bay, the discharge plume will be influenced by the prevailing wind and the reversing alongshore tidal current.

Runoff water discharged at Kolopa will be transported to the west, inside the surf zone, to at least Ekaha. Between Ekaha and Kalaekiki Point there are several deeper channels where seaward counter currents may develop. As the water moves from Kolopa to Ekaha, wave induced mixing will occur throughout the area inside the surf zone. Once transported seaward, the water mass will be influenced by the prevailing winds and tidal currents. Depending upon the tide stage, it will be transported east or west along the coastline.

The westerly flow from Kolopa along the reef flat was observed during all wind, wave and tide conditions. The currents inside the surf zone are almost 100 percent driven by the breaking waves. Since the pattern of breaking waves on the shallow reef edge is almost always the same, the westerly flow should be present most or all of the time. The only variable should be the location at which the alongshore current begins to move seaward.

The circulation in Hoai Bay, just east of Kolopa, was investigated, since that area was a potential discharge site for the storm runoff. The currents in Hoai Bay are influenced by both wave action and the wind. At times the current flows directly seaward from Hoai Bay, but most of the time the surface waters from the bay move to the west. As the water moves past Kolopa, the breaking waves off that point result in a shoreward movement. Water discharged into Hoai Bay, therefore, is very likely to end up on the reef flat just west of Kolopa, at the site of the existing discharge.

MARINE ENVIRONMENT

Winds

The predominant winds in Hawaii are the northeast trades, which approach from the sector north through east, and occur 70% of the time. The average tradewind speed is 12 knots. The frequency of the tradewinds varies seasonally, and they occur 90 percent of time during the summer but only 40 to 60 percent of the time during the winter.

The lower frequency of occurrence of the tradewinds during the winter is due to the weakening of the high pressure system of the north Pacific. The passage of low pressure systems results in winds from the quadrant south through southwest, known as "kona" winds. Kona winds are the second most common wind type in Hawaiian waters, occurring up to 17 percent of the time in the winter months, with intensities ranging from light and variable to gale force.

The surface water layers in the nearshore zone, and to some extent the water inside the surf zone, are affected by the prevailing winds. The typical tradewind flow around Kauai during moderate trades is shown in Figure 2. The winds are deflected somewhat by the mountains of central and east Kauai, and the resultant winds at Poipu are typically offshore at the shoreline and easterly farther offshore. Due to the sheltering effect of the mountains, the resultant wind speeds are lower than at Lihue Airport. Tradewinds at the site would therefore tend to move surface waters offshore and to the west.

The Poipu coastline is exposed to the direct approach of kona winds, and such winds would be onshore in the vicinity of the site. Kona winds also generate associated waves, which influence the circulation inside the surf zone.

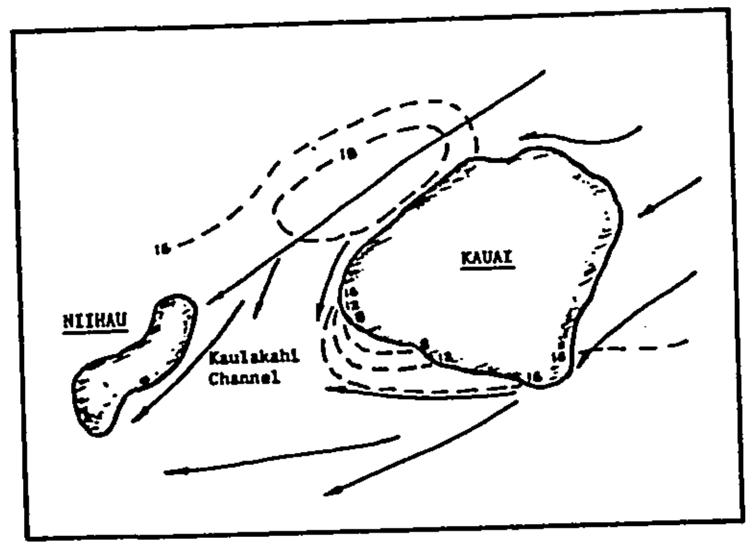

FIGURE 2

Typical Tradewind Flow Around Kauai
(from Haraguchi, 1979)

Tides

The tides in Hawaiian waters are semi-diurnal, with pronounced diurnal inequalities (i.e., two tidal cycles per day with unequal ranges of water levels). The tidal data shown below were obtained from the U.S. Department of Commerce, National Oceanic and Atmospheric Agency, National Ocean Survey. The closest tidal station is located in Port Allen, approximately 8 miles west of the project site.

		Feet Above Reference Datum
Mean Higher High Water	(MHHW)	1.7
Mean High Water	(MHW)	1.2
Mean Sea Level	(MSL)	0.7
Mean Low Water	(MLW)	0.2
Mean Lower Low Water	(MLLW)	0.0

The tides play an important role in the offshore circulation around Hawaii, as discussed later in this chapter.

Waves

The prevailing wave climate strongly influences circulation inside the surf zone. The water motion inside deepwater, or unbroken, waves is primarily oscillatory, with little overall movement of the mass of water. However, as a wave breaks the water particles move shoreward and this movement is called "mass transport". There is a resultant "set up", or increase in water level inside the surf zone. The amount of set up depends upon the breaking wave height. The set up, or increase in head, results in counter flows, or seaward movement of the water inside the surf zone. These counter flows, if pronounced, are called rip currents. The location of the rip currents depends upon the incoming wave orientation and the coastline and bottom configuration. On long sandy beaches, with sand bottoms offshore, the locations of the rip currents often change. In Hawaii, with our reefs and surge channels, the counter currents usually occur in the same place, unless there is a great difference in wave approach direction. The incoming water mass then moves shoreward with the breaking wave, flows parallel with the shoreline to the location of the rip current, then moves offshore.

The wave climate of the Hawaiian Islands is generally defined by four wave types; tradewind waves, North Pacific swell, south swell, and kona storm waves. The approach directions of the four wave types are shown in Figure 3. The project site is directly exposed to south swell and kona storm waves. South swell occurs in the spring and summer, generated by storms in the southern hemisphere. Typical deepwater wave heights are 1 to 4 feet, and surf heights of 6 to 8 feet are common. Wave periods range from 12 to 22 seconds. Kona waves are generated by local fronts and low pressure systems and occur usually during the winter months of November through April. During severe storms, waves can range up to 10 to 15 feet high. Wave periods are typically 8 to 10 seconds.

Tradewind waves do not directly approach the study area, but some wave energy does refract around Makahuena Point and influences the Poipu coastline. The amount of energy entering the area depends upon the direction of the prevailing tradewinds. During northerly trades, Poipu is in the lee of the winds (and waves) and the inshore water calm. During easterly tradewinds, a considerable amount of wave energy is refracted into the area.

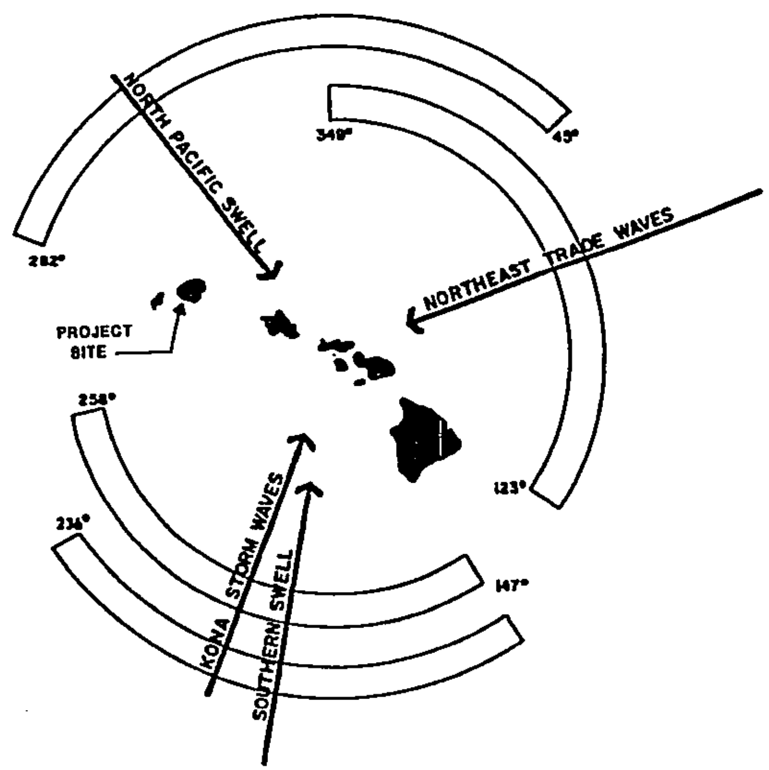

FIGURE 3

GENERALIZED WAVE TYPES
(Adapted From The Atlas of Hawaii)

Coastline and Bathymetry

The shoreline from the east end of Ho'ai Bay to the west end of Kukuiula Bay is approximately 6,000 feet long. A coastal highway parallels the shoreline, with most of the existing development located seaward of the highway.

Kukuiula Bay forms a pronounced indentation in the shoreline, and is approximately 400 feet wide across the mouth and 600 feet deep. The shoreline is primarily low outcrops of cliffs, with a very small sand beach at the head of the bay. A man made breakwater protects a boat launching ramp on the east side of the bay. An intermittent stream, which drains the sugar cane fields mauka of the highway, discharges into the head of the Kukuiula Bay.

East of Kukuiula Bay, the shoreline remains rocky and irregular until just west of Kolopa, where there is a narrow, 700-foot long sandy beach. The shoreline of the small peninsula at Kolopa and Ho'ai Bay is also rocky and irregular.

An intermittent fringing reef parallels the shoreline between Kolopa and Kalaekiki Point, with the surf zone approximately 500 to 700 feet offshore. Inside the surf zone the water is very shallow, with hard reef or basalt bottom, with scattered sand patches and sand veneer. Three popular surf breaks located along this fringing reef are; "Beach Houses", "Centers", and "Acid Drop".

Seaward of the surf zone, the bottom drops off quickly to approximately the 20 foot depth beyond the fringing reef, and then gradually to the 60 foot contour, located 2,000 feet offshore.

Circulation

Factors affecting the circulation around Kauai are the semi-diurnal tide waves, the diurnal tide waves, and the underlying westward flow of the Pacific North Equatorial Current. In the nearshore area, the resultant currents are modified by the coastline configuration and the bathymetry of the area. Surface water layers are affected by the locally prevailing winds. Inside the surf zone, the mass transport of water due to breaking waves plays a predominant role.

The semi-diurnal tide current is stronger than the diurnal tide current, and is also more consistently correlated with the phase of the tide. The diurnal tide does, however, influence the overall flow, and as tidal stages vary over a lunar month, may be responsible for much of the flow speed and directional variability in long term records. The Pacific North Equatorial Current flows in a generally westerly direction, with a great deal of variability in flow speed and direction.

Laevastu, et al. (1964) developed an idealized model for a combination of tidal currents and permanent flow around a circular island, shown in Figure 4. Brief measurements taken by Laevastu around the island in 1963 were consistent with the theory.

Measurements by Wyrtki, et al. (1969) just north of Makahuena Point showed strong steady flows to the southwest, with semi-diurnal and diurnal tidal variations superimposed. This data was also compatible with the theorized flow in Figure 4.

Sunn, Low, Tom & Hara (1973) obtained 6 days of current meter records off Port Allen in 1972. The predominant flow was to the west, at an average speed of 0.5 feet/second (25 cm/sec). The current set to the west at flood tide, high water, and ebbing tide, shifting east for only brief periods at low water.

The most detailed information for the area is the result of a circulation study conducted by Sea Engineering, Inc. (1983) to assess two potential outfall sites; one off Ehaka, and the other off Makahuena Point.

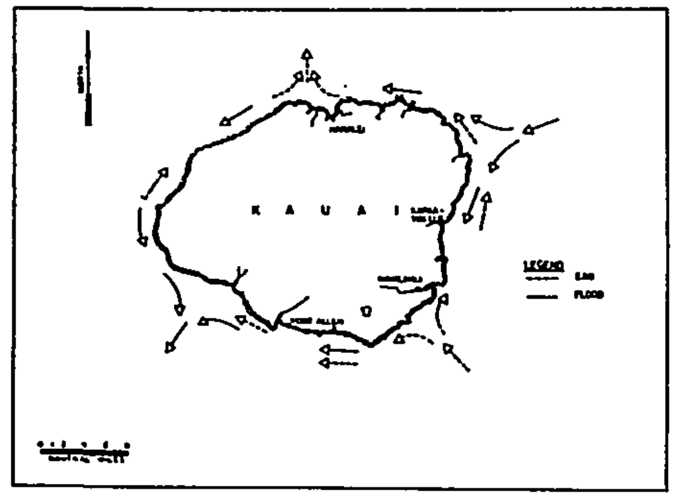

FIGURE 4

Idealized Current Flow Around Kauai
(from Laevastu et al., 1964)

Two current meters were placed off Ekaha, one at mid-depth in 45 feet of water, and the other at mid-depth in 105 feet of water. One meter was also placed off Makahuena Point, at mid-depth in 100 feet of water. Measurements of current speeds and direction were obtained for five weeks during the winter season and five weeks during the summer season.

The data from the meters off Ekaha indicated that the main influence on the currents was the semi-diurnal tide. In general, flood tide flow was to the east and ebb tide flow to the west, with flow reversals occurring on most tide changes. The results of the study showed a fairly high percentage of flow to the east, in contrast to Laevastu's theoretical flow pattern and the previous limited data which indicated a predominant flow to the east. A summary of east and west flows for the two meters off Ekaha is given below:

STATION	METER DEPTH/ WATER DEPTH	OCCURRENCE OF EAST FLOW	AVG. SPEED OF EAST FLOW	OCCURRENCE OF WEST FLOW	AVG. SPEED OF WEST FLOW
A	30'/ 45'	26%	13cm/sec	42%	15cm/sec
B	55' / 105'	42%	19cm/sec	27%	19cm/sec

The offshore meter off Ekaha showed a relatively high percentage of onshore flow during the summer months. Inspection of the meter records showed that this onshore flow occurred because the reversing tidal currents always rotated toward shore during the reversal in summer, while in winter, the rotation occurred in both onshore and offshore directions.

The observed currents off Makahuena Point were much stronger than those off Ekaha, with an average speed of 36 cm/sec. and an observed maximum of 109 cm/sec.. The current direction was predominantly to the southwest, particularly during the summer season.

In summary, the currents seaward of the surf zone in the project area are strongly influenced by the semi-diurnal tides. Flood tide flow is generally to the east, and ebb tide flow to the west. Although the flow reversals typically occur, there appear to be monthly and seasonal variations and irregularities in the reversal patterns. Average current speeds are approximately 15 cm/sec., with speeds over 50 cm/sec. (1 knot) unusual.

RESULTS AND DISCUSSION

Methodology

Circulation measurements during the study were obtained using current drogues. The objective of a drogue system is to lock into the water mass at the depth of the drogue, and therefore move with the same speed and direction as the prevailing current. The drogues used consisted of plastic tarpaulins attached to a wooden dowel at the top and weighted by a steel rod at the bottom. This type of drogue is very effective in accurately tracking currents, and is known as a "window shade" drogue. The rectangular tarp is attached to a surface buoy by a suspension yoke and a line, and can be set at any depth in the water column. The most important factor is to keep the area of the surface float small relative to the surface area of the drogue, to minimize wind influence on the drogue movement.

For areas inside the surf zone, relatively small drogues (2 ft. by 2 ft.) and small floats were used, because of the shallow water. Offshore, drogues with surface areas of 50 square feet were used.

Drogue positions were determined by measuring horizontal sextant angles to known positions on shore. Very close to shore, positioning was determined by bearing compass angles to known positions. The drogues placed offshore were followed by powerboat; inside the surf zone, drogues were followed by a swimmer on a surfboard.

Results

Three field trips, encompassing a variety of wind, wave and tide conditions, were made during this study. The results of each trip are described below. Drogue tracks measured during each trip are presented in Appendix A.

The first field trip was made on March 2 and 3, 1989, during the most severe Kona storm of the winter. A low pressure system over the islands resulted in strong southwest winds and heavy rainfall. On the morning of March 2nd, winds were gusting to 55 knots at Barking Sands and 40 to 50 knots at Lihue. Gale warnings were posted for all Hawaiian waters.

Although the weather on March 2nd precluded any boat work, it was a valuable opportunity to observe general conditions during a period of heavy runoff from land. The small stream at the head of Kukuiula Bay was discharging highly turbid water and the bay and nearshore waters were chocolate brown out to at least the 18-foot contour. The surf was ragged storm surf, 10 to 12 feet high, with multiple lines of breakers. At times, the waves broke almost entirely across the mouth of the bay. Photo 1, on the following page, shows typical conditions off the harbor breakwater on March 2nd.

Figure A-1 shows the results of limited current measurements taken on March 3rd, when the southwest winds had moderated to 25 to 30 knots. The breaking wave pattern extended all along the north side of the bay, resulting in an obvious shoreward transport of water. The measurements, and visual observations of debris movement, showed a seaward counter current in the center and south side of the bay. This seaward movement occurred even in the surface layer in spite of a 25 to 30 knot onshore wind. This seaward flow was generated by the buildup in head due to the breaking wave setup in the bay and the volume of water discharged by the stream. This was the only time during the study when the surface currents in Kukuiula Bay moved counter to the wind.

Photos 2 and 3 show conditions in the bay, looking seaward from the head of the bay. Photo 2 clearly shows incoming waves on the north side of the bay. The storm waves inside and outside the bay resulted in uniform mixing of the turbid water in the nearshore zone.

Just east of Kukuiula Bay, there was ponding on Lawai Road in two areas, but no observed sheet flow of runoff water into the ocean. The only other major discharge of runoff was at Waikomo Stream at the Koloa Landing. Between Kukuiula Bay and Koloa Landing, the surf zone and nearshore waters were still discolored and turbid, but not to the same degree as off the two stream discharges. The apparent movement of the offshore water, based upon observations of the turbidity distribution, was to the west. The nearshore water east of

KUKUIULA BAY,
MARCH 2, 1989

PHOTO 1

PHOTO 2

PHOTO 3

Koloa Landing was noticeably less turbid than the water from Koloa Landing to Kukuiula Bay. The existing drainage pipe at Ekaha was discharging a relatively small volume of water during the peak of the storm on March 2nd, but was blocked again by beach sand on March 3rd. Figure A-2 shows the averaged results of measurements taken off Ekaha on March 3rd. The transport inside the surf zone was always to the west, into the prevailing wind. The circulation on the reef inside the surf zone was predominantly influenced by the mass transport of the breaking waves. Because of the bottom configuration, the waves break almost all the way to the shore off Kolopa, and the only avenue of flow to relieve the increased head is to the west. The flow channel narrows off Ekaha, due to the pattern of the breaking waves, and the longshore current speed increased in this area. Once past the point, the current speed again decreased, and the current followed a meandering path through the surf zone. Although the drogues were lost in the storm surf, a line of debris moving slowly seaward indicated the path of the rip current. The large surf, the strong wind, and the secondary waves on the reef flat resulted in a high degree of mixing on the reef flat and in the nearshore area.

Drogues were also released in Hoai Bay, just north of Kolopa, and surface flow in the bay was consistently seaward, in spite of the large waves and onshore wind. Again, the counter flow was releasing the built up head of water caused by the mass transport of the breaking waves.

The second field trip was made on March 30, 1989 during moderate tradewind conditions. There was an incoming south swell, and breaking wave heights on the reef were 3 feet, with a period of 13 seconds.

The results of the current measurements in Kukuiula Bay are shown in Figures A-3 and A-4. In the morning, the winds were easterly tradewinds, oriented almost in line with the longitudinal axis of the harbor. The surface currents moved seaward in response to the wind stress on the water, as shown in Figure A-3.

The subsurface drogue released in the center of the harbor also moved in a seaward direction. The subsurface drogue released near the tip of the breakwater moved across the harbor, then in a westerly direction along the shore. This cross-harbor motion near the entrance was also observed on the following field trip, and is evidently caused by wave action. Incoming waves break along the breakwater and the mass transport at the tip of the breakwater causes the subsurface layers to move in alignment with the waves.

In the afternoon, the wind had shifted to a more northerly direction and both the surface and subsurface drogues moved directly downwind (Figure A-4). At this time the tide was also low slack, so any tidal influence on the drogues would have been minimal.

At the Ekaha site, in spite of different wind conditions, the inshore currents were very similar to those observed during the March 3 Kona storm. The currents inside the surf zone moved to the west, as shown on Figure A-5. However, the alongshore flow remained inside the surf zone almost to Kalaekiki Point, where the speed decreased and the water moved seaward.

The subsurface currents seaward of the surf zone were to the west, with an average speed of 0.1 ft/second. The surface drogue, influenced by the wind as well as the tide, moved west with a speed of 0.4 ft/second.

The drogues at Hoai Bay moved slightly seaward, but then, under the influence of the breaking waves and the easterly trades, travelled west around Kolopa, and were eventually caught in the surf and transported shoreward.

Limited measurements were taken later in the afternoon, primarily to check for variations from the earlier pattern. Currents inside the surf zone at Kolopa were the same as those measured earlier in the day. The westerly movement was initially relatively slow, with the speed again increasing off the point at Ekaha. The offshore surface current was again moving west at 0.4 ft/second. The subsurface current drogue showed no measurable movement over a 20 minute period.

The third set of current measurements was taken on April 4, 1989, during moderate to strong northerly winds, an incoming south swell (height 4 ft., 14 second period) and a strong rising tide.

At Kukuiula Bay, the surface drogue released in the middle of the bay moved almost directly downwind, while the subsurface drogue moved very slowly shoreward, as shown in Figure A-7. At the mouth of the harbor, the subsurface drogue was influenced by both the wind and the waves, moving downwind, but also being pushed toward shore by the wave action. The subsurface drogue moved directly toward shore, apparently in response to the mass transport of water due to the wave action of the tip of the breakwater.

The results of the current measurements off Ekaha, Figure A-8, were almost indentical to those of the March 30 field trip. The offshore currents, however, moved to the east, at speeds of 0.2 to 0.5 ft/second. Of the two drogues released at Hoai Bay, one moved around the point and was transported shoreward by the breaking waves, while the other moved seaward and out the deeper channel.

Discussion

Measurements were taken on enough days and under enough varying conditions to allow a general description of circulation in each of the project sub-areas.

The main driving forces influencing circulation in Kukuiula Bay are the wind and the breaking waves. During typical tradewind conditions, the surface layers move downwind, and out of the bay. Although there must be a deeper counter current moving into the bay, such a current was measured only one time during the study. Once out of the bay, the surface water would be entrained in the alongshore tidal currents and move either east or west along the coast.

During the occasional periods of high waves, the mass transport of water into the bay becomes the predominant driving force, as illustrated by the March 3 measurements.

The waves break along the north side of the harbor all the way to the head of the bay. The volume of water transported in the bay is sufficient to generate a seaward current flow out of the center of the bay. This seaward current, or weak rip current, was observed on March 3 in spite of very strong onshore winds.

Tidal action plays a very small role in the bay circulation. The tidal prism, or amount of water that flows into or out of the bay during a tidal cycle is relatively small.

The currents inside the surf zone between Kolopa and Kalaekiki Point are greatly influenced by the pattern of the breaking waves in the area, and the resultant mass transport of water. Under all wind, wave and tide conditions the flow on the reef flat was from east to west. The waves off Kolopa break almost to the shore, and provide the initial head increase or "push" to start the westward flow on the reef. Because of the continuous shallow seaward edge of the reef, the only possible flow route is westward along the reef flat. At Ekaha, the reef flat narrows and the surf breaks closer to shore. This narrows the flow route for the currents and adds more water to the flow as well, and the current speeds always increased through that area.

Once past the point at Ekaha, the current speeds decreased somewhat in the deeper water. Depending upon the combination of wind and waves the current may move seaward just west of Ekaha, or travel almost to Kalaekiki Point before moving seaward.

The currents in Hoai Bay are affected by both the mass transport of water by the breaking waves and the prevailing wind direction. There is a channel off Hoai Bay deeper than the surrounding reef areas, which provides a possible route for a seaward rip current. The breaking waves transport water into the bay, and a seaward counter current is formed in the center of the bay. Because of the relatively large channel, though, this counter current is weak, and is influenced by the prevailing wind. If the winds are either normal or easterly tradewinds, the water is deflected to the west and moves around Kolopa, mixing with the breaking waves, where it is then transported onto the reef flat just west of

Kolopa. During northerly trades, some of the water moves around the point and some flows seaward out of the channel.

The exception to the above pattern occurs when the surf is very high. At those times the water mass transported shoreward is sufficient to set up a relatively strong counter current which can be expected to move seaward out the channel without being deflected by the wind.

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APPENDIX A

DROGUE TRACKS

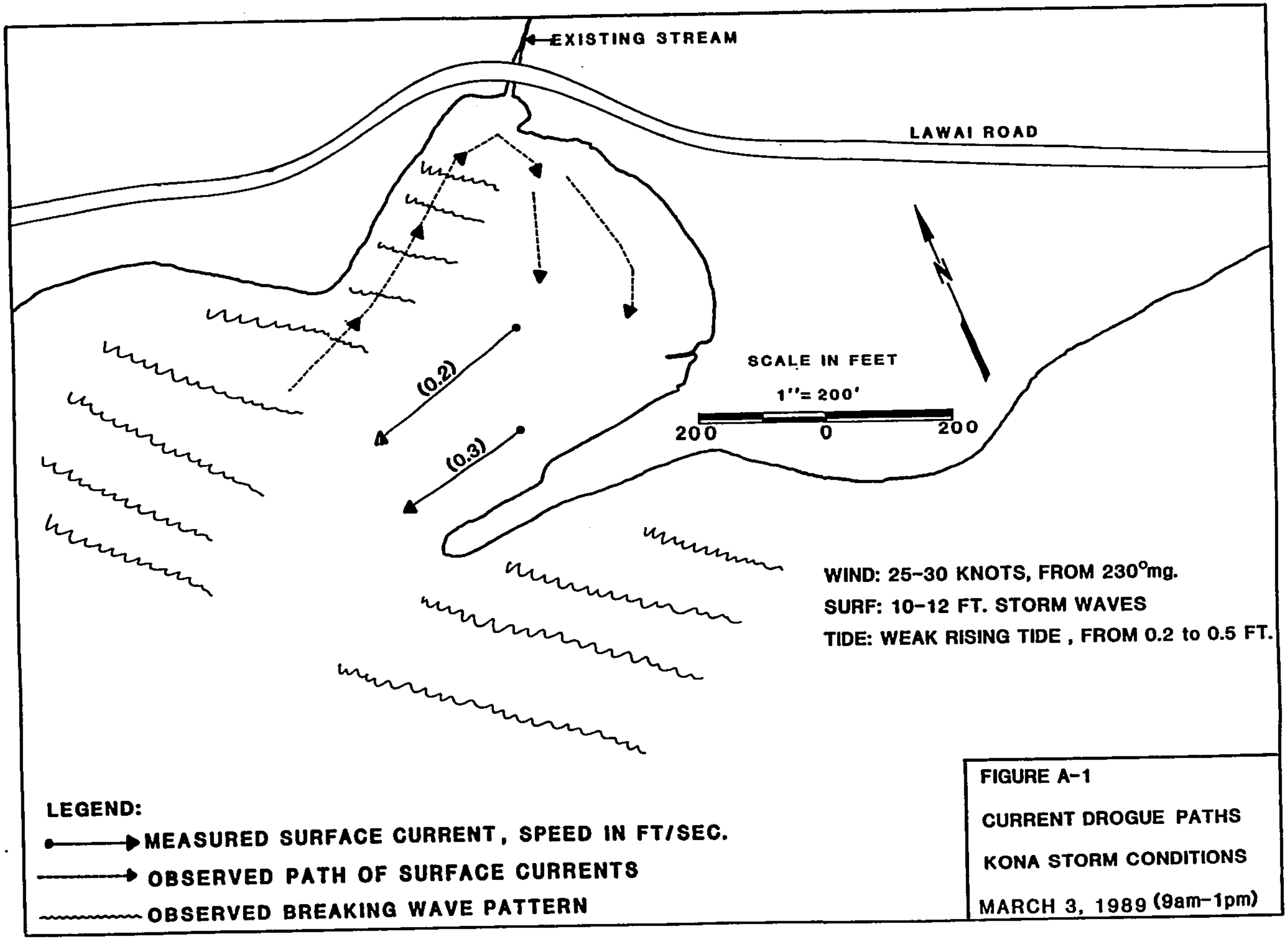


FIGURE A-1
CURRENT DROGUE PATHS
KONA STORM CONDITIONS
MARCH 3, 1989 (9am-1pm)

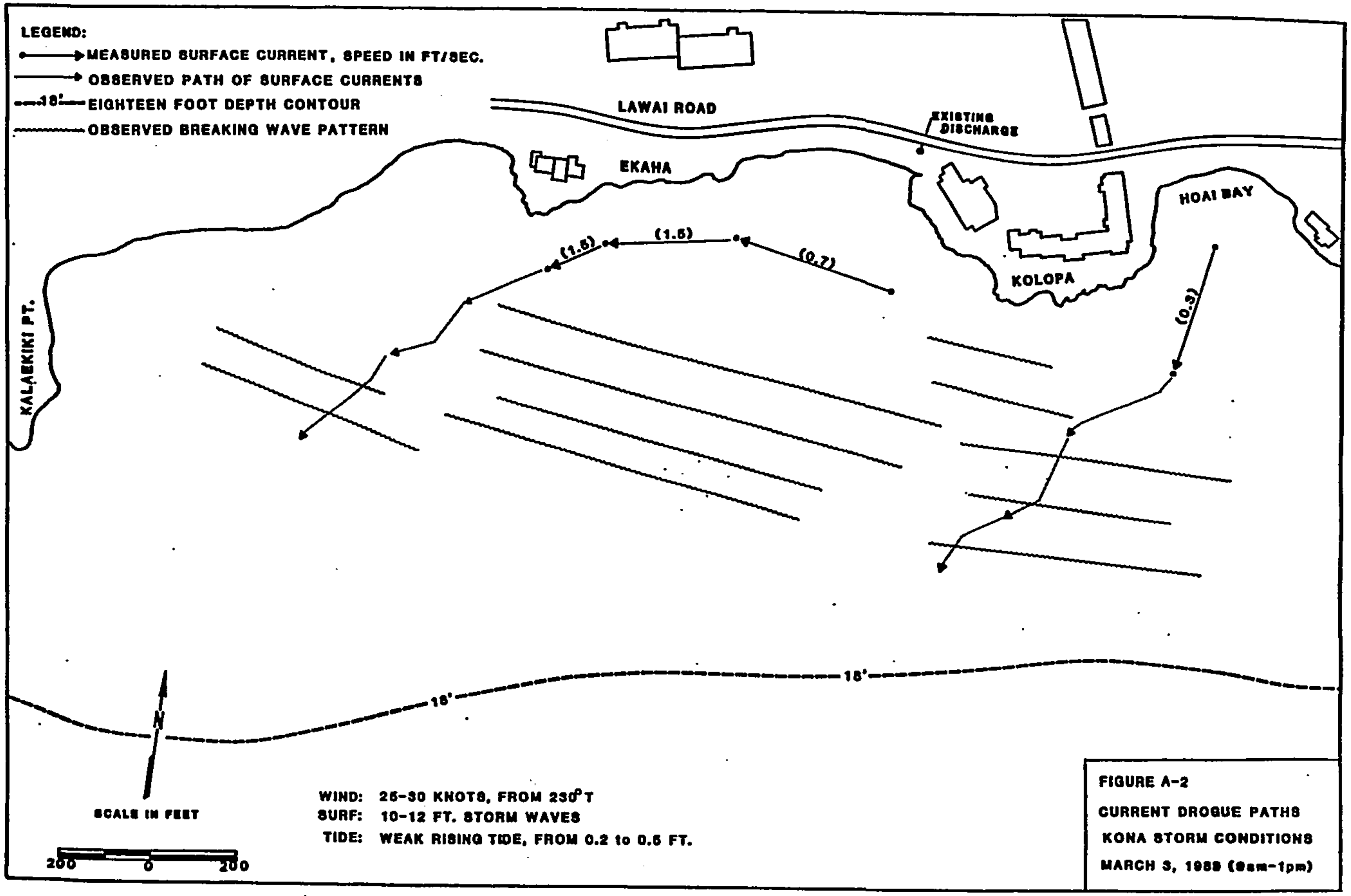


FIGURE A-2
CURRENT DROGUE PATHS
KONA STORM CONDITIONS
MARCH 3, 1989 (9am-1pm)

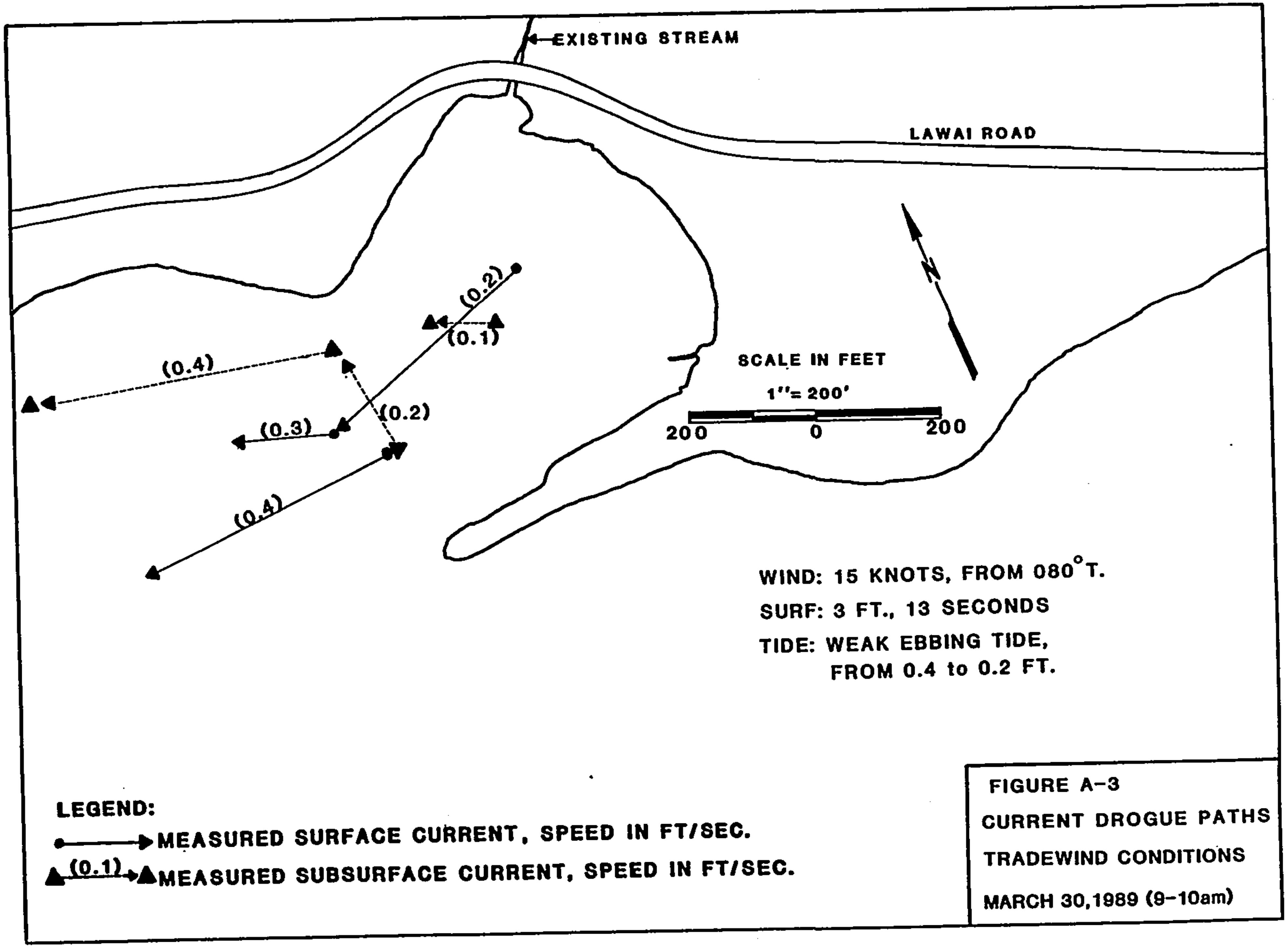
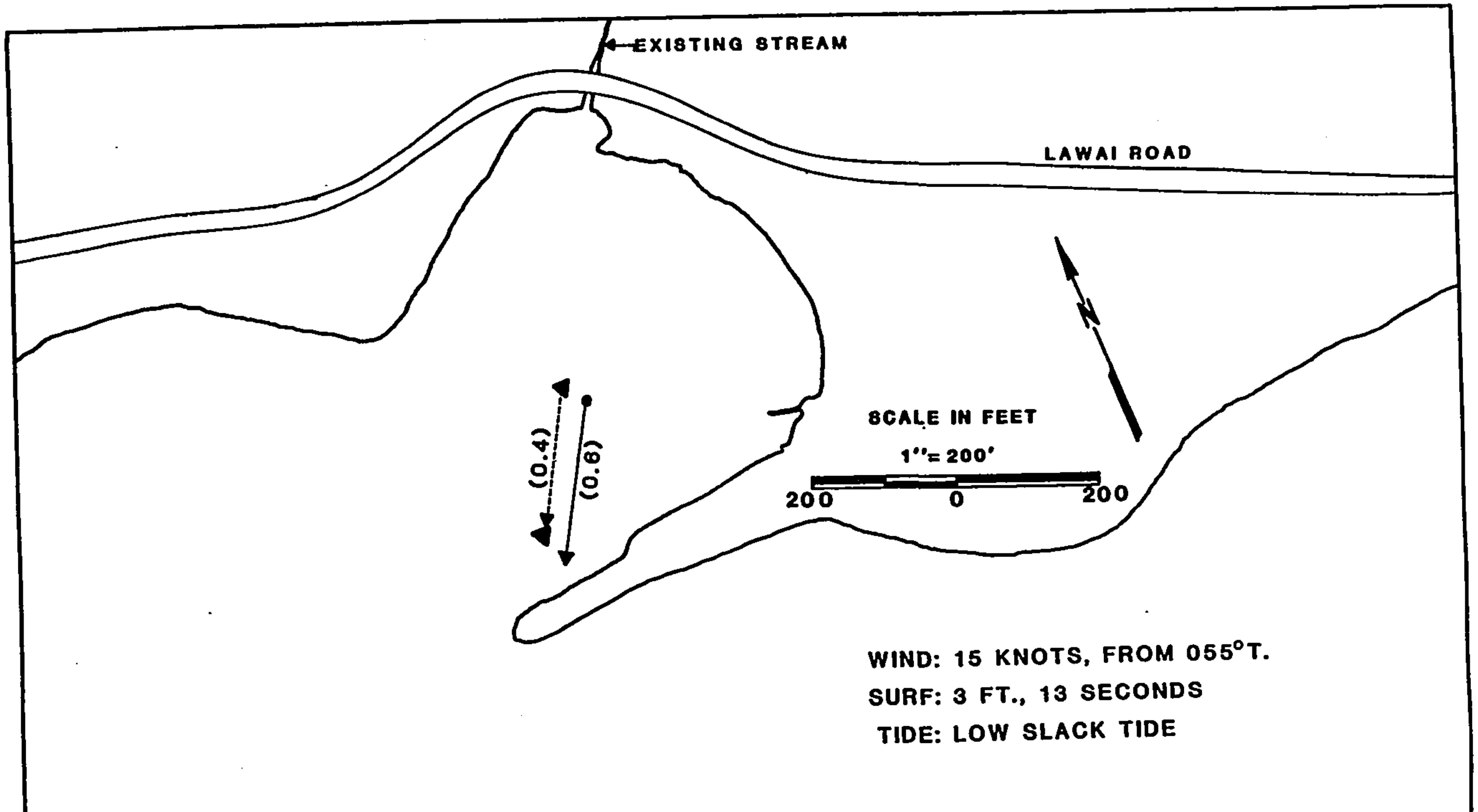


FIGURE A-3
CURRENT DROGUE PATHS
TRADEWIND CONDITIONS
MARCH 30,1989 (9-10am)



LEGEND:
MEASURED SURFACE CURRENT, SPEED IN FT/SEC.
(0.1) MEASURED SUBSURFACE CURRENT, SPEED IN FT/SEC.

FIGURE A-4
CURRENT DROGUE PATHS
TRADEWIND CONDITIONS
MARCH 30,1989 (3-4pm)

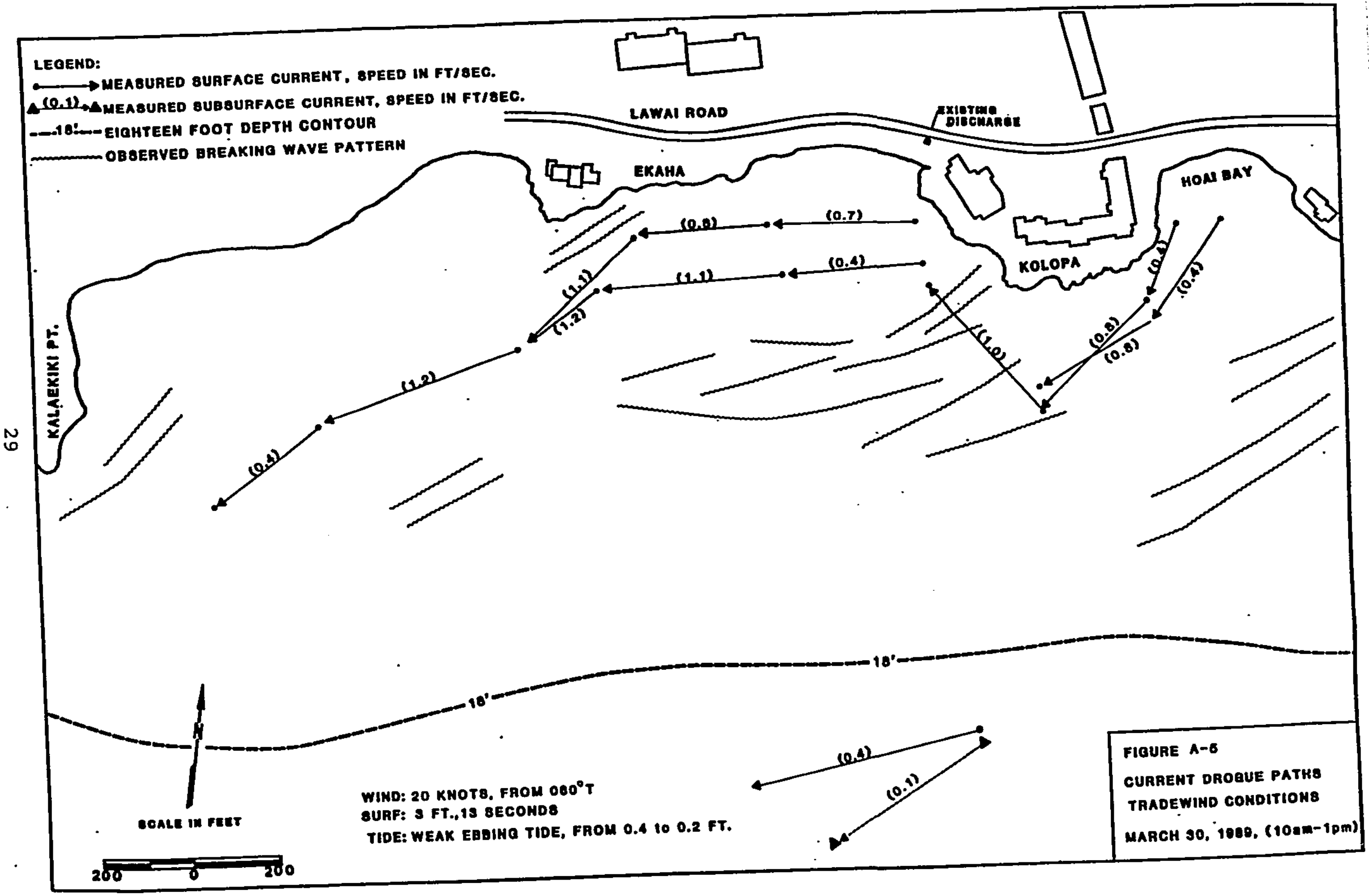


FIGURE A-5
CURRENT DROGUE PATHS
TRADEWIND CONDITIONS
MARCH 30, 1989, (10am-1pm)

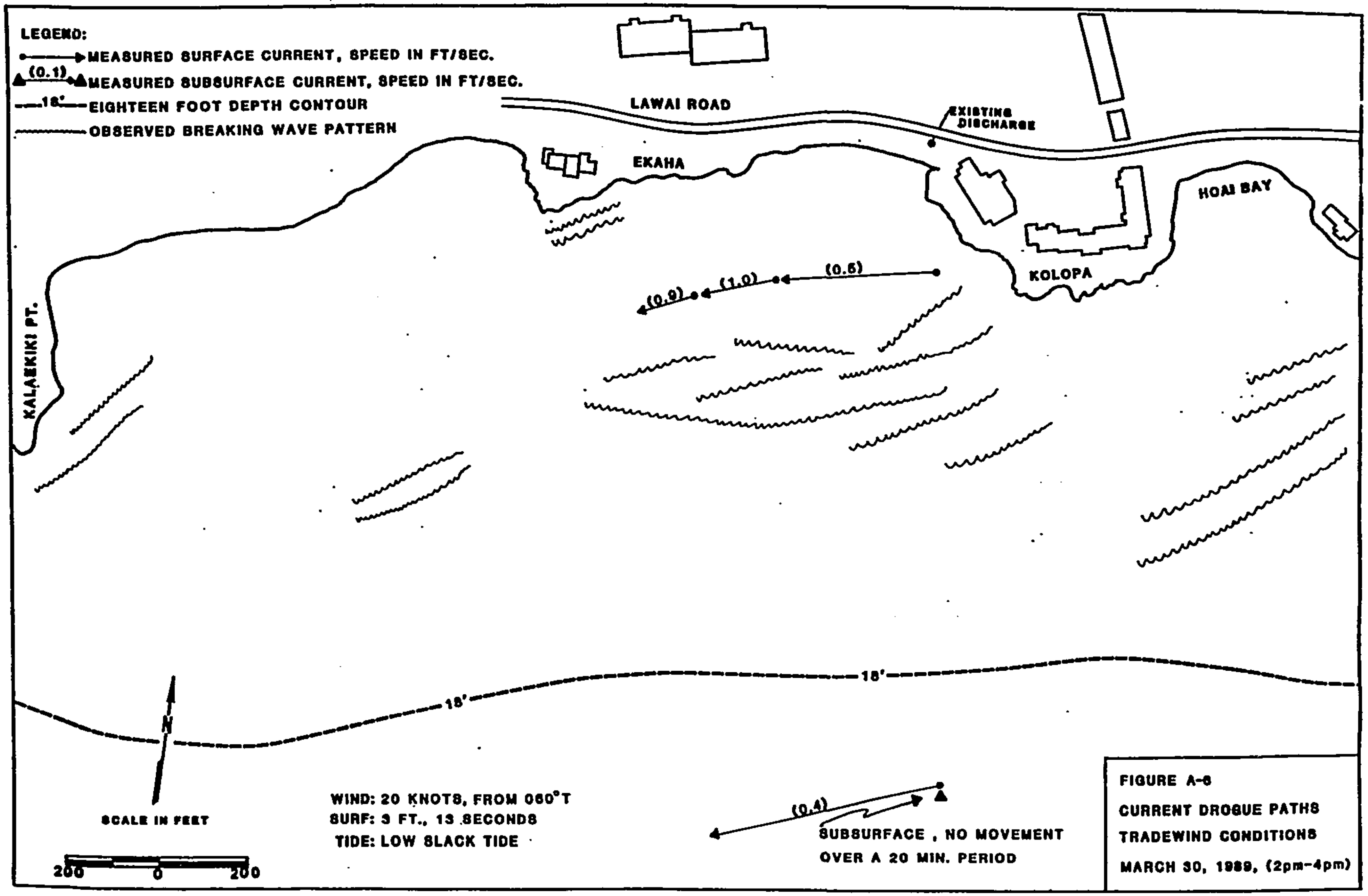


FIGURE A-6
CURRENT DROGUE PATHS
TRADEWIND CONDITIONS
MARCH 30, 1989, (2pm-4pm)

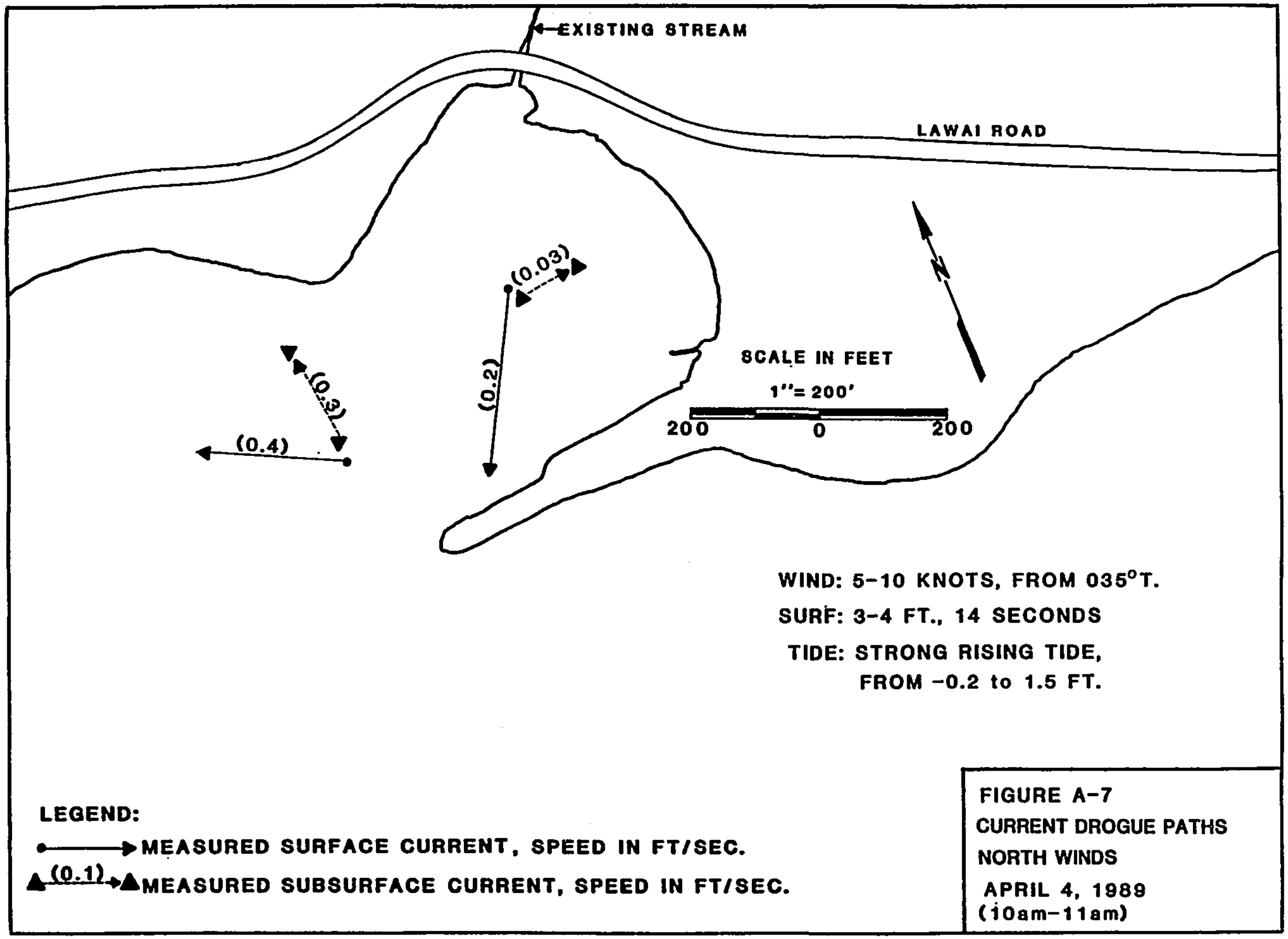


FIGURE A-7
CURRENT DROGUE PATHS
NORTH WINDS
APRIL 4, 1989
(10am-11am)

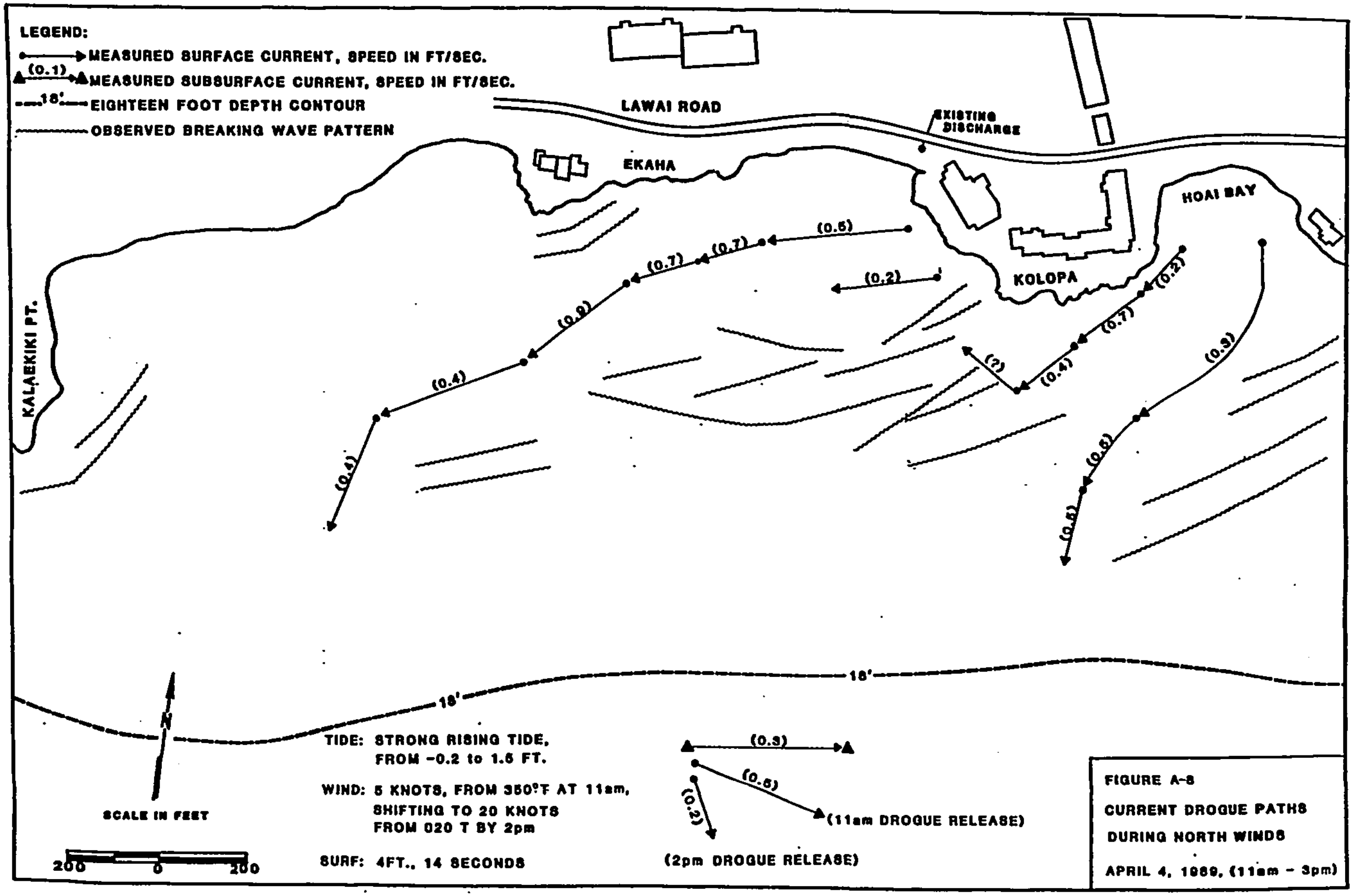


FIGURE A-8
CURRENT DROGUE PATHS
DURING NORTH WINDS
APRIL 4, 1969, (11am - 3pm)

APPENDIX H

ENVIRONMENTAL IMPACTS ASSOCIATED WITH MARINA OPERATIONS

Proposed Kukuiula Bay Marina
Environmental Impacts Associated with Marina Operations

Introduction

This report addresses the probable conditions which are likely to result as a consequence of operating the proposed Kukuiula Marina. The water quality and biological aspects addressed in this report include: physico-chemical parameters; nutrient levels; phytoplankton standing stocks; marine biological considerations and affects on resident turtle populations. The information and conclusions presented herein depend upon groundwater nutrient and input rates, the basin size and circulation patterns, and to a significant degree, basin flushing rates. The degree of uncertainty regarding each of these factors, and the relative influence of unknowns, will directly influence the accuracy of the information presented herein.

The creation of a new marina at Kukuiula will result in the creation of ___ linear feet of new intertidal protected shoreline habitat and ---acres of benthic marine habitat and the water column created therein. In addition, there will be an unquantified amount of piling and dock habitat due to construction of appurtenances associated with boat slips. This diversity of habitat may benefit the local fish populations.

Normal operations within the marina will result in fuel oils and lubricating oils incidentally being discharged into the waters. Because the marina is designed to experience mixing of the marina waters with the waters of the open ocean, these pollutants are expected to move out the channel entrance and undergo natural weathering. Therefore, the water column within the marina is expected to be well below toxic levels of any given pollutant. The discharge of boat sewage is regulated by State and Federal laws and regulations, and raw sewage cannot be discharged from the boats into the marina waters.

Due to urbanized development of the future project site, the surface runoff will increase and some will ultimately drain into the marina. Mixing of surface water runoff (with accompanying nutrients related to landscaping and agriculture) and marine waters may result in local periodic stimulation of algal and phytoplankton growth and decreased dissolved oxgyen levels. This condition is expected to be infrequent. Marina flushing rates would likely be high enough to prevent eutrophication.

During heavy rainfall events there will be low salinity water flowing out of the entrance channel. Strong mixing will occur with the ocean waters and the effects are expected to be localized and minor. The existing Kukuiula Bay anchorage is presently subject to such discharges.

Physico-chemical conditions

Because of the likelihood of non-point source groundwater discharges into the marina, a small amount of thermal stratification is likely to occur in the surface waters of the marina, a condition not unlike the present situation at Kukuiula Bay. A modest depression in salinity levels are to be expected in marina surface waters. This is because of both groundwater infiltration and the expected low salinity of groundwaters entering the basin. The anticipated salinity and temperature in the marina is not likely to have a substantial influence on biological community development. Because of the small size of the marina, significant gradient stratification is not expected in the inland reaches of the marina.

Dissolved oxygen levels in the marina waters are likely to vary with marina exchange rates. Incoming seawater can be expected to be saturated with respect to oxygen. Turbidity will decrease light penetration through the water and consequently reduce oxygen production by photosynthesis. Vertical mixing from prevailing trade winds will tend to keep low oxygen levels from developing. Conditions of lowest dissolved oxygen can be anticipated to occur in the early morning, just prior to sunrise, and during periods of calm winds which would reduce exchange rates and vertical mixing. Although increases in phytoplankton standing stocks are not expected to be significant, the likelihood for development of low and problematic dissolved oxygen problems could ensue in localized areas in the absence of significant flushing (Bienfang, 1979).

The anticipated vertical and horizontal distributions of temperature, salinity and dissolved oxygen are not expected to exert a strong influence on biological community development within the Kukuiula Marina. The dissolved oxygen levels are most likely to be of concern in influencing marina ecology. Low dissolved oxygen conditions would be favored by low flushing rates, high surface inflow rates, high turbidity levels, and prolific sediment inputs. Light limitation is generally accompanied with anaerobic sediments, odors, the paucity of corals, and wide oxygen variations over a diurnal cycle (Bienfang, 1979).

In addition to increasing turbidity levels, a significant increase in phytoplankton levels increase the likelihood of encountering "bloom" conditions, such as periodically occur in Pearl Harbor where chlorophyll stocks range from 8-27 micrograms (ug) chlorophyll/liter. Such blooms often result in radical decreases in oxygen, development of anoxic conditions in both pelagic and benthic environments, generation of odors, and fish kills (Bienfang, 1979).

The nutrient load associated with incoming groundwaters are expected to support near maximum phytoplankton growth rates and higher than baseline standing stocks. However, because of likely ample flushing rates, such increases are unlikely to be noticeable. A portion of the phytoplankton bloom would also be harvested by the herbivorous zooplankton community. The manner and magnitude with which grazing might attenuate phytoplankton biomass is highly variable and will depend on the acceptability of the marina water to support zooplankton communities. In the case of Honokohau Harbor (Hawaii Island), zooplankton stocks in the most inland basin were found to be nearly 30-fold greater (on a numerical basis) than those in the outside ocean waters. Since this population was almost entirely herbivorous, the grazing pressures exerted undoubtedly had a strong effect on reduction of the chlorophyll levels of that basin. Studies in the Barbers Point basin showed very different results, and showed much lower standing stocks (on a dry weight basis) of herbivorous zooplankton within the harbor (Bienfang, 1979).

Source:

Bienfang, P.K. 1979. Predictive Analysis of Chemical and Biological Conditions in the Proposed West Beach Marina. A Basin Influenced by Groundwater Intrusion. Rept. submitted to Alfred A. Yee and Associates.

Impacts on the Green Sea Turtle

Green sea turtles are known to occur in the vicinity of Kukuiula Bay. The potential exists for direct and indirect impacts to occur to the turtle resource in the area. Among the possible impacts are those associated with the operations of vessels in the vicinity of turtle resting and foraging areas. However, available information suggests that green turtles presently coexist with moored and moving boats. A major green turtle resting site occurs within 150 meters of the main entrance channel to the Hawaii Kai Marina on Oahu. These turtles forage on the nearby reefs, sharing the area with many users of the Maunalua Bay. This resting area frequently harbors as many as

forty (40) turtles, yet the operation of private vessels and various commercial "thrillcraft" for many years has not caused a decline in the resident turtle population. At Mala Wharf, Maui, a number of turtles rest offshore of the wharf around an old sunken vessel that now serves as a mooring for at least one commercial boat. These turtles forage around the wharf and amongst the moored vessels.

Source:

Brock, R.E., 1988. Assessment of the Resident Green Sea Turtle Population in the Vicinity of Launiupoko State Park. West Maui, Hawaii. In Towill, R.M. 1988. West Maui Marina. Launiupoko, Maui, Hawaii - Draft Environmental Impact Statement.

General Water Quality

Long-term impacts could result from changes in water quality associated with marina operations. Water quality changes could result from the introduction of fuel, sewage, and trash from boats. Marine sanitation devices may discharge disinfectants or other chemicals of greater potential harm to marine biota than untreated waste, the latter potentially posing as a sanitation problem. Sewage should not pose a problem in this project because marina development will include shoreside facilities, precluding the need to use shipboard facilities.

Vessels could leak or spill fuel and oil. However, floating petroleum products and oil have not been conclusively shown to damage corals (Grant, 1970; Rutzler and Sterrer, 1970; Johannes, 1975) and reef communities can exist in areas subjected to chronic, long-term oil pollution (Spooner, 1970; Shinn, 1972). These impacts are usually minor pollution problems and can be controlled through careful management of the facility. Many of the marina users will derive their livelihood from the nearby marine resources and thus have an economic incentive to prevent pollution problems.

Pollution problems associated with shipboard sanitary systems can be reduced by providing and maintaining convenient lavatory facilities (connected to the onshore sewage system) for use of boaters. Depending on anticipated need, consideration should be given to providing a pumpout station for sanitary waste holding tanks, although experience has shown that fuel docks are the most convenient locations for pumpout services (Chmura and Ross, 1978). Providing and maintaining convenient trash receptacles can reduce litter problems.

Coliform Bacteria

Studies within the manmade portions of the Hawaii Kai Marina have not shown heavy degrees of fecal contamination associated with harbor operations. In the marina, median fecal coliform levels (all data) ranged from 2 to 205 most probable number (mpn) per 100 milliliters (ml.) versus 2.1-4.5 mpn/100 ml in the adjacent Maunalua Bay and ocean (Water Resources Research Center, 1973). Fecal coliform analyses conducted in 1974 ranged from 1 mpn to 2,000 mpn/100 ml., with a high of 10,000 mpn/100 ml. measured once. Estimated T 90 values (the time required for 90 percent disappearance of coliform organisms) were calculated to be approximately 20 minutes, falling within the range of 10-35 minutes measured at Sandy Beach, suggesting that coliform organisms would not survive long in the marina. Since coliform data in the Bay and ocean indicated compliance with applicable water quality standards, the Hawaii Kai Marina is not a major source of bacterial pollution in the offshore environment, but is part of the overall input from the surrounding region. During high rainfall periods coliform concentrations can increase approximately 10 times over normal conditions but return to normal concentrations within 2 days. Coliform concentrations during this time behave similarly to storm water created turbidity, increasing near drainage outlets into the marina, and being associated with suspended solids, even those resuspended by wind agitation. It is not unlikely that boat-propellor agitation of sediments is associated with increased coliform densities.

Source:

Water Resources Research Center, 1973. The Quality of Coastal Waters, Second Annual Progress Report, No. 77. Technical Report No. 31, Estuarine Pollution in the State of Hawaii, Vol. 1.

Chmura, G.L., and N.W. Ross. 1978. The Environmental Impacts of Marinas and their Boats. A Literature Review with Management Considerations. Marine Advisory Service, Univ. Rhode Island, Narragansett.

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Johannes, R.E. 1975. Pollution and degradation of coral reef communities. Chapter 2. In Ferguson-Wood, E.J. and R. E. Johannes (eds.). Tropical Marine Pollution. Elsevier Oceanography Series, 12. Elsevier Scientific Publishing Co., New York.

Rutzler, K. and W. Sterrer. 1970. Oil pollution damage observed on tropical communities along the Atlantic seaboard of Panama. Bioscience 20:222-224

Spooner, M. 1970. Oil spill in Tarut Bay, Saudi Arabia. Mar. Pollution Bull. 1:166-167.

Shinn, E.A. 1972. Coral reef recovery in Flora and in the Persian Gulf. Environmental Conservation Dept., Shell Oil Co., Houston, Texas.

Impacts on Marine Algae

Algal assemblages outside of the immediate area of construction might be adversely impacts by changes in water movement and water quality characteristics. Within the proposed marina, some recovery of the algal assemblage would occur on rock revetments, pilings, and walls, but the species composition would be quite different from that which is found directly offshore. This difference would be the result of the low wave-energy environment found within the marina. Minor spills of fuel and oil could taint any desirable (edible) species growing within the marina.

The marina walls, docks and slips would provide a substrate for the development of a diverse benthic algal community. The continual advection of high nutrient groundwater over the area and the presence of sufficient light make this an excellent growth environment for marine algae. Both encrusting and macrothallic algae would likely be present. Algal mats would also provide grazing habitat for echinoderms (urchins), as has been the case at Honokohau Harbor on the Big Island and a nursery for juvenile fishes (Bienfang, 1979).

Additional support for the diversity and density of macroalgae is found at Maalaea Harbor on Maui. A 1987 survey showed the presence of 54 species of algae within a rather limited (shallow water) area within and around Maalaea Harbor (Brewer, 1987). This contrasts with a total of 59 species from Maalaea Bay reported by Maciolek (1971) (1972) and a total of 83 species recorded by Kinzie (1972) (to the -60-foot contour) within Maalaea Bay. These data suggest that Maalaea Harbor supports an especially rich flora compared to other locations in Hawaii. This was attributed to the presence of spring discharges and surface and groundwater dcischarges of nutrient-rich waters derived from upland sugar cane cultivation. Approximately 34 of the 54 species recorded were found within the confines of the marina proper (Brewer, 1987).

Source:

Brewer, W.A. 1987. Baseline Marine Environmental Surveys. Maalaea Harbor, Maui, Hawaii. Tech. Rept. prepared for Maalaea Triangle Partnership. In: Maalaea Triangle - Concurrent State Land Use Boundary Amendment and Rezoning Applications (1987).

Maciolek, J. 1971. Aquatic Ecosystems of Kealia Floodplain and Maalaea Bay, Maui. University of Hawaii. Hawaii Institute of Marine Biology Tech. Report No. 27.

Kinzie. 1972. Environmental Impact Analyses for the Proposed Maalaea Bay Generating facility. Westinghouse Environmental Systems Dept. Prepared for Maui Electric Company (Appendix C.)

Impacts on Corals and Other Invertebrates

The proposed development of a marina at Kukuiula would have little direct negative impact to extant invertebrate and coral communities for the reason that these are poorly developed in the area.

The development of coral communities is generally favored under conditions of good water quality, low turbidity, low sedimentation rates, and high exchange rates. The existence of hard substrate for the coral larvae (planula) to settle on is a primary consideration. The pressure of sediment reduces this likelihood, and the associated reduction of water clarity may also exhibit strong limitation to the development of large coral populations. There some evidence that the rate of coral colonization is influenced by the relative distance of particular sites from the adjacent ocean, which is the origin of planula. Thus lower colonization rates might be expected in the most inland regions because of the lesser chance of encounter by the planula with those areas. However, given the relatively small size of the proposed Kukuiula Marina, this factor is unlikely to be of any consequence. The likely presence of sediments on the marina floor and existence of low light levels argue that coral development is likely to be more rapid on the marina walls (Beinfang, 1979).

Although corals are rarely associated with marina environments subject to freshwater intrusion, they are not unknown from such settings. Monitoring studies conducted at the Hawaiian Electric Company's Honolulu generating plant have shown the presence of ten species of coral within the main basin of Honolulu Harbor

(Buske & McCain, 1972). Similarly, Brewer (1987) reported the presence of small coral colonies along the main bulkhead of Maalaea Harbor, Maui, in an area chronically exposed to freshwater runoff and siltation.

Source:

Buske, N. and J.C. McCain, 1972. A Preliminary Survey of the Marine Environmental Impact of the Honolulu Power Plant. Hawaiian Electric Company.

Impacts on Fishes and Fishing

Fish populations generally do not attain high biomass levels in marina environments. Such areas tend to support predominantly juveniles. Fish distributions are governed by many factors, but habitat diversity (shelter and food diversity) is a very important factor. The relative paucity of habitat heterogeneity within marinas argues against development of large and/or diverse adult fish assemblages. Studies within the Barbers Point Basin routinely recorded 21-30 species of fish, most of them juveniles. Information on fishing pressure did not suggest that the removal of substantial numbers of adults was the reason for their lower numbers. Rather it is suggestd that adult forms may exit the harbor in search of more diverse habitat and food. The higher stocks of phytoplankton and zooplankton within many marinas and harbors may, on the other hand, provide food supplies essential to the juvenile populations (Bienfang, 1979).

Amongst the fishes recorded within developed reaches of Maalaea Harbor, a marina comparable in size to the proposed Kukuiula Marina, were the Hawaiian anchovy (nehu), manini, aholehole, and moray eels (Brewer, 1987). Honolulu Harbor has been found to support a total of 47 species of fishes. Small numbers of fishes are generally associated with the dredged channel basins within the harbor and around harbor pilings and bulkheads. The harbor has also been shown to serve as a nursery for several species of reef and pelagic fishes, including several species of carangids (papio), mugilids (mullets), sphyraenids (barracudas) and mullids (goatfishes) (Buske & McCain, 1972).

It has been recognzied that a connection exists between algal growth on new surfaces and tropical fish poisoning (ciguatera) (Dawson, et al., 1955; Randall, 1958). The mechanisms is not well understood, and dredged or disturbed reef areas frequently do not result in a ciguatera problem.

Source:

Dawson, E.Y. 1959. Changes in Palmyra Atoll and its Vegetation Through the Activities of Man 1913-1958. Pac. Nat., 1:1-51.

Randall, J.E. 1958. A review of ciguatera, tropical fish poisoning, with a tentative explanation of its cause. Bull. Mar. Sci. Gulf Caribb., 8:236-267.

Impacts Associated with Maintenance Dredging

Approximately every 10 years or so, maintenance dredging will likely be necessary to maintain a safe navigational depth. Resuspension of sediment associated with maintenance dredging could release organic material that could decrease the dissolved oxygen content of the marina and release nutrients that could stimulate planktonic growth. However, based on the small size of the marina and presumably high flushing rates it is unlikely that resuspension of nutrients would stimulate phytoplankton growth. Typically phytoplankton growth and density is related to the residence time of marina water (Sunn, Low, Tom & Hara, 1974). Similarly the organic content of marina sediments is low, suggesting that dissolved oxygen will not be depressed by resuspended organic material. Sakoda (1975) reported very low levels or organics within the Hawaii Kai Marina.

Nutrients

Based on data developed for the Hawaii Kai Marina, levels of total nitrogen and total phosphorus may be expected to increase. Total phosphorus was found to increase approximately two-fold after periods of high rainfall; total nitrogen values increased two- to four-fold. In the Hawaii Kai situation, nutrients associated with heavy runoff conditions in the marina were found to influence adjacent waters in Maunalua Bay, though no adverse impacts were detected.

Sunn, Low, Tom and Hara, 1974. Final Report of the Investigation of Hawaii Kai Marina Waters. Prepared for Kaiser-Aetna, Corp.

Sakoda, E.T. 1975. The Marine Geology and Sedimentology of Hawaii Kai and Adjacent Maunalua Bay. M.S. Thesis in Geology. University of Hawaii.

Boat Docks and Launching Facilities

Boat docks and other in-water appurtenances provide solid substrate for colonizing intertidal organisms. The facilities

will reduce light availability on the marina bottom by shading and reducing the water surface area exposed to direct sunlight. This condition will contribute to light-limiting conditions on the marina bottom and will restrict the development of photosynthesizing organisms under the structures and on the bottom. Juvenile and larval marine life will utilize the structures for shelter from predators and the associated fouling organisms for protection, and as a source of food.

These microenvironments, as well as water quality, will be affected by the maintenance of the dock; i.e., leaching of termite pesticides from wood used in the dock structures; paint, rust proofing, and marine growth inhibiting compounds falling or leaching into the water; synthetic floatation compounds, which could fume and diffuse in the water; and petroleum pollutants spilled or discharged from boating operations and maintenance; and salinity variations created by washing and flushing of boating equipment.

Boat and boat docking facilities can interfere with the wind forces, which are primarily responsible for water mixing. Boats and structures that block and deflect wind energy will reduce the amount of energy the wind can impart on the water, resulting in less mixing in the water column and causing the development of random surface current eddies. Flushing and water quality within the marina will be impaired as the number of boats and boat docking structures that block or impede the prevailing winds increase. The effects will not be pronounced in marina areas where the wind is not the primary mixing or flushing factor.

U.S. Army Engineer District, 1975. Final Environmental Statement for Department of the Army Permit Action in the Hawaii Kai Marina, Oahu, Hawaii. Corps of Engineers, Pacific Ocean Division.

Pesticides

The most prevalent man-made substances in the marina waters and sediments of Hawaii Kai during the 1960's and 1970's were pesticides (WRRC, 1973). Chlordane derivatives, PCP and lindane ranged from 0-0.041 parts per billion in the marina, and 0-0.019 parts per billion in the offshore waters. DDT, dieldrin and PCP were the most prevalent pesticides with the others more infrequently detected. Total organochloride concentrations in the Maunalua Bay (outside the marina) ranged from 0-10.5 parts per billion. As pesticides are normally synthetic to the environment, their presence in the offshore sediments suggests an outward transport from the marina and surrounding areas to the

Maunalua Bay. While having an immediate toxic effect, pesticides can become impotent with dilution and degradation over a period of time and can also be assimilated and concentrated in organisms with undeterminable effects. The presence of pesticides in Hawaii Kai is directly related to the housing development in the area and related use of termite treatment pesticides and preservatives in home construction.

U.S. Army Engineer District, 1975 (op cit.)

Heavy metals

In the Hawaii Kai marina, heavy metal concentrations above normal baseline levels were infrequently detected in the water column with copper and zinc being more frequently detected at low concentrations. The reduced levels of heavy metals are attributed to the lack of industrial sources of heavy metals around the marina. Urban stormwater runoff is probably the principal man-made source of heavy metals to the marina environment. Heavy metal concentrations in the marina sediment for lead, zinc, cadmium and mercury were below maximum concentrations established for dredged spoils by the USEPA. The mean heavy metal concentrations in the marina sediments were within the range of concentrations found in Hawaiian soils. Since there is a lack of industrial heavy metal input into the marina, the observed concentrations may reflect natural conditions, where leaching of soils has concentrated naturally occuring heavy metals in the sediments of the valley floors (Sunn Low Tom & Hara, 1974)

WRRC, 1973 (op cit.)

Effect of Vessel Operations on Water Mixing

Mixing of the water column resulting from vessel maneuvers and propellor action has been shown to be an important oceanographic parameter in Pearl Harbor (Evans, 1974). "Ship mixing" has been shown to reduce the bottom water residence times and raise large amounts of silt. Benthic sediments typically have a very large exchange capacity which can operate to sequester heavy metals from the water column. Vessel stirring would, in effect, greatly increase the active exchange surface and hence the efficiency of the exchange process. This effect might be beneficial to marine inhabitats of the upper water layers. For smaller vessels, with propellers near the surface, churning of the surface with the resultant emulsification of surface oil films can increase the toxicity of oil to marine life. An analysis of heavy-metal burdens in Pearl Harbor sediments suggest that there may be some

interaction between oil and bottom material. Increased vertical mixing due to vessels would be expected to improve dissolved oxygen levels in the bottom waters. Metals, especially from antifouling coatings are known to enter the water column from vessel hulls. Vessel movements, however, possibly interacting with surface oil and bottom material may operate to reduce the biological availability of those metals to organisms dwelling in the upper portion of the water column (Evans, 1974).

Source:

Evans, E.C. III (ed.), 1974. Pearl Harbor Biological Survey - final Report. NUC TN 1128. Naval Undersea Center, San Diego, California.

APPENDIX I

ARCHAEOLOGICAL REPORT

ARCHAEOLOGICAL INVENTORY SURVEY OF THE PROPOSED KUKUIULA BAY PLANNED COMMUNITY, KŌLOA, KAUA'I

by

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ABSTRACT

An archaeological inventory survey was conducted on approximately 1000 acres within the makai area of Kōloa Ahupua'a, Kaua'i for the proposed Kukuiula Bay Development. A total of 58 archaeological sites comprising 150 individual features were located, mapped and described. The majority of these sites are located within the east and southeastern portion of the project area which is presently in pasture land. Most of the rest of the survey area is cultivated in cane. Both prehistoric and historic archaeological sites were found. The prehistoric sites are remnants of the former extensive late prehistoric (early historic) irrigated agricultural complex which stretched eastward from Lāwai Valley to Weliweli. This complex includes auwai, fields, house sites, shelters, burial features, occupied lava tubes and 2 heiau. Modern land disturbance has been heavier in the project area than in previously surveyed Kīahuna lands east of Poipu Road. Many of the site complexes are only remnants of former settlement. Historic era sites include cattle walls, abandoned cane fields, a house site and remnants of a large railroad berm. The two heiau and a unique auwai section are recommended for preservation with follow-up testing and excavation on most other sites.

ACKNOWLEDGEMENTS

We wish to thank Mr. Bruce Tsuchida and Ms. Joanne Hiramatsu of R. M. Towill Corporation for their coordination and support, particularly in supplying large numbers of orthophoto maps, mylar and blueprinting. The photo maps were a great convenience in accurate location and mapping of sites. Mr. William Campbell of Alexander and Baldwin also provided advice and support particularly in gaining access to McBryde Sugar lands.

The field crew for this project consisted of the authors and Mr. Jared Hammatt. Site descriptions were prepared by the 3 junior authors and Mr. Borthwick prepared the historical summary. Drafting of site maps involved considerable effort by Mr. Steve Clark and typing was done by Ms. Vicki Creed of Windword Processing.

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GLOSSARY

A-horizon	-a soil layer characterized by the accumulation of organic matter at the ground surface
Ahu	-heap, pile, collection, mass, altar, shrine; a traplike stone enclosure made by fishermen for fish
Ahupua'a	-a traditional Hawaiian land unit extending from the mountain to the sea
Ali'i	-chief, chiefess, nobility
Archaeological feature	-the discrete remains of post activity preserved in the ground
Artifact	-any object made by man
Auwai	-irrigation ditch(es)
Flake	-a piece of stone struck from a larger piece
Hale	-house
Hammerstone	-a stone used for percussion, flaking or driving
Historic	-in Hawaii, the period after the landing of (post contact) Captain Cook in 1778.
'ili	-a small land unit, a subdivision of an ahupua'a
in situ	-the place of original deposition
kapu	-taboo, prohibition
kihapai	-small land division, garden plot
konohiki	-headman of an ahupua'a land division under the chief
kula	-non-irrigated garden plot
lo'i	-irrigated field
makai	-towards the sea
mauka	-towards the mountains

midden	-faunal and floral remains from archaeological deposits, usually food remains
ohana	-a kin group of extended families
pedogenic	-related to soil forming processes
profile	-the vertical section of the ground
soil texture	-describes the size of the mineral grains in soil
shard	- a fragment of broken ceramic
soil structure	-describes the aggregates of soil particles
stratum	-a visually distinct layer of sediment
volcanic glass	-a structureless cooled lava which occurs naturally in lava flows and was used by Hawaiians as small cutting tools.

ILLUSTRATION SYMBOLS AND ABBREVIATIONS

BASALT COBBLE/BOULDER SURFACE OR PAVEMENT
BASALT BEDROCK
ROCK PILE
DEPRESSION OR HOLE
STONE-LINED DEPRESSION
COLLAPSED CONSTRUCTION
CORE-FILLED WALL
AUWAI (IRREGATION DITCH-ARROW INDICATES WATER FLOW DIRECTION)
TREE
RAILROAD BERM
LINEAR EARTHEN MOUNDS
DIRECTION OF DOWNSLOPE
PA PLANTING AREA
d DEPTH (IN FEET)

I. INTRODUCTION

This survey involved the location of 58 site complexes and 150 separate features spread over approximately 1000 acres of land. The size of the project area and the number of sites presented somewhat of a challenge in presentation of results, particularly in respect to site locations. Figure 4 (in back pocket of report) shows all sites and is drawn to scale (1 inch = 400 feet). More detailed complex maps (1 inch = 50 feet) within Section VI show the sites in considerably more detail in the same scale in which they were mapped in the field. Site locations in the text (section VI) are in reference to the seven 1 inch = 50 feet aerial photo sheets whose location is shown on Figure 4.

Table 1 which appears in the appendix is a summary list of all sites and features with brief description recommendations and significance assessments according to the National and State Register of Historic Places criteria. For planning purposes the last two sections of the report are most useful.

II. PROJECT AREA DESCRIPTION AND PREVIOUS LAND USE

The Project Area

The total survey area amounts to approximately 1,000 acres and stretches from Poipu Road on the east side to the edge of Lāwai Valley to the west (Figs.1-3). The makai boundary is marked by Lāwai Road, except for some excluded lots around Prince Kuhio Park. The mauka boundary is a straight line marking the top boundary of the master planned area (Fig. 4). Of the total survey area, approximately 650-700 acres is presently cultivated in cane and 300-350 acres is in pasture. The pasture land is concentrated in the southeast and east portion of the project area. There are non-cultivated "islands" within cane fields, as well as steep gullies and ridges throughout the cane lands which are not cultivated.

The main access to the study area is along a main east-west cane haul road which crosses Poipu Road and extends west to Lāwai Valley. Elevation above sea level varies from 10 ft (3.048 m.) in the makai portion to a high of 350 ft (106.68 m.)in the northwest. The soils in the cane areas are Lihue-Puhi Association - fine textured and deep with thin very rocky silty clay Waikomo Series in the pasture areas (Foote et al. 1972). The rain shadow effect on this side of the island creates fairly dry conditions of less than 60 inches per annum.

The bedrock is composed of massive flows of pahoehoe of the post-erosional Kōloa Volcanic Series which date to the Pleistocene (McDonald and Abbot, 1970). Because of the relative youth

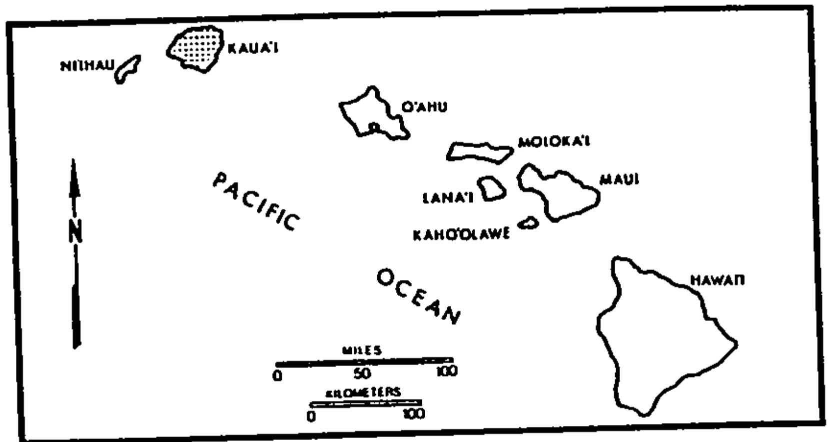

FIGURE 1
State of Hawai'i

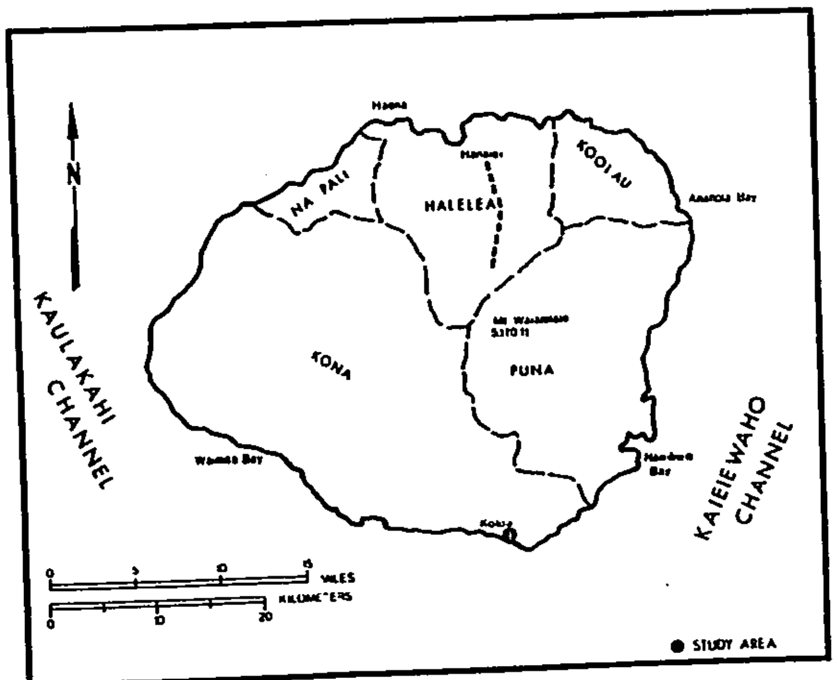

FIGURE 2
General Location Map, Kaua'i Island

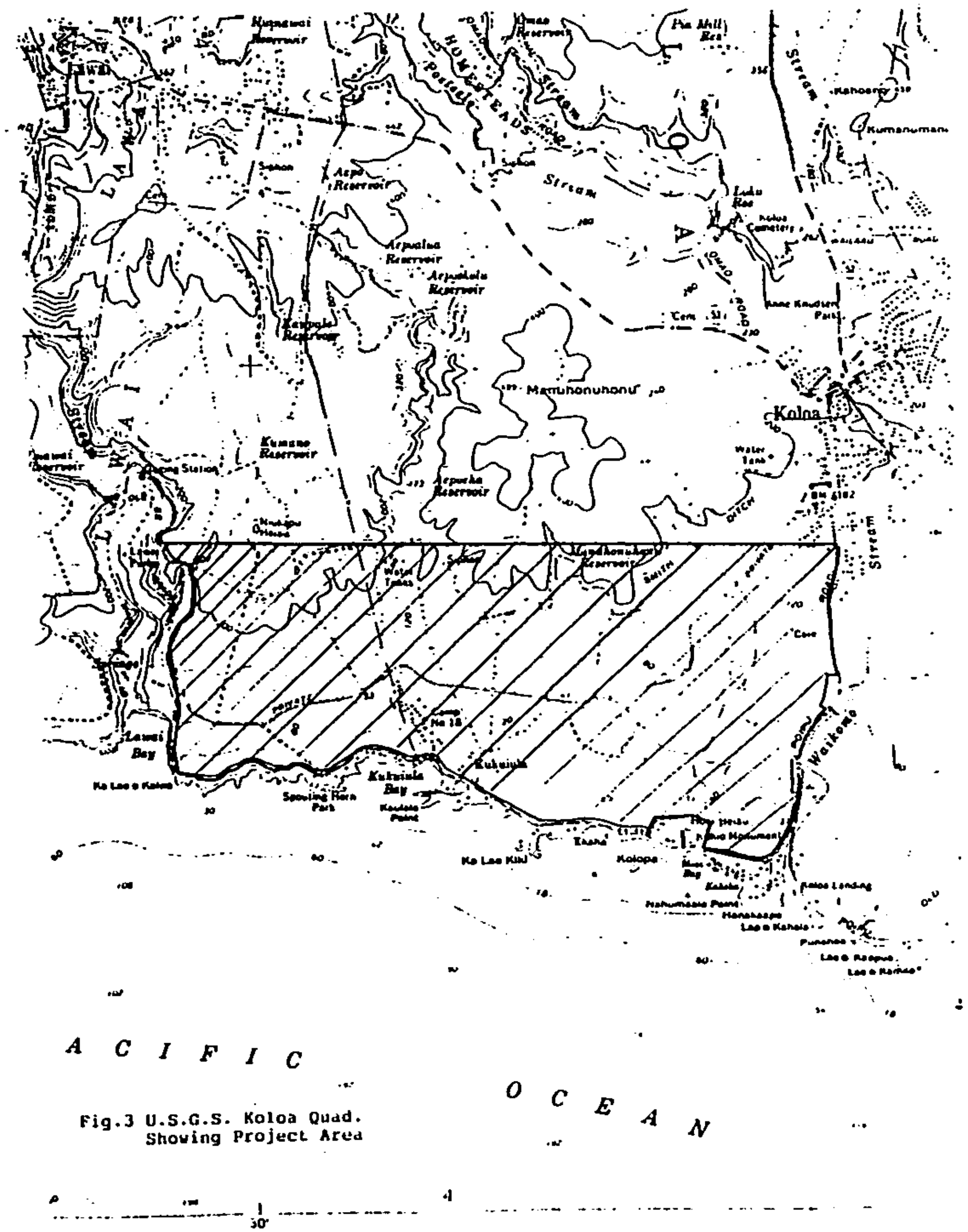

Fig.3 U.S.G.S. Koloa Quad.
Showing Project Area

of the flows and low rainfall, surfaces of more recent flows remain relatively unweathered and are overlain by thin deposits of unconsolidated alluvium. In some areas wind erosion, partly caused by overgrazing, has left bare tables of smooth pahoehoe. The distribution of these younger pahoehoe flows correlates to the land presently used for pasture.

Lava tubes are a common feature of the younger flows of the Kōloa Series. Seven occupation caves were located in the present survey within the pasture land. These caves and others in the Kōloa area have been known and explored for a long time by local residents. Charles Tanimoto in his personal autobiography talks of exploring caves as a young boy in Kōloa. He mentions a "burial cave" and a "robber cave," but does not give the location. His description of a "prison cave" matches exactly with Site 15 lava tube cave located in the present survey.

> The mouth of the cave opens downward into the ground. The cave is shaped like a giant globular glass fishbowl with the mouth on the top. The cave floor is about 12 feet below the surface and the cavern is spacious enough to house dozens of people at one time. Although there is no written record about the cave, it is believed that this so-called "Prison Cave" was used as a jail at one time. (Tanimoto 1973:20)

At present the pasture lands of the project area are very largely in koa-haole (Leucaena glauca) with some prickly pear cactus (Opuntial megacantha), Java plum (Eugenia cuminii), Banyan (Ficus sp.), lantana (Lantana camara), and a variety of grasses.

It is clear from historic records and maps, as well as the survey results, that the bulk of the low-lying portions of the

study area, irrespective of their present use, were irrigated agricultural fields in prehistoric times. Auwai were tapped from Aepo (which drained into Kukuiula Bay) and Waikomo Streams. Cultivation of tradition crops: taro, sweet potatoes, yams, supplemented with introduced vegetables - pumpkins and other squash varieties, continued through the late 19th Century, both as subsistence farming and as cash crops to supply visiting ships. The workers of Ladd and Company in the 1830's were allowed time to work their smaller subsistence plots while being employed in sugar cultivation (Palama and Stauder 1973:20). Gradually however, sugar encompassed more and more land and demanded larger quantities of water. Sugar fields were expanded to include all but the extreme makai central portion of the project area. In fact, the 1923 field map of McBryde Sugar Company (Conde and Best 1973:193) shows sugar fields in the southeast portion of the project area in lands which are presently in pasture (Fig. 6). These fields have since been abandoned for the deeper soiled areas mauka. What remains are the earthen mound field boundaries, auwai, and stone piles from field clearance. It is certain the many of the traditional lo'i areas were simply taken over and planted in cane with those having thin soil over pahoehoe being abandoned because they were not economical for continuous planting. There is clear indication, however, that the process of transforming lo'i to cane fields included consolidating smaller patches to larger fields. The large open areas in present pasture land exceed the scale of even the largest lo'i. Clearly, the land improvement required for cane cultivation had great impact on the archaeological sites. Field areas were completely cleared of rocks, and in the process, the archaeological sites (consisting mostly of rocks) were systematically moved and consolidated into large piles.

Charles Katsumu Tanimoto, in his autobiography as a youth in the plantation town of Kōloa, remembers his father operating a steam plow and the history of the steam tractors on Kaua'i.

> It is also recorded that steam plows made their initial appearance on Kauai in 1893. These slow moving land locomotive were equipped with a cylindrical geared machine for winding a cable. These first machines are museum pieces today. Standing at opposite sides of the field, one engine would pull the plow while the other released its cable. A reverse process was repeated at the end of a line and the machine slowly advanced forward a few feet at a time. Mills, irrigation, ditches or any other kind of obstruction restricted their effectiveness as plowing was done only in a straight line. (Tanimoto 1982:41).

This technique of field cultivation explains why it was necessary to expand the size of the fields as well as make them rectangular to make use of the steam equipment in the 1890's. The cable winches on the steam tractors were also used to drag rocks from the fields. In the present survey, many broken cables were observed in rock piles, and in some cases, larger boulders had been grooved so that a cable could be secured around them. The winching of rocks also explains the present distribution of piles along the edges of fields. This is where the steam tractor was parked and this is where the rocks were disconnected from the winch cable and piled.

In the makai central portion of the project area, where cane was never planted, the contrast is extreme. Here the adaptive modification of the rocky terrain by Hawaiians to construct auwai, small lo'i, terraces, house sites, etc. is integrated into the microtopography.

Although land modification for cane cultivation has had the most impact on the former Hawaiian landscape, there have been other impacts as well. There is evidence of bulldozing for pasture improvement and there are numerous bulldozed roads throughout the grazing areas. In the area to the east of Kukuiula Bay there is an abandoned U.S. Coast Guard "Loran" Station (makai west portion of Sheet 6) (see Fig. 4). This facility included a number of antenna sites, access roads, and building pads. This construction would have impacted the archaeological sites which survived previous historic land use.

On the steeper slopes above the present cane fields in the mauka central portion of the area are the plow ridges left from former pineapple fields of the Kaua'i Pineapple Company. These slopes are presently in pasture, supporting closely cropped grass. The plentiful plastic mulch particles on the ground indicate that pineapple was probably planted here less than 20 years ago.

Finally, one must not discount the considerable effects of the 1982 Hurricane Iwa. There are still large debris piles left by storm surf in the low-lying makai portions of the study area Lāwai Beach Resort and Kukuiula Bay.

III. HISTORIC BACKGROUND

The project area is located within the Ahupua'a of Kōloa, in the Kona district of Kaua'i. Kōloa is a relatively large ahupua'a (ca. 9,500 acres) and is bounded on the west by Lāwai and on the east by Weliweli Ahupua'a(s). The derivatives for the place name Kōloa include: "Kō-loa, the large, soft, Hawaiian sugar cane (S. officinarum) once found in the area; Kōloa, "on the east bank of Waikomo Stream in Kōloa town there is a steep rock from which the district takes its name. The bank was called Pali o-Kōloa; Kōloa, after the native Hawaiian duck (Anas wyvilliana)" (Kikuchi 1963: 46 and Pukui et al. 1974:116).

Early historical and ethnographic information suggests that Kōloa was well populated during late prehistoric time. The earliest explorers, like Cook and Vancouver, used Waimea for anchorage and victualizing, with no mention made of Kōloa. However, their descriptions of well maintained, watered agricultural systems, on this dry Leeward coast, are echoed in the early descriptions of Kōloa.

Cook states: "What we saw of their agriculture, furnished sufficient proofs that they are not novices in that art. The vale ground has already been mentioned as one continuous plantation of taro, and a few other things, which all have the appearance of being well attended to" (Cook 1784). Vancouver's description, in part, states: "...the low country which stretches from the foot of the mountains toward the sea, occupied principally with the taro plant, ...interspersed with some sugar-canes

of luxuriant growth and some sweet potatoes" (Vancouver, 1798).

In 1835 two American naturalists, Thomas Nuttall and John K. Townsend, visited the Kōloa area with Townsend noting "fields of taro, yam, and maize(? probably sugar cane), irrigation networks and sweet potato patches in the dryer areas" (Townsend 1839:206). Also in the 1830's J.J. Jarves, in "Sketches of Kauai" remarked on the fields of sugar cane, taro, and, yams which indicated a more than usual attention to agriculture.

The extensive agricultural fields and their well maintained appearance indicate a relatively well populated area. Bernice Judd in "Kōloa: A sketch of its Development" (1935) suggests that prior to European contact the population of Kōloa must have been several thousand. The first missionary census (1833) accounted for a population of 2,166 for "Kōloa," but "Kōloa" referred to the area between Wahiawa and Kalapaki.

Other evidence indicating the importance of the Kōloa area during prehistorical time includes a relatively large number of heiau. The Lahainaluna schools listed 14 heiau and 1 fishing shrine for Kōloa. Of the 14 heiau at least 3 were Luakini class, 2 were po'okanaka, 5 associated with fishing, 2 medicinal, 1 agricultural, with 4 of unknown function (Lahainaluna 1885 HHS 43 #17).

The first missionary (Protestant Mission ABCFM) stationed at Kōloa was the Rev. Peter Gulick who moved from the Waimea Station in 1834. In 1835 a grass house some 30 by 60 ft (9.144 by 18.288 m.) was erected as the meeting house and school. Gulick also initiated sugar cane cultivation and a cattle herd for the Protestant Mission. In 1837 an adobe church was built and the first mission doctor, Dr. La Fon arrived. Dr. La Fon moved to Lihue in 1840 and was replaced by Dr. J. W. Smith in 1842. Dr. Smith as both doctor and missionary could not continue the farming activities started by the Rev. Gulick and reduced the cattle herd and sends to Honolulu 7,000 lbs. of sugar which was produced from cane grown on mission lands (Stauder 1973:22). At the time of the Mahele (ca. 1850) the ABCFM (Protestant Mission) received about 825 acres in Kōloa, some near Prince Kuhio Park (i.e. within present project area) with the bulk around Kōloa Town.

Sugar

The Kōloa area is the site of the oldest sugar plantation in Hawai'i. In 1835 Ladd and Company gained the lease of some one thousand acres at Kōloa for the purpose of growing sugar cane. "The lease, allowed the use of the waterfall and an adjoining mill site at Maulili Pool, the right to build roads, and the privilege of unrestricted buying and selling, and freedom from local harbor dues" (Stauder 1973:18, from Judd, 1935). Ladd and company were not the first to mill sugar cane in the area, as there was a Chinese operated granite roller mill in operation at Māhā 'ulepū, Kōloa in 1830. Ladd and Company were, however, the first "plantation" organized industry in Hawai'i. Along with the lease the company was allowed to "hire native workers provided they paid the king, Kamehameha III, and Kaikioewa, appointed

Governor of Kaua'i, a tax for each man employed and paid the men satisfactory wages" (Ibid.:18). The plantation set up houses for native workers and a store where the employees could purchase merchandise with the plantation currency in which they were paid. The cane growing activity of Ladd and Co. was not done directly on the project property, but the commercial activity initiated by the plantation had wide spread ramifications. Kōloa Town and the landing at the mouth of Waikomo Stream became major commercial centers. The landing or "roadstead" as it was called, was a busy port during the mid 1800's. "An estimate in 1857 stated that 10,000 barrels of sweet potatoes were grown each year at Kōloa, and that the crop furnished nearly all the potatoes sent to California from Hawai'i. Sugar and molasses were also chief articles of export" (Judd 1935:326). Whalers also used the "Kōloa Roadstead" during this era (1830-1870) and took on provisions of squashes, salt, salt beef, pigs, and cattle. Hawaiians grew the squashes (pumpkins) on the rocky lands north of the landing and numerous salt pans were located along the shore near the landing (Stauder 1973:20).

Ladd and Company actually went bankrupt in 1845, but incorporated in 1880 (Kōloa Sugar Co.) following a succession of individual and partnership owners. In 1948 The Kōloa Sugar Company became part of the Grove Farm Company.

Sugar cane cultivation was not initiated on a large scale in the project area until the 1880's and 1890's. A 1891 map by M.D. Monsarrat (Fig. 5) shows cane just mauka of Kukuiula Bay, but the

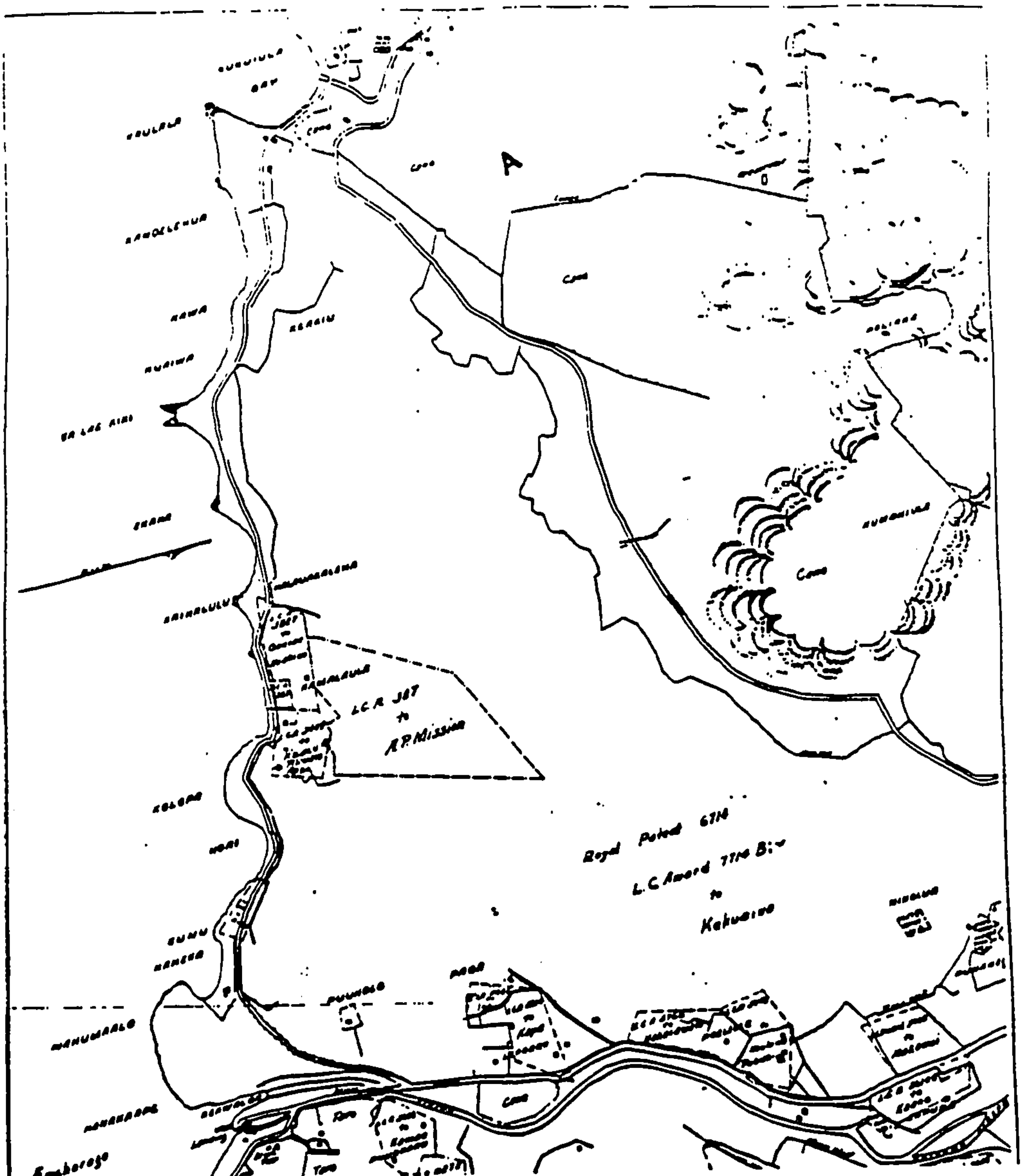

Fig. 5 1891 Monsarrat Map of Kōloa, Showing Land Court Awards and a Major <u>Auwai</u>.

majority of the project area was still not in cane cultivation. This changed with the advent of McBryde Sugar Company in the late 1890's. Benjamin F. Dillingham incorporated "three estates, namely Kōloa Agricultural Co. (No connection with Kōloa Sugar Co.); Eleele Plantation, and Wahiawa Ranch" (Conde and Best, 1973:191). Theo. H. Davies was the acting agent until 1909 when Alexander and Baldwin took over agency control.

Expansion of cane fields and rail lines was rapid, as by 1903 rail lines had been completed to their Kōloa Fields and Kōloa Landing. The manager's report of 1904 states: "Our permanent railroad had been graded into Kōloa Village.... A span has also been run down from the main track to the coral sand beach between Kukuiula and Kōloa Landing, so that we are able to load sand as required for fertilizer and other uses ...." (Ibid.:191). A 1923 map McBryde Sugar Co. (Fig. 6) shows field numbers (portions of 20, 21, 22, 23), as well as the railroad alignment within the project area. It was not long after this (ca. 1925) that use of Kōloa Landing was phased out and Port Allen became the major port facility.

Evidence of major land modification related to cane cultivation is still very apparent within the project area. Reservoirs built ca. 1910 and expanded upon in the 1930's border the project on the mauka side (Aepoeha and Manuhonuhonu). The railroad berm (Site 37), and the large rock piles observed, as "islands" in the present cane fields, larger linear rock mounds on edges of present cane fields and piles within the present dry pasture land

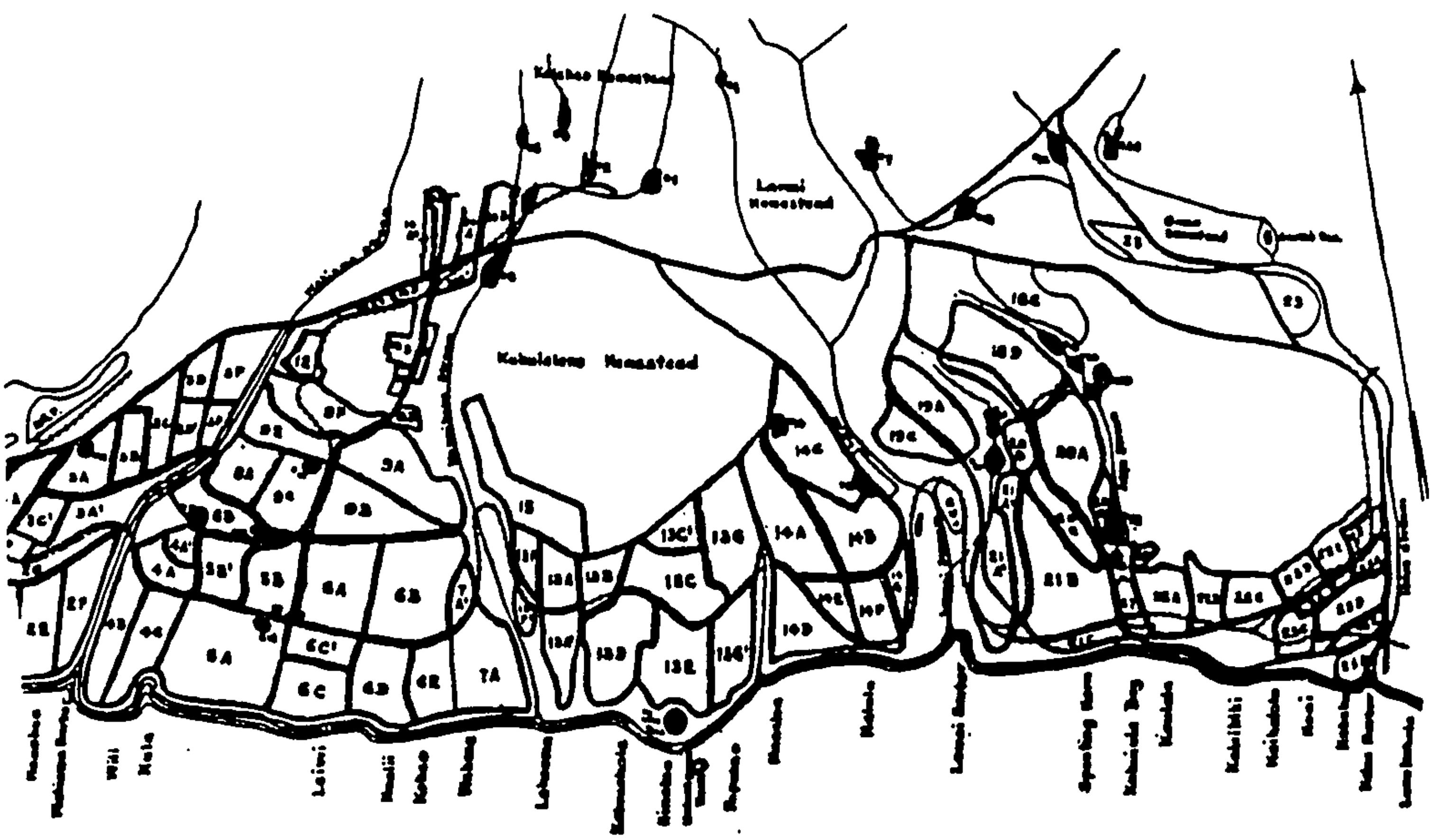

Fig. 6 Field Map of a Portion of the McBryde Sugar Company from Conde and Best 1973:193.

attest to the energy expended in cane cultivation. The rock piles, evidence of large scale land clearance, are a common feature associated with commercial agriculture, but in some cases the rocks were a useful resource. "Many Hawaiian plantations were plagued with rocky soil and McBryde was no exception. It also followed the general practice of piling rocks in the fields and then using them to fill in under rail trestles, culverts and the like (Conde and Best 1973:191). In the 1930's McBryde completed long sections of rock fill, replacing trestles at Kawaihaka, Lāwai and Kukuiula gullies. However, by 1947 all cane hauling activities were taken over by trucking for McBryde Sugar Co. The present bay pasture lands, in the project area, that were formerly cane fields, were taken out of production some time after 1923, exactly when is unknown at this time.

<u>Mahele Records</u>

The bulk of the <u>ahupua'a</u> of Kōloa at the time (ca. 1850) of the "Great Mahele," went to Moses Kekuaiwa (LCA 7714-B). The award covered some 8,620 acres for "West Kōloa," which refers to the actual <u>ahupua'a</u> of Kōloa, as Kōloa was also the district name. Moses Kekuaiwa was the brother of Alexander Liholiho (Kamehameha IV), Lot Kapuaiwa (Kamehameha V), and Victoria Kamamalu. The next largest award went to the Protestant Mission (ABCFM) and consisted of some 825 acres (LCA 387). The majority of the mission lands were located in the vicinity of Kōloa Town, where the parsonage is located. The large parcels just <u>mauka</u> of Kōloa Town

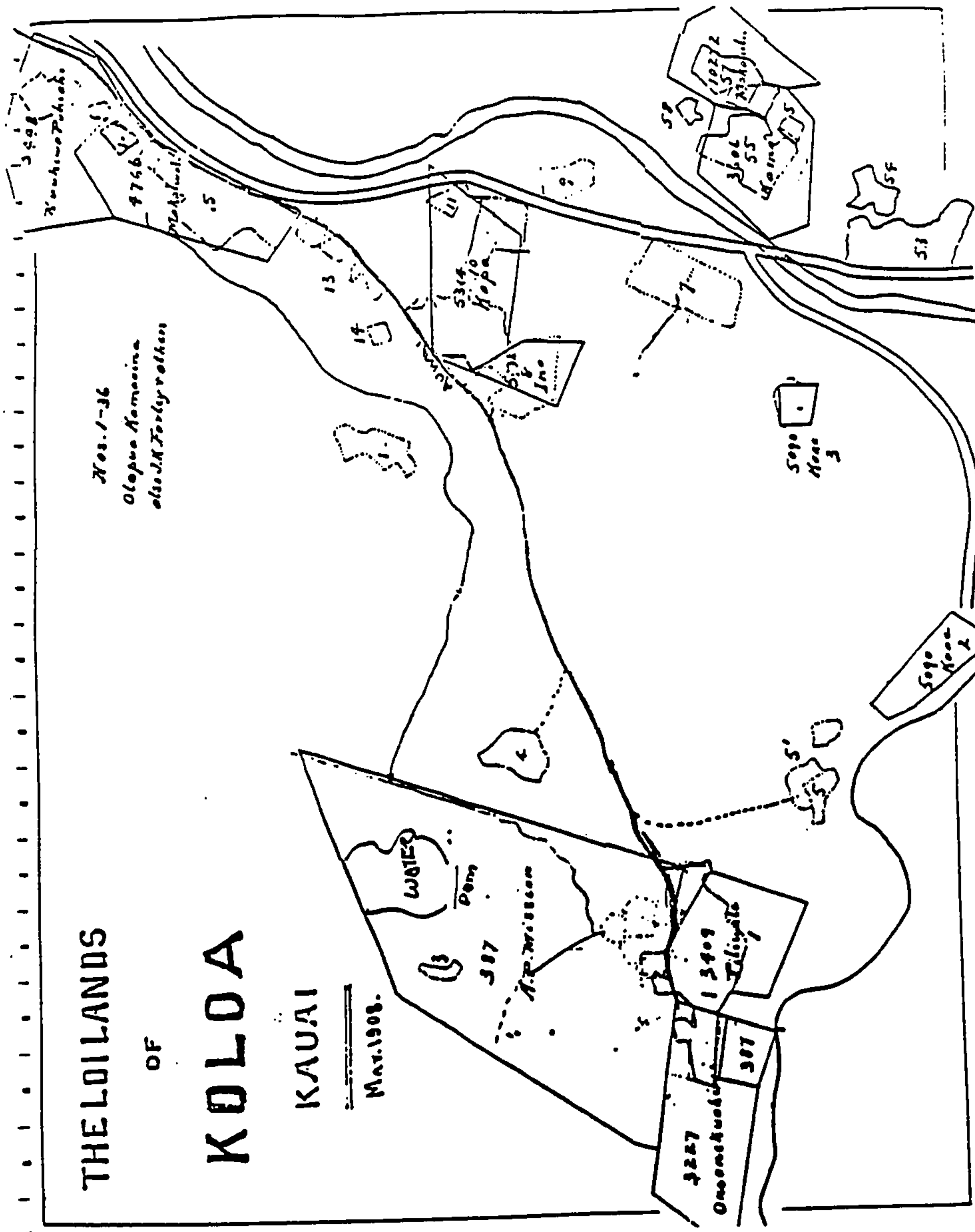

Fig. 7 Portion of the 1908 Grove Farm Map. The Lo'i Lands of Kōloa showing Land Commission Awards and auwai.

were utilized for sugar cane cultivation and cattle pasture. However, a portion of LCA 387 was located in a roughly triangular shaped parcel within the present survey area.

Correlation between the older maps (Figs. 4, 5, 7) and the present survey suggests the well constructed auwai (Site 38) and associated agricultural features may still have been functioning into the early 1900's. There were approximately 20 other LCA(s) awarded to individuals within the project area (Fig. 7). These LCA(s) are kuleana type land holdings for house lots, kula and lo'i. The information from the Native and Foreign Registers and Testimony(s) indicate that during the mid-1850's traditional crops of taro, sweet potato were still being grown. The concentration of awards, including lo'i and house lots were along auwai associated with Waikomo Stream. The Registers and Testimonies offer a wealth of information. Most indicate, the name of the applicant, number of lo'i, and size of kula, who they got the land from, or whom entitled them to it, boundaries and neighbors, and numerous place names for the ili in the area. The general picture that emerges from this information is taro, grown in lo'i, was still the dominate crop within kuleana. Some pieces of kula land(s) had been converted to sugar cane, to be sold to the Kōloa Sugar Mill. This power of the Kamehameha dynasty was evident in that the appointed governors of Kaua'i and their konohiki were responsible for entitling the awardees to their specific kuleana.

Correlation of archaeological sites and Land Court Awards is

tentatively possible by matching locations of sites to award parcels as placed on the 1891 Monsarrat Map (Fig 5). These correlations are as follows:

Site		LCA
6,7	-	10478 to Naiwi (5 lo'i, 1 kula, (1) houselot, Place Name: "Punahelu"
49,50	-	4582 to Ino (4) lo'i, (1) kula
		5314 to Kapa (6 lo'i (1) kula, Place Name: "Paoa"
48	-	5090 to Koae (2) lo'i, (1) kula, Place Name: "Puuholo"
30,40	-	387 to A.P. Mission, 3409 to Piliwale (3) lo'i, (1) kula, Place Name: "Kualu"
		3227 to Oneoneikuahiwi (1) large lo'i (1) kula, Place Name: "Kamaloula"

(LCA information from Native and Foreign Testimonies and Registers, Hawaii State Archives.)

Summary

The historical information indicates that even though Kōloa is a relatively dry area (ca. 30 in. of rain per year), a perennially flowing Waikomo Stream allowed for a fairly extensive agricultural development. The present survey area had evidence of an expansive traditional agricultural complex and associated habitational features. Early historical accounts (Jarves: 1830, Townsend 1839, Farley 1907, Judd 1835) describe a relatively continuous, well maintained agricultural complex of taro, yams, sweet potato, and sugar cane that was watered by an extensive auwai system.

The Kōloa area became the site of Hawaii's first sugar plantation, Ladd and Co., in the mid-1830's. This brought about a general commercialization of the area, a move to a market based society. Kōloa Landing became a busy port, not only for export of sugar and molasses, but other agricultural goods as well. Whalers stopped at Kōloa for salt, beef, pigs and squashes. The California Gold Rush was another impetus for agricultural exports with over 10,000 barrels of sweet potatoes shipped out of Kōloa.

During the mid-1800's the project area still had quite a few traditional farmers as evidenced by the kuleana(s) awarded and the information in the Native and Foreign Testimony(s) and Register(s). However, this information also includes reference to cattle, and commercial sugar cane growing. This suggests that though traditional farming was still taking place (i.e. for subsistence) market oriented agricultural was beginning to dominate. Kuleana farmers were probably selling "excess" taro to native plantation workers, with kula lands producing cane, to be sold to the mill and sweet potatoes, yams and squashes grown to be sold for export.

It is not until the late 1890's that the project area comes under the full weight of commercial sugar cane cultivation.

McBryde Sugar Co., probably using some of the existing auwai system, planted most of the project area in cane. McBryde also extended the railroad from the Eleele Plantation through the project area to Kōloa Landing. E.S.C. Handy noted the preexisting taro terraces at Kōloa and briefly describes the area: "The terrace areas of Kōloa were as follows: Maenui, and Kahukini, watered from Wailana Stream; Niihau (upper Waikomo) near the Catholic Church (Kīahuna Golf Course area) and Keaku watered from Maulele (Maulili) Stream. Now these areas are not used for taro, because the water is taken by the sugar plantation. There were extensive terraces on the land now under sugar cane west of the highway and in the neighborhood of Kuhio Park..." (Handy 1940:-65). The area "Keaku" and the "neighborhood of Kuhio Park" apply directly to the project area.

Kōloa Landing was phased out around 1925 with McBryde Sugar Co. and Kōloa Sugar Co. using Port Allen. Soon after this McBryde ceased to use the makai Kōloa fields and much of the project area was converted into pasture land. Presently, the Medeiros family runs cattle in lands leased from McBryde.

IV. PREVIOUS ARCHAEOLOGICAL RESEARCH

<u>William Bennett, 1931</u>

The earliest systematic archaeological survey on the Island of Kaua'i was conducted by William Bennett in the late 1920's. He examined and recorded 202 sites on the island. Those in the Kōloa area of relevance to the present project area are as follows (see Bennett 1931:116).

<u>Site 70</u> Mamalu Heiau at the center of the mouth of Lāwai Valley - now destroyed.

<u>Site 72</u> Niu Kapukapu Heiau - on the top of Niu Kapukapu Hill on the east bluff of Lāwai Valley. His description is as follows:

> The outside measurement of this heiau are 46 by 95 feet. At the front and for 60 feet on the east side, a section of the wall remains which is 3-4 feet wide, 3 feet high on the outside, and 1 to 3 feet high on the inside. Both east and west, the steep slopes of the hill, are faced with stone. On the east side the cross section shows the wall 2 feet high on the inside, 3 feet wide on the outside and 4 feet wide. At the base of the wall is a flat space 5 feet wide, then a 1 foot drop and another space 2.5 feet wide and then a 2 foot drop from whence the facing continues at an angle for 15 feet or more down the side of the hill. This double step feature is on both sides. In front of the seaward side of the wall the paving continues out for 15 feet (Bennett 1931:116-117).

<u>Site 73</u> This is described as "stone work on the hill just inland from Site 72" (<u>ibid</u>." 117). Bennett was able to define an irregular rectangular structure, but identified some of the stones as cleared from the plantation.

<u>Site 74</u> Fishing shelter on the shore near the mouth of Kukuiula Valley. The site is described as 5 feet high 6 feet wide at the base (<u>Ibid</u>.:717, Plate VIc).

<u>Site 75</u> "Kuhio Park on the shore west of Waikomo Stream, Kōloa. Taro patches, a small heiau, an oven, paved house platform, fishpond, game ground with seats around and fishing shrine are the principal features shown" (<u>Ibid</u>.: 117).

Of these five sites, none are actually in the present survey study area Site 70 - the heiau in Lāwai Valley is outside the west boundary and within the adjoining <u>ahupua'a</u>. Site 72 is <u>mauka</u> of the study area. It was visited by the survey team and appears to be in very much the same condition as described by Bennett over 50 years ago. Site 73 further <u>mauka</u> of this large <u>heiau</u> was not visited, but is probably still extant because of its position on an uncultivated knoll. Site 74 is outside the project boundary along the shoreline. This area was observed by the survey team and its appears very unlikely that this small site has survived the extensive modern land modifications Kukuiula Harbor.

The Kuhio Park complex (Bennett's Site 75) is also <u>makai</u> of the study area. Stone features and the small fishpond still extent within the grounds of the present Prince Kuhio Park appear to correlate with Bennett's descriptions. The complex is named Ho'ai which is the name of the small <u>heiau</u> west of the Prince

Kuhio monument and adjacent to the Prince Kuhio Hotel.

In the context of the present survey results it is of interest to note that Bennett does not mention the extensive agricultural and habitation features scattered throughout the inland areas behind Kuhio Park. It is possible the he simply did not observe these features and that their presence was not generally recognized by local informants on which he relied. He did record the extensive complex east of Poipu Road as Site 85: walls, enclosures and house sites (Ibid.: 120), but failed to mention that all of these structures are a component of an extensive irritated agricultural complex with many auwai and lo'i. Without this perspective provided by modern detailed survey techniques (and aerial photography) it would be understandable not to expect extensive prehistoric use of this dry cactus covered country.

William Kikuchi, 1963

Dr. William Kikuchi conducted a field investigation in the early 1960's of the Kona District of Kaua'i, including all ahupua'a from Hanapepe eastward to the Kipu Kai (Kikuchi, 1963). This study was sponsored by the Committee for the Preservation of Hawaiian Culture. Information from Thrum (1907), Bennett (1931), The Lahainaluna Schools Manuscripts (1885) and other sources was combined with field survey to locate major archaeological sites. In addition, limited subsurface testing was conducted at some sites. One focus of the project was to provide information on the extent of damage done by vandals to certain archaeological

resources. This survey was selective as to areas and sites and was not intended as a complete inventory by Kikuchi. A number of archaeological sites were recorded within the present study area although only approximate locational information is given; some of these correlated to sites recorded in the present survey. Other sites could have been destroyed or altered over the past 25 years.

Kikuchi recorded 3 features in the area just to the east of Kukuiula Bay (Kikuchi 1963:47). These include 2 walls and a partially paved outcrop by the abandoned Loran Station. The walls were 1.5 to 3 feet high and were continuous for 20 to 70 feet. The pavement was built along an outcrop, but was partially destroyed by bulldozing. These specific sites were not identified in the present survey, but the area was observed to have been recently bulldozed.

Caves

Kikuchi located 8 caves which he designated Site 76 A-H. His locational map (approximate only) shows their distribution on a line from the settling pond mauka of Prince Kuhio Park in a northeasterly direction (Kikuchi 1963:49-54). Kikuchi's descriptions are condensed - (from northeast to southwest) and correlations to cave sites found in the present survey are as follows:

Cave 76A "this is a cave 8 feet deep and an inside diameter of 30 feet. Cultural material including white coral was found inside. The floor is of dirt and quite damp." - Not found in the present survey, possibly filled for pasture improvement or cane cultivation.

<u>Cave 76B</u> "This is a cave which is now being used by the Civil Defense of Kauai as a fallout shelter. The cave is very large with 3 branches, one leading towards the sea and the other two inland ... a small pit excavated by the author and a crew of four uncovered part of a fishhook and an adz...." - This is definitely lave tube Site 15 located in the present survey. Kikuchi's test pit was observed by us in the west side of the main chamber.

<u>Cave 76C</u> "A large sink about 30 feet by 10 feet which had one end 8 feet deeper than the other. Within the deeper section a small entrance was found leading into the cave." - This is probably cave site 19 found on the north side of the cane haul road in the present survey.

<u>Cave 76D</u> "About 300 feet from Site 76C and in a bearing of 48 degrees magnetic another cave was found." - This could be site 24 from the present survey.

<u>Cave 76E</u> "A small cave 4-5 feet in diameter was found. The entrance was ringed with pavement of lava stones." - This could be site 23 from the present survey.

<u>Cave 76F</u> "This cave was 20 feet wide and 5 feet deep. A large quantity of midden was seen within it." - Possibly covered since 1963, not found in the present survey(?).

<u>Cave 76G</u> "On a clear field a cave was found whose entrance was built up of stones. The cave was estimated to run over

150 feet in length. Midden was noted but vandals had already excavated part of the cave." - This description appears to match that of site 24 found in the present survey, but doesn't match Kikuchi's location.

<u>Cave 76H</u> "Seaward of Site 76F another cave was found. The cave was 50 feet long and 125 feet wide. A platform of rocks was built at the entrance ...." - No cave was found in the location shown for this site. Its entrance was probably filled since 1963.

Kikuchi located a total of 8 caves in the present project area. Of these, only four can be correlated to cave sites in the present project area. This may be an indication of land modification since 1963. Since the modern drainage channel leading to the settling pond above Prince Kuhio Park roughly follows the line of his caves, it is possible that more recent bulldozing for this channel could have filled in lava tube sites. Kikuchi's observations about the caves are of direct relevance to the importance of those which have survived. Although they have been disturbed by vandals, the soil deposits contain plentiful cultural material in soil deposits, indicating their use for Hawaiian habitation.

<u>Site 77 Platform</u>

Kikuchi observed a platform in the vicinity of Cave site 76F and describes it as follows:

> The platform stands nearly 4 feet high next to a trail of large boulders.... The mound is a large pile of stones at first glance but proved to have definite boundaries. There were observed several steps or ter-

races of stone as part of this platform. We neglected to take further measurements or take more detailed notes. The site is probably the heiau called Kamaloula after the area name. (Kikuchi 1963:54).

The source of the name is the Lahainaluna Schools Manuscript:

> Located at Kamaloula, that was the site of Makea's house (female). This heiau was built for the purpose of multiplying food plants. (Lahainaluna Schools Manuscript 1885 HMS#43)

Although Kikuchi's location is somewhat at variance, this feature appears to match the description of Site 51. The large platform (heiau) on the north (mauka) side of the settling pond.

Palama and Stauder, 1973

The next archaeological investigation within the project area was conducted by Stephen Palama and Catherine Stauder. This was an archaeological survey along the route of the then proposed main cane haul road which presently traverses the study area from east to west. The proposed new section of road extended from Weliweli Road southwestward across Poipu Road connecting to an existing cane haul road. The section within the present survey area west of Poipu Road is approximately 3,000 feet long with a proposed north/south branch approximately 1,500 feet long. A total of 18 sites were recorded along the road corridor and nine of these were located within the present study area. Condensed descriptions taken from Palama and Stauder (1973:27-28) and correlations to the present survey results are presented as follows:

Palama and Stauder Sites Sites	Description	Correlation to Present Survey
3173	Remnant of old wall	Not found - destroyed since 1923
3174	Monument/Platform burial	Not found - destroyed by bulldozing for beehives
3175	Wall remnant	Not found - destroyed by bulldozing since 1973
3176	Rectangular House enclosure	Not found - destroyed by bulldozing for settling pond since 1973
3177	Disturbed house platform	Not found - destroyed by bulldozing for settling pond since 1973
3178	crude walled enclosures (pen)	not found, probably destroyed by cane haul road construction since 1973.
3179	Dwelling Cave	found, cave site 19 on north side of cane road
3180	Dwelling Cave	not found, covered by cane haul road since 1973
3181	Agricultural area	not found, covered by cane haul road since 1973

Only one of the 2 dwelling cave sites ultimately survived the construction of the cane haul road and the bulldozing which occurred along its periphery. The other dwelling cave (3180) probably lies directly under the south side of the road and may have been collapsed by heavy machinery.

Although the Palama and Stauder study was limited in scope to the proposed road right of way, there is a short but thorough historical summary and a penetrating grasp of the place of archaeology sites within the context of the Kōloa Ahupua'a. An extensive auwai system was observed east of Poipu Road and the general comments on this system and the sites in general are very relevant to the archaeological significance of the area as a whole and the historic processes at work.

> Our reconnaissance revealed that the most significant archaeological feature located within the study area is the extensive auwai system. Remnants of this irrigation system were observed on both sides of the Waikomo Stream. As we mentioned above, this network of watering canals proved to be the key to the success of the prehistoric Hawaiian Culture in turning these marginal lands into flourishing wet and dry agricultural fields. From information gathered from local informants and preliminary historical investigation of this area it is evident that the early commercial growers of sugar cane utilized the existing auwai system. Gradually as more and more fields came under sugar cane production these replaced the wet and dry fields of an earlier day. Today the archaeological sites remaining stand as islands as these marginal cane lands were taken out of production and turned into pasture (Palama and Stauder 1973:-4).

Hammatt et al. 1978, The Kīahuna Complex

In 1978 Hammatt, Bordner and Tuggle prepared a survey report on 460 acres for the then proposed Kīahuna Golf Village. This parcel is located on the east side of Waikomo Stream and Poipu Road. The survey results are of direct relevance to the present project not only because it was located within the same ahupua'a but also because similar kinds of features indicate that the same land use patterns occurred in the present survey area.

The Kīahuna survey recorded 583 archaeological sites including 175 stone enclosures and 108 stone house platforms, some of

which are clustered as family compounds. The water channels (auwai) ponded fields, terrace plots, and mound fields all indicate extensive wet and dry land agriculture (Hammatt et al. 1978:5). The water source for this highly integrated agricultural system was Waikomo Stream which was tapped up stream. Additional sites included 10 occupation caves and a heiau.

Although there was some bulldozing for pasture roads and construction of cattle walls in more recent times, the prehistoric Hawaiian complex was relatively intact. The land was used by the Knudsen family for cattle grazing, but was never under sugar cultivation, except along the flood plain of Waikomo Stream. The main auwai is intact as well as side branches and all are highly visible. The routes of former irrigation channels could be traced clearly through individual fields. Special features such as raised (aqueducted) auwai and tunnelled auwai were noted and all were well preserved. In many areas, except for minor disturbance by grazing cattle, the auwai and fields were so intact as to appear only recently abandoned.

This picture of the Kīahuna complex and its high degree of preservation is in sharp contrast to the present study area. Both areas were probably equally as heavily inhabited and used for intensive irrigated Hawaiian agriculture. However, the Kukuiula study area the last hundred years or so has seen heavy land modification which has destroyed many sites. Even areas presently in pasture were formerly under cane cultivation and the process of field clearing described elsewhere resulted in the survival of mere remnants of former sites. There are few areas with surviving integrated field complexes and the auwai are generally truncated by existing cane fields or former cane fields.

Hammatt recommendations included preservation of 5 separate areas of the best preserved feature complexes with salvage excavations within the areas not designated for preservation (*Ibid*. 1978:6). As of 1988 these 5 areas have been saved and the archaeological sites within 4 of these remain intact. Salvage excavations were undertaken, but a final report was never generated. Unfortunately there is little or no quantitative information on the development and age of the Kīahuna complex. The rocky lands of Kōloa were modified for irrigated agriculture almost certainly in the late prehistoric period and fields continued in use into the early historic era for sweet potatoes and yams until the demands of expanding sugar cultivation overshadowed other agricultural pursuits in the latter half of the 19th Century.

Jim Landrum, 1984

In 1984 the Bishop Museum conducted an archaeological reconnaissance for Alexander and Baldwin of the *makai* and eastern portion of the present study area and included most non-cultivated lands *makai* of the McBryde Cane Haul Road and east of Kukuiula Bay to Poipu Road. The walk through was conducted over a period of 5 days. The survey results consist of brief descriptions of 37 feature areas (Fig. 8) which are designated by shaded

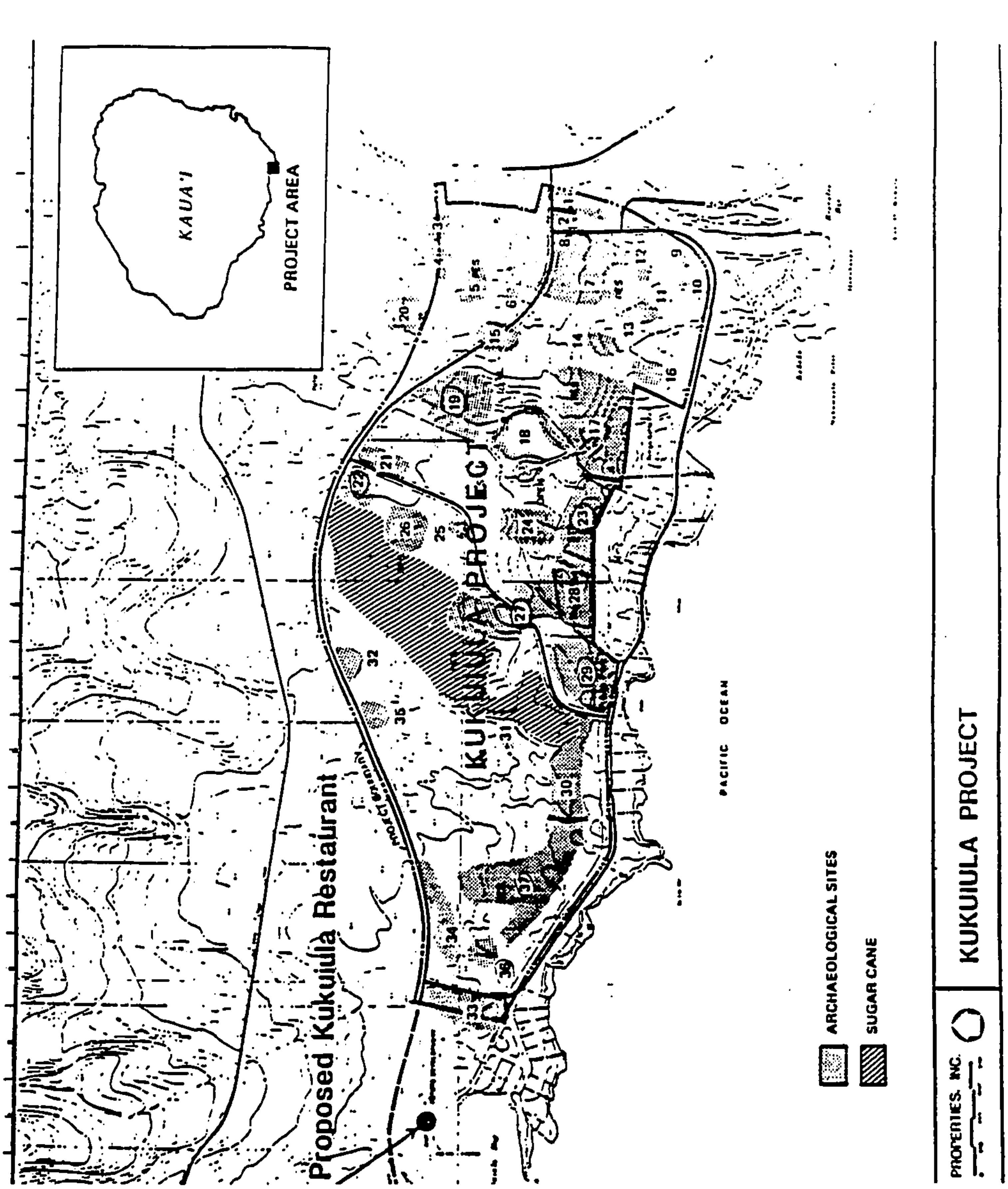

Fig. 8 Bishop Museum Archaeological map Showing Shaded Site Areas (From Landrum 1984:2).

areas on the project map (Landrum 1984:2). The feature area descriptions are condensed as follows with correlation to sites and complexes found during the present survey.

Landrum Feature Area	Description	Correlation to Present Survey
1	Terrace with historic glass and shards	Site 49 area
2	Alignments, walls, platform	Site 44 area
3	large boulder out-cropping	Site 49 area
4	large boulder out-cropping	field piles (Sheet 1)
5	large boulder out-croppings, walls	field piles (Sheet 2) and <u>lo'i</u> walls
6	L-shaped wall with	field piles
7	<u>Lo'i</u> and <u>auwai</u> some historic material	Site 49 area
8	early historic habitation with platform	Site 49B
9	dirt berm, alignment historic materials	not found, adjacent to Poipu Road, probably bulldozed
10	walled enclosure	not found, probably bulldozed, adjacent to Poipu Road
11	boulder outcropping platforms	field piles Sheet 2
12	boulder wall remnant and mound	Site 48A,B
13	large boulder out-cropping <u>auwai</u>	<u>auwai</u> west of Site 49, field piles

Landrum Feature Area	Description	Correlation to Present Survey
14	large boulder out-cropping, large C-shape <u>auwai</u>	field piles same <u>auwai</u> as above
15	large boulder out-croppings, <u>auwai</u>	possibly Site 26
16	paved area and a terrace	located on map part of Prince Kuhio Park Complex, historic, possibly modern in age
17	extensive complex <u>mauka</u> of Prince Kuhio Park	Sites 46, 47, 38, 40
18	Settling pond area, <u>heiau</u>	Site 51
19	agricultural complex, walls, <u>auwai</u>	Site 28
20	terraces	Site 26
21	outcrop	field pile Sheet 1
22	platform and terrace, <u>auwai</u>	field piles with <u>auwai</u>, possibly part of Site 29
23	habitation, <u>auwai</u>, walls, mounds	Sites 41,43
24	large platform, possibly burials	Site 34
25	sink hole	Site 29, Feature F
26	agricultural complex	Site 29
27	extensive agricultural habitation complex	Site 32
28	enclosure, L-shape, mounds, terraces, brackish water pond	Sites 41, 42, 43
29	<u>auwai</u> built of slabs agricultural features	Sites 33, 44
30	enclosures, terraces	Sites 52, 53

Landrum Feature Area	Description	Correlation to Present Survey
31	3 platforms and a terrace	Site 54
32	cave shelters	Site 31
33	historic debris scatter volcanic glass	Not found, located in present cane area, "volcanic glass" is cone slag
34	small platform under barbed wire	probably Site 55, or not found
35	large sink hole with platform remnant	Site 58
36	extensive agricultural/ habitation complex, 3 cairns	Site 57 (Landrum has his site area mislocated
37	agricultural and habitation features	Site 56

Landrum's report and feature area map was actively used during the present survey field work. An effort was made to relocate the features he described. In some cases, his features were reidentified as field clearance piles. This turned out to be a matter of judgement based on the perspective of viewing cane field/pasture boundaries and the immense rock piling efforts involved in rock clearing by the sugar planters. In our judgement stone piles with large rocks which could only have been moved by mechanical equipment were field piles. Piles of smaller rocks which stretch along the edges of cane fields are identified as hand clearing piles by virtue of their occurrence on the edges of fields. Many of these have level paved areas, curved alignments

and even rough platform like features which in our judgement was creation of deliberate sorting for intended reuse of the rocks for walls, berms, etc. Clearly, many archaeological sites were dismantled to make these piles and the midden and coral mentioned by Landrum on these piles were probably transported with the rocks. To summarize Landrum's report, he recognized that his survey area was once part of an extensive irrigated agricultural complex developed in the prehistoric period with superimposed historic era occupation (Landrum 1984:24). His brief sketch of the historic background includes 2 early maps, one of which is entitled the "Loi Lands of Kōloa." These maps show Land Court Awards for <u>lo'i</u> lands predictably clustered by Waikomo Stream and major <u>auwai</u> (<u>Ibid</u>. 1984:5-6).

<u>Hammatt et al. 1985</u>

Hammatt et al. conducted a survey with subsurface testing for the proposed Kōloa - Poipu Bypass Road which extends 9,000 feet along the boundary of Kōloa and Weliweli Ahupua'a. The road corridor is to connect Poipu Road (the beach road) to Weliweli Road, southeast of Kōloa Town. A total of 47 archaeological features were located along the corridor. These were concentrated at the <u>makai</u> end and include the western end of the "Kīahuna Complex" documented by Hammatt et al. in 1978. The C-shaped shelters and enclosures were test excavated with the recovery of minuscule amounts of midden, a few opaque specimens of volcanic glass and some basalt flakes and historic materials. Cultural layers within an around the structures were discontinuous and thin, but two features contained small buried lenses from which charcoal was collected. Although the charcoal samples were not dated the mixture of historic materials appear to indicate a post-contact age for the sites (Hammatt et al. 1985).

V. SURVEY METHODS

Mapping

Field work for this project was conducted over a period of 20 work days from March 2 through March 31, with a survey team of 3-5 archaeologists. R. M. Towill provided seven sheets of one inch = 50 feet orthophoto topographic maps. These seven sheets provided coverage of all lands within the project area not currently planted in cane. Naturally the vast majority of sites were located within these areas. Scaled maps of the sites were placed on the 1" = 50 foot sheets. There were four sites (Sites 1-4) which were located within uncultivated gullies, ridges or rocky "islands" surrounded by cane. These were located on the 1 inch = 400 foot topographic map and aerial photograph of the entire project area. In all cases the sites were mapped in their actual configuration and not simply as dots. Because of the large size of the 1 inch = 50 foot sheets (4-5 feet square) and for purposes of report production the site drawings were all transferred to the 1 inch = 400 foot topographic map. However, the originals of the larger field sheets are available for further field studies.

Survey Coverage

Although the vast bulk of the survey time was spent in the uncultivated pasture lands in the east and southeast portion of the project area, all areas not presently in cane were inspected including uncultivated gullies and ridges and the sloping hill-sides in the mauka portion of the project area which were formerly in pineapple cultivation (plow ridges and field plastic are still visible). Of particular concern were the ten or more rocky "islands" - small isolated areas in the middle of cane fields which were used for stockpiling large field boulders. All of these were carefully inspected with the thought in mind that pre-existing rock structures (archaeological sites) may have been chosen by sugar planters as easy places to pile more rock from the fields. Generally, these proved to be amorphous rock piles with no indication of underlying archaeological structures. However, in one exceptional case a large heiau was discovered partly buried under piled field boulders (Site 4).

Survey archaeologists were spaced 50-100 feet apart in the pasture land areas depending on vegetation. Generally, the ground surface was visible under the grass cover, especially where there are thin soils over bedrock. Cattle grazing was also an advantage in creating visibility. Major features, such as auwai, walls and larger rock structures, were visible on the 1 inch = 400 foot scale aerial photograph. Many sites were found, however, under a thick canopy of Koa haole. These trees comprised reliable vegetation markers for archaeological features in the pasture area because they designate less disturbed rocky, well drained portions of the landscape.

The gullies, ridges and rocky "islands" in the cane lands were covered first (3 days) and the remaining field time was spent on the large expanses of pasture land. Each of the seven 1

inch = 50 foot orthosheets was surveyed as a distinct survey unit. The mauka areas were covered first (Sheet 4), then the southeast (Sheets 1, 2, 3, 5), and finally the southwest (Sheets 6 & 7).

The areas presently planted in sugar cane were not surveyed, mainly because a surface inspection would be of little benefit. The question remains whether archaeological sites lie buried beneath the surface of the fields. In our judgement, we believe this is not the case. The archaeological features in the non cane areas are invariably less than 2-3 feet deep and many are actually built up on the ground surface. Soil profiles on the edges of cane fields show plow zones 3-4 feet deep and even deeper in areas where slope wash has accumulated. Some of these fields have been cultivated continuously for 140 years. If one assumes a deep plowing every 15 months, these fields would have been plowed over 100 times. The likelihood of archaeological sites surviving is virtually nil. The large rock piles on the edges of fields are evidence of complete clearing of the fields. This process would have systematically destroyed archaeological sites even before plowing. Also no sites were recorded in abandoned fields now given over to pasture. This further reinforces our belief in the absence of archaeological potential within the present fields.

Survey Recording

When an archaeological feature was found in the survey sweep the following routine was used:

1. The site was located on the large orthosheet and mapped to scale. Site location was made easier because landmarks (trees, etc.) were visible on the aerial photo.
2. The site was described verbally in a field notebook, including sketches of configuration and internal features and mention of related nearby sites. Condition of site, probable function, scientific potential; internal and external dimensions and special characteristics were also recorded.
3. Photographs were taken of almost all sites.
4. A survey flag was placed at the site with the site and feature number marked on it. A second flag was marked and placed under a rock nearby to designate the site datum and provide a more permanent site marker.
5. In cases of large, complex or particularly significant sites a scale map was prepared in addition to that placed on the orthosheet. Mapping was done by compass triangulation or compass and tape.
6. The 11 X 17 inch archaeological site complex maps included in this report were compiled from the 1 inch = 5- foot orthosheets supplemented by the field book sketches and scaled drawings.

It is worthy of note that the field mark for the present project was aided by the information gathered in a 1984 Bishop Museum Reconnaissance survey of the makai area (Landrum 1984).

Site areas defined and briefly described by Landrum could be correlated to sites found in the present survey. It should be pointed out that the Bishop Museum team walked the property during Hawaii's worst recorded drought. Conditions of ground visibility would have been far superior to those experienced during the fairly wet spring of 1988. In spite of this and partly because of the quality of the aerial photography we are confident of the completeness of the present survey coverage.

There is an additional point of direct relevance to the present survey and interpretations of rock features which comprise the Hawaiian cultural landscape. This area of Kaua'i is one of the earliest placed in cane cultivation (1840's). From these early beginnings of plantation agriculture, particularly in the geologically "young" makai portion of Kōloa, tremendous labor was invested in clearing rocks from fields. Much of this work was done by hand. The fenced boundaries between the cane fields and the pasture were the dumping places for these rocks. Some were piled in a fairly orderly fashion creating well sorted piles which, to the untrained eye, have the appearance of archaeological sites. It was only after seeing many such piles and observing their location bordering cane fields that their origin became evident. After this point it was a fairly easy matter to distinguish field piles from remnant archaeological sites. For the matter of record, the large and more expansive piles were marked on the field maps as "field piles" or "rock piles."

Why would early sugar planters invest such labor to clear rocky land for cultivation? The answer lies in the traditional Hawaiian use of the land for taro lo'i. A complex irrigation network tapped from Waikomo Stream was already in place.

One major site - Niu Kapukapu Heiau - is located on the survey map even though it is outside the present northwestern boundary of the survey area. Because of the importance of this site, particularly in the context of the Site 4 heiau makai along the same ridge line, the site location is included in this report. The heiau was inspected by the survey team, but no notes or drawings were made.

The 1963 U.S.G.S. map (Fig. 3) of the area shows Kukuiula Camp or Camp No. 18 as a cluster of at least 34 buildings mauka of Kukuiula Bay. This was a sizable plantation camp. It was demolished after 1963 and today most of the area is planted in cane. The only remains of the camp are a few concrete pads along the edge of Aepo Stream.

VI. SITE DESCRIPTIONS

Site 1

Site 1 is an auwai remnant situated some 800 ft. (243.84 m.) makai of Aepoeha Reservoir on the eastern slope of Aepo/Kukuiula Valley. The auwai is discontinuous, but can be traced for approximately 1,150 ft (350 m.). The remnant sections range from just a relatively indistinct soil trough to stone lined sections. Discernable sections range from 3 to 4 ft. (.914 to 1.219 m.) wide and 1 to 2 feet (.305 to .610 m.) deep. A few sections incorporate large boulders into their wall, possibly indicating historic modification. The 1890's territorial Map (Fig. 5) shows rice cultivation in the area of this auwai, suggesting its use during historic times.

Site 2

Site 2 is an auwai remnant situated on the makai (southern) end of a brush covered ridge makai (south) of Manuhonuhonu Reservoir. The auwai is discontinuous, but traceable for approximately 400 ft (121.9 m.). The distinct sections have mostly a cut bank upslope side with soil and stone lining for the downslope embankment. The auwai averages 3 ft (.914 m) wide and 1 to 2 ft (.305 to .610m.) deep in the more defined sections. There are also a few indistinct agricultural rock clearance mounds on the downslope side of the auwai. The auwai is possibly prehistoric, but more likely it is related to early commercial cane cultivation. Presently Site 2 area is a "peninsula" into cultivated cane fields.

Site 3 (Fig 9)

Site 3 is a possible heiau structure which has been impacted by cane field bulldozer clearing and the growth of three large banyan trees. The remaining structure is a maximum of 80 ft. (24.38 m.) wide NE/SW by 300 ft. (91.44 m.) long NW/SE. It consists of five (5) terrace levels that share a virtually continuous, mostly undisturbed, boulder faced slope (which ranges in height from 3 to 10 ft or .914 to 3.048 m. South to North) on the eastern side. The western side of the structure has been the most impacted by can field bulldozing. This includes positing of large boulders and soil onto the structure. Presently a cane field road runs down the western side of Site 3.

Level 1, the makai (southern) most level, measures approximately 25 by 40 ft (7.62 to 12.192 m.) and has a relatively level boulder/cobble paving. There is a boulder alignment, 10 ft. (3.048 m.) long, 2 ft (.610 m.) wide, that creates a 2 ft (.610 m.) high facing in the northern portion of this level. There is also, a 2.5 ft (.762 m.) in diameter by 1.5 ft. (.457 m.) deep, stone lined depression and two possible post holes on Level 1.

Level 2, measures 30 ft (9.144 m.) by 50 ft. (15.24 m.) and has a sloping (to east) boulder paved surface. Again, the western side of this level is heavily impacted by bulldozer push. The eastern faced slope has two separate alignments, one for retaining the terrace surface, the other at the bottom of the slope, retaining the faced slope. Also there is a stone lined

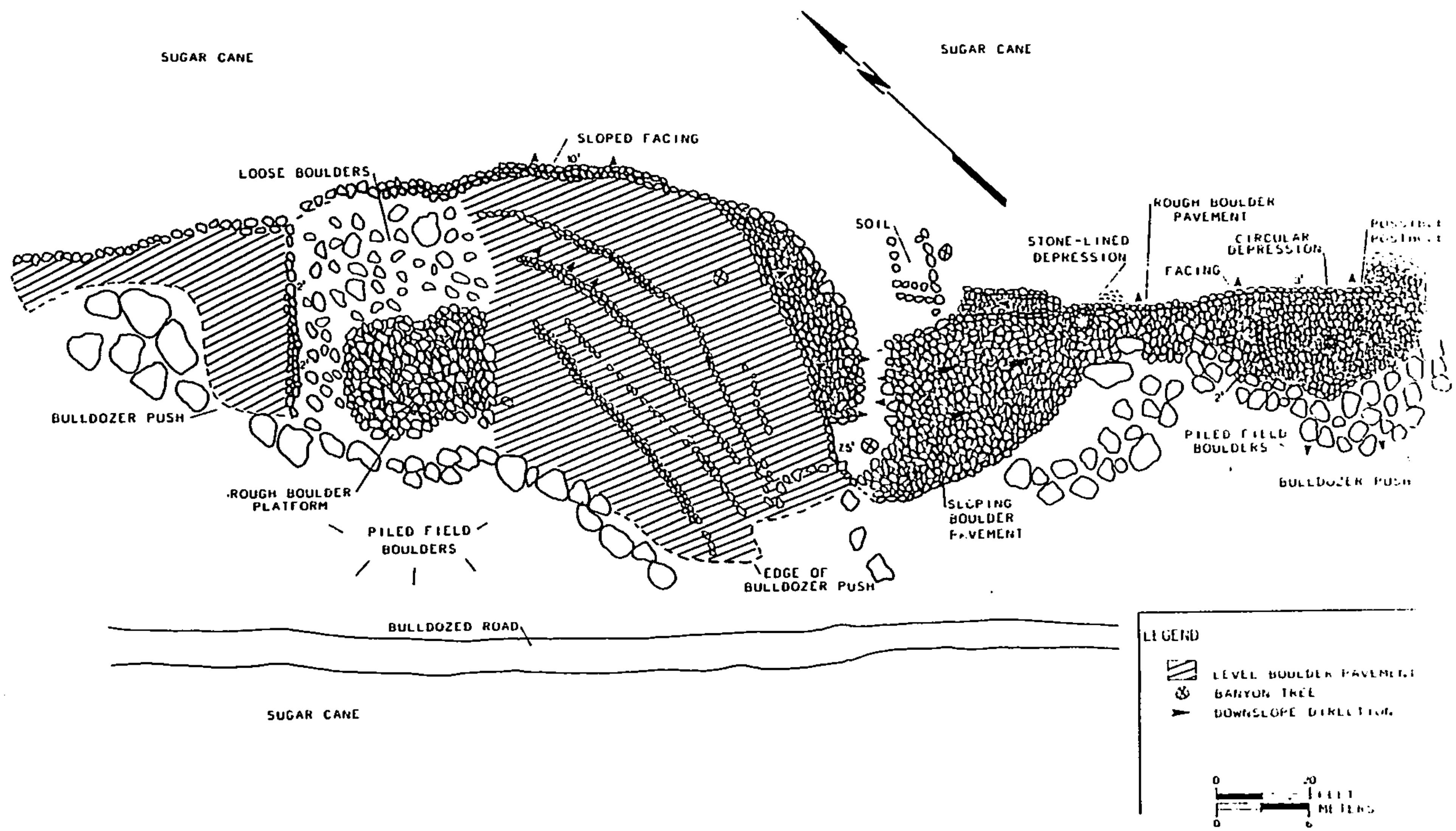

Fig 9 Site 3 <u>Heiau</u> Plan View

Fig. 10 Heiau, Site 3, Showing Third Level View Southwest.

Fig. 11 Heiau, Site 3, Showing Level 5, Partially Buried by Field Boulders, View to North.

depression 3 ft (.914 m.) in diameter by 1.5 ft. (.457 m.) deep in the SE portion of Level 2.

Level 3 (Fig. 10) is the largest, most complex level, and includes four distinct, internal alignments. The maximum dimensions of this level are 70 ft (21.336 m.) E/W by 100 ft (30.48 m.) N/S and it is 7 to 10 ft (2.134 to 3.048 m.) higher than the makai levels (1 and 2). The alignments are boulder construction and appear like separate construction phases. The alignments, which are separated by level cobble pavings, are 3 to 4 ft (.914 to 1.219 m.) wide and 1 to 1.5 ft (.305 to .457 m.) high, but are also visibly discrete as alignments, extending downward into the structure. Another unusual aspect of these alignments is that they are curved. At the SW corner of this level is a roughly 10 ft (3.048 m) square, possible pit feature. The pit feature somewhat separates levels 2 and 3, but a large banyan tree is growing out of the probable pit and it has heavily impacted the feature. Level 4 measures 40 ft (12.192 m.) NW/SE by 50 ft (15.24 m.) NE/SW and has a sloping boulder paved surface on the western side (20 ft. or 6.096 m. NE/SW by 40 ft or 12.192 m. NW/SE) with an uneven boulder surface on the eastern side. Level 4 is separated from level 5 by a 2 ft (.610 m.) high stacked boulder facing.

Level 5 (Fig. 11) has been partially buried by large bulldozer pushed boulders, especially the NW portion. Presently the paved area of level 5 is roughly L-shaped, measuring 35 ft (10.668 m.) NE/SW by 60 ft (18.288 m.) NW/SE with the paving

being a cobble boulder mix.

This possible heiau is situated some 2,300 ft (701.04 m.) makai (south) of Niu Kapukapu Heiau (Bennett Site 72, Bennett 1931:117), but there is no reference to it by W.C. Bennett. Presently Site 3 appears as an "island" of dense vegetation within the cultivated cane fields. Upon first observation, especially from the western side, it appears to be just a large bulldozer pushed rock pile and this may account for its apparently unrecorded status.

Site 4

This is a probable site remnant, located some 400 ft (121.92 m.) makai (south) of Site 3 and like Site 3, it appears as an "island" of dense vegetation within the cane fields. Presently Site 4 appears as an approximately 100 ft (30.48 m.) in diameter large boulder pile. There is a barely discernable curved alignment 40 ft. (12.192 m.) long E/W by 3 to 4 ft (.914 to 1.219 m.) wide and 1 ft (.305 m.) high on the makai (south) side which may have been a retaining wall or enclosure wall. However, the entire perimeter and portions of the interior have been impacted by bulldozing for cane field clearing. No paved or leveled areas were observed on this boulder pile and excavation potential appears poor.

Site 5

Site 5 is two adjacent probable habitation platforms, located in the north central portion of Sheet 4. The platforms are situated in a relatively densely vegetated area, but cane fields are within 30 ft (9.144 m) both to the north and south.

The larger platform (#5) is roughly rectangular in shape and measures a maximum of 20 ft (6.096 m.) N/S by 25 ft (7.62 m.) E/W and 2 ft (.610 m.) high. It is constructed of stacked boulders with mounded facings and an uneven boulder surface. Two pieces of shell midden were observed and excavation potential appears fair to poor.

The other platform (5A), located 25 ft (7.62 m.) to the east of #5, is 20 ft (6.096 m.) square and a maximum of 1.5 ft (.457 m.) high. It is constructed mainly of boulders, but has a cobble/pebble paving in the NE portion of the platform surface. No midden or artifacts were observed and like the other platform, excavation potential appears fair to poor.

Site 6 (Fig. 12)

This site is a complex of probable habitation and associated agricultural features. Site 76 is located in the NE portion of Sheet 4 with the main habitation feature situated at the _makai_ (southern) end of an exposed pahoehoe bedrock outcrop. Features associated with Site 6 include an _auwai_, large, probable _lo'i_ type fields, a smaller walled field, three probable habitation enclosures and a probable habitation terrace.

The _auwai_ is traceable for approximately 900 ft (274.32 m.), and is oriented NW to SE. It ranges in width from 2 to 4 ft

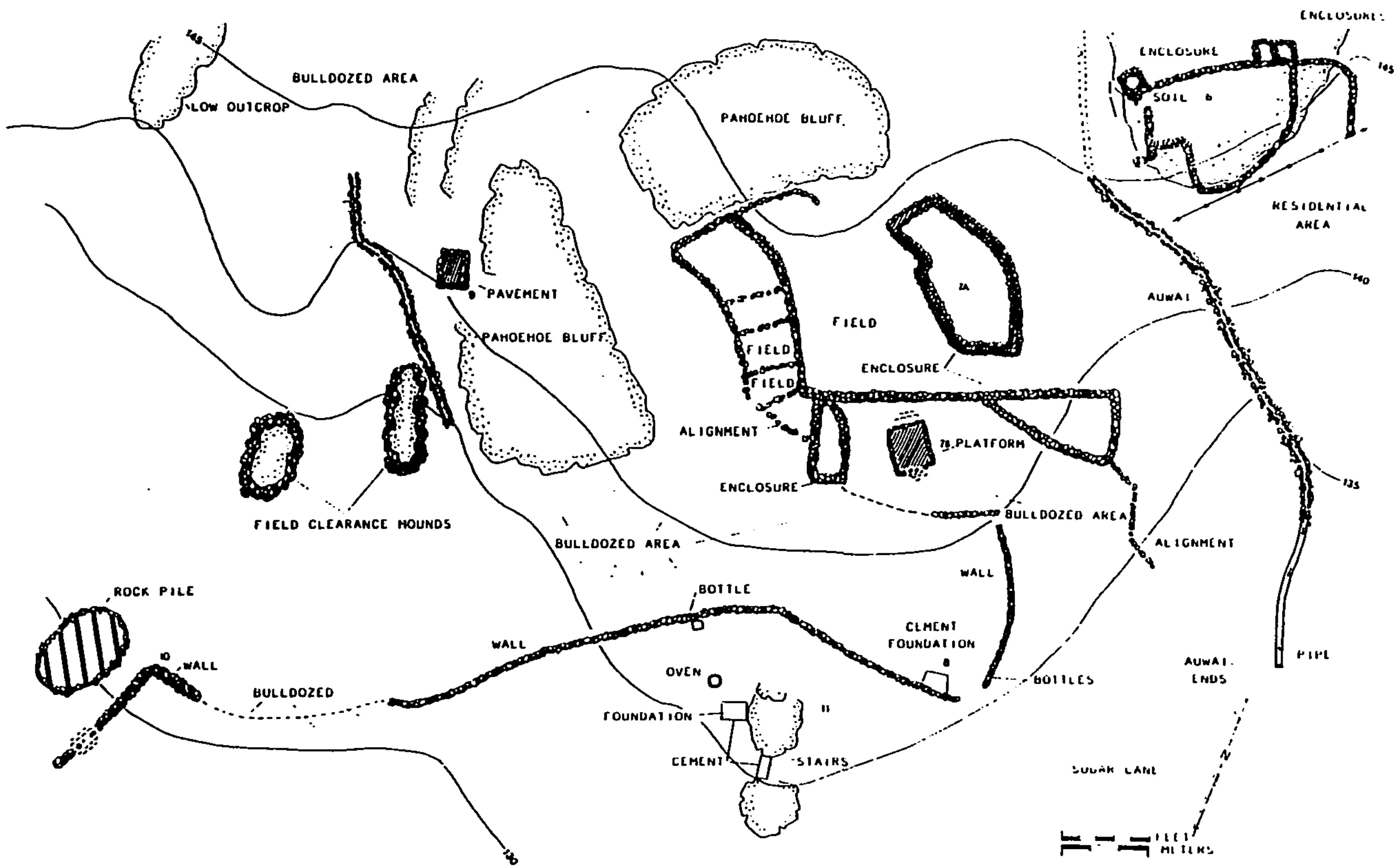

Fig 12 Sites 6-11, Plan View. (Map Sheet 4)

(.610 to 1.219 m.), and in depth from 1 to 2 ft (.305 to .610 m.). For most of its observable course it has soil embankments with short sections of rocky sides and interior, indicating that it was, at least in part, stone lined at one time. The auwai was used during historic times as a metal water pipe replaces the soil ditch where it exits the project area to go under Poipu Rd. However, the large lo'i type walls, (mounded soil embankments with a central boulder course), located to the SW of the auwai suggest a traditionally used auwai, for taro cultivation, which was then used during historic times, probably for cane. The auwai and the mounded field walls are in relatively poor condition, especially the walls. This is probably due to bulldozing for pasture land and possibly use of this area for cane cultivation.

The main feature of Site 6 is the probable habitation terrace with three adjoining enclosures and a walled field. The terrace has a back or mauka wall that is 120 ft (36.58 m.) long, oriented NE/SW, and ranges in height and width from 2 to 4 ft (.610 to 1.219 m.), and is constructed of stacked boulders. The terrace on the makai side of the wall is roughly L-shaped with maximum dimensions of 45 ft (13.716 m.) NW/SE by 80 ft (24.384 m.) NE/SW. The southeastern side of the terrace is defined by a well-faced (3 ft or .914 m. high) stacked boulder retaining wall 3 feet wide. The surface of the terrace is mostly boulder paving with some exposed bedrock and soil sections. The three probable habitation enclosures are incorporated in the mauka side of the

back wall. The most intact enclosure is situated at the SW end of the back wall (within 20 ft or 6.096 m. of the auwai) and measures 8 ft (2.437 m.) square with vertical stacked boulder walls 3 ft (.914 m.) high and 2 to 4 ft (.610 to 1.219 m.) thick. The other two enclosures are adjoining features near the central section of the back wall. They are in poor, mostly collapsed condition, but are also roughly 8 ft (2.437 m.) square. Adjoining the NE end of the main back wall is a probable agricultural field, with a soil area of 75 ft (22.86 m.) to 35 ft (10.668 m.). The SW and NE walls are 2 to 3 ft (.610 to .914 m.) in height and width, with some core filled sections and a lower course of upright boulders. This agricultural field was probably an enclosed feature, but existing house structures, on the edge of the project area, have destroyed a portion of the walls. There were a few historic artifacts observed (bottle glass, a metal pot, plastics) which were obviously modern refuse from the houses and businesses along the project boundary. No traditional type midden or artifacts were observed and excavation potential appears fair.

Site 7 (Fig. 12)

Site 7 is a complex of agricultural and probable habitation features located in the NE portion of Sheet 4. The agricultural features include walls, fields and enclosed fields. The probable habitation features include a platform and a C-shaped structure.

The best defined agricultural feature (#7A) is a roughly

oval enclosure measuring 45 ft (13.716 m.) NE/SW by 90 ft (27.432
m.) NW/SE. The walls range in height from 3 to 4.5 feet (.914 to
1.372 m.) and are up to 6 ft (1.829 m.) wide, mostly core filled,
with a lower course of upright boulders on the interior. The in-
terior is level soil, virtually rock free. Other agricultural
features included, four adjoining walled fields, a stacked boul-
der wall, and a mounded wall. The enclosed (walled) fields are
built off of the stacked boulder wall which forms the north and
northeast walls of these agricultural features. The stacked
boulder wall ranges in height and width from 2 to 4 ft (.610 to
1.219 m.). The enclosures range in size from 15 by 20 ft (4.572
to 6.096 m.) to 30 by 50 ft (9.144 by 15.24 m.). The largest of
these enclosures (35 by 50 ft or 9.144 by 15.24 m.) has a natur-
ally broken-up columnar type pahoehoe bedrock interior with the
other enclosures having mostly soil interiors. The mounded wall
is presently L-shaped running 40 ft (12.192 m.) NE/SW by 90 ft
(27.432 m.) NW/SE, ranges in height from 2.5 to 4.5 ft (.762 to
1.372 m.) and in width from 3 to 6 ft (.914 to 1.829 m.). However
this wall, like the surrounding area, has been impacted by bull-
dozing, which has pushed the wall down in some places and piled
debris on it in others. The mounded wall suggests lo'i type ag-
riculture (ponded taro), like that suggested for Site 6 area (and
its associated auwai), was continuous through the Site 7 area.

Site 7B is roughly rectangular, a probable habitation plat-
form situated on a low pahoehoe bedrock outcrop. The platform
measures 21 ft. (6.401 m.) NE/SW by 25 ft (7.62 m.) NW/SE and has

a relatively level boulder/cobble surface. The SE and NE sides
have collapsed facings 1 to 2 ft (.305 to .610 m.) in height with
the NE side in the best condition. The NW and SW sides of the
platform are nearly level to the bedrock surface. No midden or
artifacts were observed and excavation potential appears fair to
poor.

Site 7C is a C-shape type structure with external measure-
ments of 15 ft (4.572 m.) NW/SE by 15 ft (4.572 m.) NE/SW and
interior dimensions of 5 ft (1.524 m.) NW/SE by 6 ft (1.829 m.)
NE/SW. The C-shaped shelter wall is mostly collapsed and is
presently a maximum of 2 ft (.610 m.) high, with the back wall
(NE) being 5 ft (1.524 m.) thick. The interior is mostly soil
though the C-shaped structure is built on a low bedrock outcrop.
No midden or artifacts were observed and excavation potential
appears fair.

Site 8 (Fig. 12)

Site 8, located in the eastern central portion of Sheet 4,
is two adjacent cement slabs and a scatter of associated historic
artifacts. The slabs probably supported small wood frame struc-
tures. The surface scatter of artifacts has been impacted by
bulldozing, but observed bottles suggest an age range of late
19th to early 20th Century. Excavation potential for recovery of
historic materials appears fair to good.

Site 9 (Fig. 12)

Site 9, located in the eastern central portion of sheet 4, is a probable habitation pavement situated in a pahoehoe bedrock boulder outcrop. The boulder and cobble pavement, which is fairly level, measures 16 ft (4.877 m.) E/W by 20 ft (6.096 m.) N/S. The east and west sides of the pavement are delineated by low stacked boulder alignments, which are 1 to 2 ft (.305 to .610 m.) high and a maximum of 2.5 ft (.762 m.) wide. Incorporated into the eastern alignment is a 2 by 3 ft (.610 by .914 m.) upright boulder. No midden or artifacts were observed and excavation potential appears poor.

Site 10 (Fig. 12)

Site 10, located in the eastern central portion of Sheet 4, is a surface scatter of historics and a large L-shaped wall section. The historic artifact scatter is situated in a boulder outcrop under a large banyan tree. The old bottles observed suggest early 20th Century manufacture. The L-shaped wall remnant, measures 32 ft (9.754 m) E/W by 77 ft (23.47 m.) N/S, and ranges in height and width from 2 to 4 ft (.610 to 1.219 m.). Most of the wall is stacked boulder construction, but some sections are core filled. The wall appears to have been an agricultural field wall (core filled sections) that had been historically modified, in association with possibly early 20th Century occupation, and impacted again by modern sugar cane cultivation activities. Excavation potential appears poor.

Site 11 (Fig. 12, 13, 14)

Site 11, located in the eastern central portion of Sheet 4, is a historic house site, consisting of a basalt and mortar stairway, brick and mortar oven, and cement slabs. This house site area, under a canopy of large banyan trees, is bounded on the west, south, and east sides by a cane field road and on the north side by a stacked boulder wall and wire fence.

The stairway (Fig. 13) is 8 ft (1.438 m.) wide and 4 ft (1.219 m.) high and probably led up to a large elevated wood frame house. The oven (Fig. 14), some 40 ft (12.192 m.) to the NW from the stairs, is 6 ft (1.829 m.) in diameter by 5 ft (1.524 m.) high and is dome shaped. The inside of this "Portuguese Oven" is lined with fire bricks and the outside is basalt boulders and mortar. The slabs probably supported wood frame structures, the larger one (10 by 15 ft or 3.048 by 4.572 m.), has a hole in it and may have been the outhouse. There is plentiful historic refuse lying around, with some obvious modern materials (Budweiser bottles, etc.), but for the most part older materials dominate.

The house site (11) is probably associated with Site 8 to the east and Site 10 to the west. These sites (8, 10, 11) indicate an intensive historic use (probably late 19th to early 20th Century) of the area which probably relates to early sugar cane cultivation. The excavation potential for recovery of historic materials appears good to excellent.

Fig. 13 Site 11, Historic House, Showing Stairway View to North.

Fig. 14 Site 11, Bread Oven, View to Northwest.

Site 12 (Fig. 15)

Site 12, located in the southeast central portion of Sheet 4, is a complex of agriculturally related walls and an enclosure. The walls range in height from 1.5 to 2.5 ft (.457 to .762 m.) and in width from 2.5 to 4 ft (.762 to 1.219 m.). Most of the walls show evidence of being core filled, though some just have the lower course of stones left. The enclosure is a well-defined agricultural field 50 ft (15.24 m.) N/S by 80 ft (24.384 m.) E/W with a soil interior.

The fields associated with these core filled walls were presumably enclosed fields, but bulldozing for pasture and cane cultivation have severely altered the area. A few historics (bottle glass and ceramics) were observed and the walls are under a canopy of Mango, Banyan and Java Plum trees with a few coffee trees present also. No traditional midden or artifacts were observed.

Site 13 (Fig. 15)

Site 13, located in the southeastern portion of Sheet 4, is a probable habitation platform. It is rectangular in shape, measures 22 ft (6.706 m.) NW/SE by 26 ft (7.925 m.) NE/SW and is a maximum of 2 ft (.610 m.) high. The platform is faced on all four sides, but the best facing is on the southeast side. The surface of the platform is a boulder paved with some large loose boulders apparently historically piled on it. No midden or artifacts were observed and excavation potential seems fair.

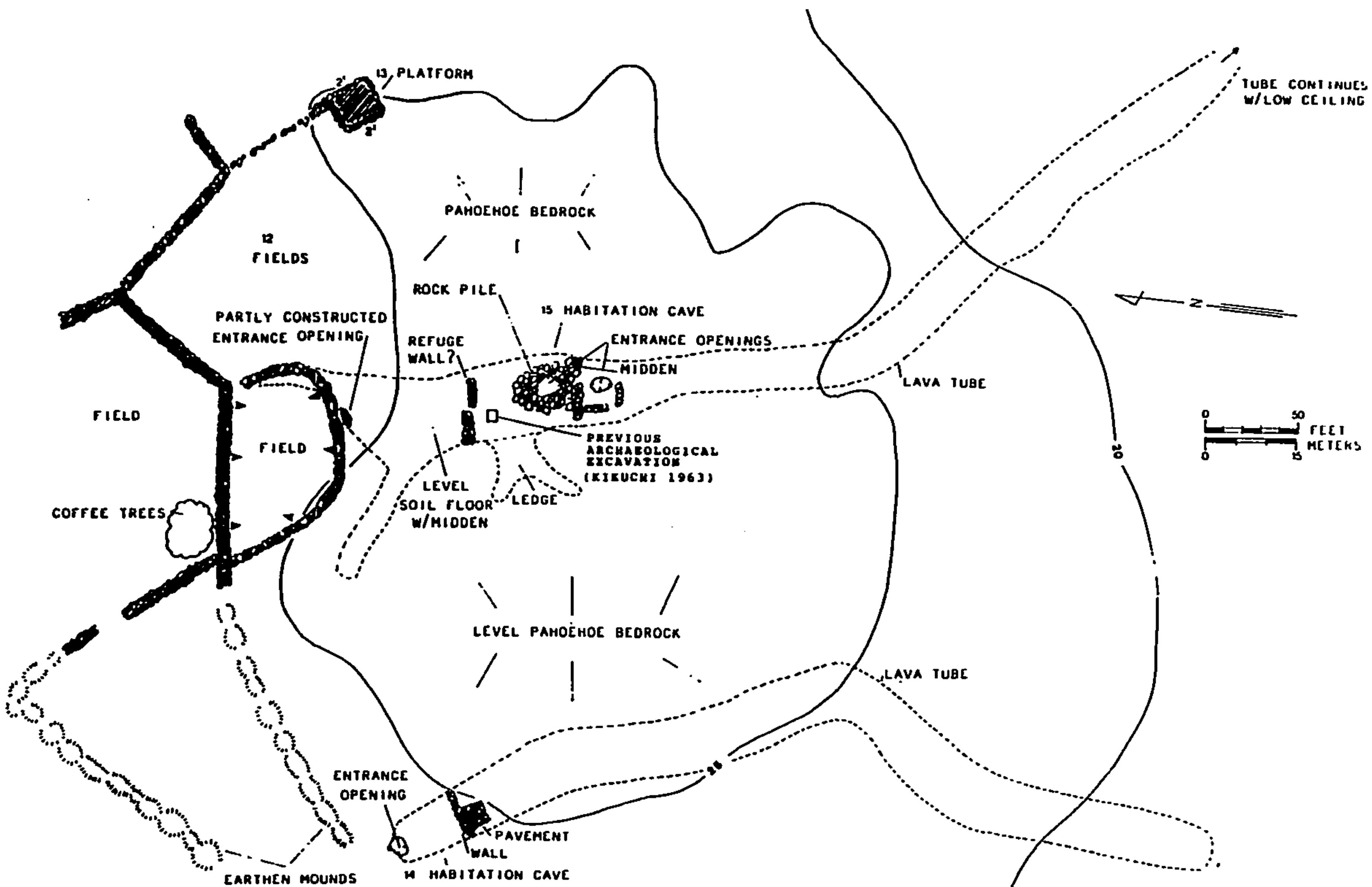

Fig 15. Sites 12-15, Plan View, (Map Sheet 4)

Site 14 (Fig. 15)

Site 14 is a probable habitational cave (lava tube), located in the SE portion of Sheet 4. The tube is situated on the edge of a cane field road and some modern trash is visible near the entrance.

The opening to this lava tube is from a modified sink area. The sink area is roughly 10 ft (3.048 m.) in diameter and 4 ft (1.219 m.) deep with the tube entrance on the SE side. Modifications include piling of stones along the sink's walls, especially the south and SE sides. The entrance measures 2 by 3 ft (.610 by .914 m.) with a nearly vertical 2 to 3 ft (.610 by .914 m.) drop to the tube floor.

The tube is easily negotiable for some 400 ft or 121.92 m. (roughly NW/SE) to where it pinches down to less than 1 ft (.305 m.) in height, but continues in a SSE direction. In general, the tube ranges in width from 25 to 40 ft (7.62 to 12.192 m.) and the ceiling height varies from 3.5 to 7 ft (1.067 to 2.134 m.).

The interior entrance area consists of boulder and cobble paved terrace structure. The modified area is 40 ft (12.192 m.) long (NW/SE) by 25 to 40 ft. (7.62 to 12.192 m.) wide. The 40 ft. wide section is the makai (SE) end of the terrace and it has a stacked boulder retaining wall 2 to 3 ft (.610 to .914 m) high and 2 feet (.610 m.) wide. Also there is a 6 by 5 ft (1.829 by 1.524 m.) by 1 ft (.305) high cobble paving located at the base of the SW end of the retaining wall. Midden was observed in association with the terrace and the paved area.

The rest of the tube appears unmodified, but at 250 ft (76.2 m.) from the cave entrance the bedrock floor becomes covered by reddish silty clay loam. The silty clay loam layer is probably due to cane field cultivation and alluvial deposition through the tube's ceiling.

Excavation potential for the entrance area of this probable habitation cave appears good to excellent.

Site 15 (Fig. 15)

Site 15 is a large modified lava tube, located in the SE portion of Sheet 4. This lava tube is a probable habitational/-refuge cave which has been extensively used during historic times. The lava tube was used by the County of Kaua'i as a Civil Defense Bomb Shelter. There are still wooden crates containing 1960's Civil Defense supplies and modern refuse is strewn about the main entrance chamber.

The tube, which is oriented generally NW to SE, extends nearly 400 ft (121.92 m.) to the SE, makai from the entrance, before it becomes too narrow to follow. The tube also extends 160 ft (48.768 m.) to the NNW (mauka) before a collapsed section seals it off. The tube ranges in width from 15 to 40 ft (4.572 to 12.192 m.) with ceiling height in the main chamber a maximum of 12 ft (3.658 m.).

The entrance to the tube is from a "skylight" opening, which is 4 ft (1.219 m.) in diameter. The drop to the tube floor is 12 ft (3.658 m.), but a crudely piled ahu on a platform below the opening allows for a somewhat difficult climb down. There is another skylight just to the south of the entrance one. It measures 1.5 by 2.5 ft (.457 to .762 m.) and does not appear to have been utilized as an entrance.

The main chamber, below the entrance skylight, is 35 ft (10.668 m.) E/W by 75 ft (22.86 m.) N/S. In the center of the chamber is a platform remnant measuring 33 ft (10.058 m.) E/W by 35 ft (10.668 m.) N/S. This platform has been seriously impacted during historic times, probably by artifact seekers, Civil Defense activities, and others. However, the makai (southern) face of the platform is still somewhat intact. It measures 33 ft (10.058 m.) long, by 1.5 to 2.5 ft (.457 to .762 m.) in height and is constructed of stacked boulders. Presently, most of the platform appears like a mounded pile of boulders and cobbles. There is a 4 ft (1.219 m.) high by 2 to 3 ft (.610 to .914 m.) in diameter stacked boulder slab "ahu" in the center of the platform. The ahu, apparently modern, is rather precariously balanced, though it does allow access from the skylight. The mauka tube extension (NNW) has a broken down boulder wall that may have sealed off or restricted movement to and from the main chamber. Presently, the wall is 15 ft (4.572 m.) long E/W, 5 ft (1.424 m.) wide, and 1 to 2 feet (.305 to .610 m.) high.

There were a few indigenous artifacts (basalt flakes, Cowry shell scraper) and plentiful midden observed in the main chamber and the mauka tube extension. The makai tube extension has little cultural material past the main chamber area, and even-

tually the bedrock floor becomes covered with reddish clay loam. The clay loam layer is due to alluvial filtration through the tube's ceiling from the cane fields above.

Though the lava tube has been heavily disturbed by historical activities, it still shows evidence of being an important prehistoric site. The collapsed section of the mauka tube may have been an entrance from the Site 12 area. There is a small (less than 1 ft or .305 m. in diameter) hole to the outside from the collapse into the SE portion of the enclosed field of Site 12. Also there is a 2 by 4 inch piece of construction grade wood in amongst the rocks in the collapsed area. The pieces of wood possibly indicate purposeful collapse or sealing of a tube entrance, possibly the former main entrance. The platform in the center of the main chamber below a skylight, has associated midden and artifacts visible on the surface. The floor of the mauka tube, and the main chamber is soil and also has visible midden and artifacts. A one-meter excavation was noted, and Dr. W. Kikuchi indicated that he dug there in the 1960's and found plentiful midden in a stratified deposit (Dr. Kikuchi per comm. 3/88). The excavation potential of Site 15 is excellent.

Site 16

Site 16, a possible habitation platform, is located in the south-central portion of sheet 4. The platform is rectangular in shape, measures 24 ft (7.62 m.) E/W by 30 ft (9.144 m.) N/S and is a maximum of 1.5 ft (.457 m.) high. The platform is constructed on a low bedrock outcrop with boulders piled along the edges, then boulders and cobbles were used to roughly level the bedrock surface.

Sixty feet (18.288 m.) to the east is a 160 ft (48.768 m.) long section of an auwai. The auwai, oriented north/south, is cut by existing cane fields. The auwai is mostly stone lined, ranges in width from 3 to 5 ft (.914 to 1.524 m.) and in depth from 1 to 2 ft (.305 to .610 m.).

There was no midden or artifacts observed in association with the platform and excavation potential appears fair to poor.

Site 17

Site 17, a rectangular boulder and cobble mound, is located in the west-central portion of Sheet 4. The mound measures 7 ft (2.134 m.) N/S by 10 ft (3.948 m.) E/W and is a maximum of 2.5 ft (.762 m.) high. It is constructed of a piled boulder perimeter and cobble size rock fill with a mounded surface. There were no artifacts or midden observed in direct association with this probable agricultural rock clearance mound, and excavation potential appears poor.

Forty feet (12.192 m.) makai (south) of the mound is a surface scatter of historic artifacts. The scatter covers an area of approximately 30 feet (9.144 m.) in diameter and is situated on flat exposed pahoehoe bedrock. Artifacts include: cane slag, bottle glass (one twist top type closure), metal, and ceramics. The relatively small amount of material does not

indicate habitation or a dump site and the presence of the twist top suggests a post 1920 age range.

Site 18

Site 18, a rectangular platform, is located near the north-central edge of Sheet 1. The platform is situated within 20 ft (6.096 m.) of a cane field (to the east) and 10 ft (3.048 m.) of bulldozing and the fence line associated with the main cane haul road. The platform has been impacted by bulldozing with large boulders pushed onto the sides and a few boulders onto the top of the platform.

The platform measures 33 ft (10.058 m.) E/W by 35 ft (10.668 m.) N/S and a maximum of 2.5 ft (.762 m.) high. Abutting the mauka side of the platform is a 15 ft (4.572 m.) long 30 ft (9.144 m.) wide triangular shaped pile of boulders, which appears to be just bulldozer push, but it may have been part of the platform. The intact platform consists of two levels, a makai (southern) level 10 ft (3.048 m.) by 33 ft (10.058 m.) and a 25 ft (7.62 m.) by 33 ft (10.058 m.) mauka level. The makai level is cobble paved with the mauka level being .5 ft (.152 m.) higher and boulder paved.

There were no artifacts or midden observed, but 80 ft (24.384 m.) to the SW is a probable habitation cave (Site 19) and the excavation potential of the platform appears fair to good.

Site 19

Site 19, a probable habitation cave (lava tube), is located near the north-central edge of Sheet 1. The entrance area, a small sink, is situated in the bulldozed <u>mauka</u> shoulder area of the main cane haul road, but it was not directly impacted. However, the tube, which extends <u>makai</u> (south) from the entrance was collapsed by the can haul road construction.

The tube is 72 ft (21.946 m.) long (to the collapse), averages 12 ft (3.658 m.) wide, with ceiling height ranging from 2.5 to 4 ft (.762 to 1.219 m.). Fifteen feet (4.572 m.) from the entrance is a 9 ft (2.743 m.) long, 2 ft (.610 m.) wide and 1.5 ft (.457 m.) high boulder retaining wall. The area between the retaining wall and entrance is relatively level soil with visible midden. The opening to the tube is 3 by 5 ft (.914 to 1.524 m.) and is situated on the southern side of a small sink. The sink is roughly oval in shape, measuring 30 ft (9.144 m.) E/W by 35 ft (10.668 m.) N/S and is a maximum of 5 ft (1.524 m.) deep. Fronting the opening, on the east and west sides, are low piled boulder walls, which are 1 to 2 ft (.305 to .610 m.) high, 1.5 to 2.5 ft (.457 to .762 m.) wide, and 10 to 15 ft (3.048 to 4.572 m.) long.

There was midden, coral, and a waterworn boulder observed and excavation potential for the cave and sink area appears good to excellent. This site was given number 50-KA-10-3179 in 1973 by A.R.C.H. staff (Palama, Stauder 1973).

Site 20 (Fig. 17)

Site 20, a rectangular platform, is located in the NW corner of Sheet 1. The platform measures 12 ft (3.658 m.) N/S by 15 ft (4.572 m.) E/W and is a maximum of 1.5 ft (.457 m.) high. The surface of the platform is boulder slab paved with pebbles in the cracks between the slabs creating a relatively level surface. The sides of the platform are of stacked boulder construction, but are not well faced. Extending 20 ft (6.096 m.) to the NW from the NE corner of the platform, is a piled boulder alignment, 1 to 2 ft (.305 to .610 m.) high and 2 to 3 ft (.610 to .914 m.) wide. There were no artifacts or midden observed in association with this probable habitation platform and excavation potential appears fair.

Site 21

Site 21, a rectangular platform, is located in the NW corner of Sheet 1. The platform measures 15 ft (4.572 m.) NE/SW and is a maximum of 2 ft (.610 m.) high. The surface of the platform is a relatively level boulder pavement. The southern side(s) of the platform has had large boulders pushed (bulldozed) onto it, with the northern sides, especially the NE corner, being well faced. There were no artifacts or midden observed in association with this probable habitation platform. Excavation potential appears fair to good.

Site 22

Site 22, a modified outcrop, is located in the NE portion of Sheet 1. The modified outcrop is roughly oval in shape and measures 31 ft (9.449 m.) N/S by 50 ft (15.24 m.) E/W with a maximum height above surrounding terrain of 3.5 ft (1.067 m.). Modification includes piling of boulders around the perimeter of the outcrop, especially the western side. The piling of rocks on the western side is 30 ft (9.144 m.) N/S long by 20 ft (6.096 m.) E/W wide and 3 ft (.914 m.) high. The center of the outcrop is unmodified exposed bedrock. This site is a possible habitation feature, but more probably an agricultural rock clearance mound. There were no artifacts or midden observed and excavation potential appears poor.

Site 23 (Fig. 16)

Site 23, a modified sink and probable habitation cave (lava tube), is located in the north-central portion of Sheet 1. The sink is roughly oval in shape, measures 90 ft (27.432 m.) NE/SW by 40 ft (12.192 m.) NW/SE, and is a maximum of 5 ft (1.524 m.) deep. Modifications to the sink include: a road-like feature, a rough boulder alignment, and a paved area fronting the cave opening. The road-like feature cuts across the sink in an East/West orientation and is constructed of stacked boulders with a compact boulder and cobble surface. It is 10 ft (3.048 m.) wide, 1 ft (.305 m.) high and has the appearance of a low berm. However, there were no obvious tracks or roadway leading to or from the

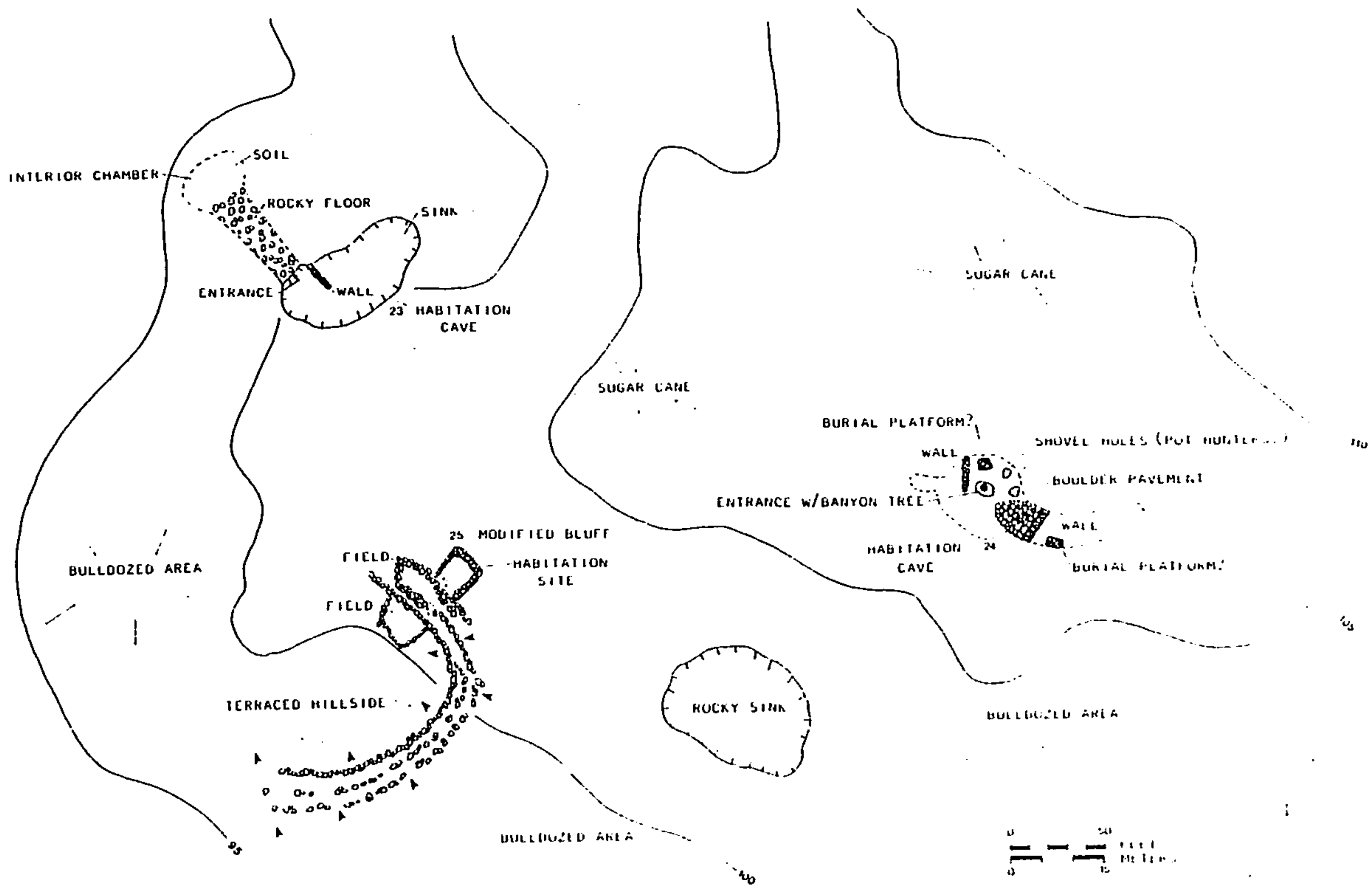

Fig 16 Sites 23 24, and 25, Plan View, (Map Sheet 1)

Fig. 17 Site 20, Platform Showing Paving

Fig. 18 Site 26 Stonelined Auwai, View East.

berm, but bulldozing in the area may have obliterated such evidence. The boulder alignment is 35 ft (10.668 m.) long (E/W, 1 to 2 ft (.305 to .610 m.) high and 2 to 3 ft (.610 to .914 m.) wide. Essentially it is just a rough modification to the bouldery sink. The paved area fronting the cave is 15 ft (4. 572 m.) in diameter and is roughly leveled with boulders and cobbles.

The cave is 90 ft (27.432 m.) long and ranges in width from 12 ft (3.658 m.) at the entrance to 38 ft (10.668 m.) near the back, with the ceiling height varying between 2 and 4 ft (.610 and 1.219 m.). The entrance is partially blocked by a piled boulder wall 12 ft (3.658 m.) long, 1.4 ft (.762 m.) high, and 2 ft (.610 m.) wide. The cave floor for the first 50 ft (15.24 m.) is mostly boulders with the back 40 ft (12.192 m.) being mostly exposed bedrock floor. In the boulder floor area and especially near the entrance are plentiful midden and a few artifacts. However, there has been much disturbance, including digging of holes and moving rocks around, probably by artifact seekers. The excavation potential of this cave appears excellent.

Site 24 (Fig. 16)

Site 24, a probable habitation and burial cave, is located in the north-central portion of Sheet 1. The cave opening is situated at the NE end of a large rocky sink. The sink is roughly oval in shape and measures approximately 100 ft (30.58 m.) NE/SW by 45 ft (13.716 m.) NW/SE and is a maximum of 5 ft (1.524 m.) deep. The sink is essentially just a large boulder and

cobble rubble-lined depression, which is the surface feature of a collapsed chamber of an old lava tube.

The entrance to the cave is almost entirely blocked by a large banyan tree. Presently the opening is 2.5 ft (.762 m.) in diameter with a nearly vertical drop of 3 ft (.914 m.). The entrance appears modified, with piling of cobbles and boulders around the opening, but because of the banyan tree disturbance it is difficult to tell. The entrance is near the center of a 40 ft. (12.192 m.) in diameter lava tube chamber that has an average ceiling height of 4 ft (1.219 m.). This main chamber has a mostly soil floor with plentiful midden and a few artifacts (basalt flakes, hammerstone, basalt mirror) visible on the surface. There is a possible burial feature abutting the NE wall of the main chamber. The feature is a low platform which measures 3 by 7 ft (.914 by 2.134 m.) 2 to 1.5 ft (.305 to .457 m.) high and is constructed of stacked boulders and cobbles.

The tube associated with the main chamber extends 122 ft (37.187 m.) to the NE (<u>mauka</u>) and 3.5 ft (1.067 m.) SW (<u>makai</u>) from the entrance. The <u>mauka</u> tube extension has a stacked boulder wall 32 ft (9.754 m.) from the entrance. The wall is 22 ft (6.706 m.) long N/S (side wall to side wall), 1.5 to 2.5 ft (.457 to .762 m.) in width. The <u>makai</u> oriented tube section also has a wall, which is 15 ft (4.572 m.) long NW/SE, 1 to 2 ft (.305 to .610 m.) in height, 1.5 to 2.5 ft (.457 to .762 m.) in width and is constructed of stacked boulders. This wall abuts the northern tubes wall and does not extend across the entire tube.

The cave has been heavily disturbed with the stacked boulder walls being pushed over, holes dug in the main chamber, (by artifact hunters) and banyan tree root action. However, the plentiful midden and the few artifacts observed, plus the possible burial feature indicate that excavation potential is excellent.

Site 25 (Fig. 16)

Site 25, a modified bedrock bluff (habitation) and associated agricultural features, is located in the north-central portion of Sheet 1. The habitation feature of this site is the modified top surface of a pahoehoe bedrock bluff. Modifications include piecing of boulders and cobbles along the north, east, and south sides of the high point of the bluff, then leveling the top with pebbles and cobbles. The southern (makai) facing is the most impressive, being up to 4 ft (1.219 m.) high and incorporating a few large upright boulders. The level area, which does have sections of exposed bedrock measures 20 ft (6.096 m.) E/W by 25 ft (7.62 m.) N/S.

The agricultural features include narrow soil terraces with piled rock retaining walls on the south facing bluff slope and a large soil planting area at the base of the slope. The narrow terraces are 2 to 3 ft (.610 to .914 m.) wide and the retaining walls 1 to 1.5 feet (.305 to .457 m.) high and 1 to 2 ft (.305 to .610 m.) wide.

The large soil area has been disturbed by recent bulldozing for a new barbed wire fence line, but measures roughly 50 ft

(15.24 m.) E/W by 70 ft (21.336 m.) N/S.

There were a few pieces of marine shell midden observed in association with the habitation feature, but no artifacts. The agricultural features are generally not well defined and in relatively poor condition. However, the excavation potential for Site 25, especially the habitation feature appears fair to good.

Site 26 (Fig. 18)

Site 26, an auwai and associated features, is located in the SW portion of Sheet 1. The auwai, oriented NW to SE, is traceable for some 900 ft (270 m.). The NW end is lost near a modern sugar cane drainage ditch with the SE end disappearing into bulldozed pasture land. The better sections of the auwai have stacked stone embankments up to 2.5 ft (.457 m.) high and 2 ft (.610 m.) wide with the ditch ranging between 2 and 3 ft (.610 and .914 m.) wide.

Associated features include poorly defined agricultural fields, probable lo'i, and one cluster of small fields and a probable habitation feature. The lo'i type features have been severely impacted by pasture bulldozing and are presently linear and L-shaped mounded walls. The lo'i(?) are situated on the down slope (southern) side of the auwai with the walls ranging in length from 30 to 60 ft (9.144 to 18.288 m.), in height from 1.5 to 2.5 ft (.457 to .762 m.), and in width from 2.5 to 4 ft (.456 to 1.219 m.). They are constructed of stacked boulders and cobbles.

The cluster of features includes three small probable agricultural fields and a faced pahoehoe bluff. Two of the fields are situated on the mauka side of the auwai and one on the makai side. The fields average 10 ft (3.048 m.) wide and 20 ft (6.096 m.) long. They are bounded by 1 to 2 ft (.305 to .610 m.) high boulder walls, which range from 1 to 2.5 ft (.305 to .762 m.) thick. The interiors of the fields are relatively level soil.

The faced bluff is a probable habitation feature and is situated 40 ft (12.192 m.) mauka of the auwai, just above the two small fields. Modification to the bluff consists of a J-shaped piled boulder wall which creates a relatively level top surface of the bluff. The level area measures 7 ft (2.134 m.) N/S by 15 ft (4.572 m.) E/W but the surface is mostly exposed.

There were no artifacts or midden observed and the poor condition of associated features, including the probable habitation feature suggest a poor excavation potential.

Site 27

Site 27, a modified boulder outcrop, is located in the NW central portion of Sheet 1. The outcrop is roughly oval in shape and measures 60 ft (18.288 m.) E/W by 80 ft (24,384 m.) N/S with the modifications on the southern side of the outcrop. Modifications include a possible auwai section and paved areas on the outcrop itself.

The auwai-like feature fronts the outcrop on the makai (south) side and is oriented NE to SW and is 60 ft (18.288 m.)

long. This feature consists of a narrow (3 ft or .914 m. wide) soil trough rounded on the mauka (north) side by piled rocks against the outcrop and by a piled boulder and cobble alignment on the makai (south) side. However, bulldozing has heavily impacted the makai alignment by pushing more rocks onto it. Presently, the makai alignment does not have the appearance of an auwai embankment.

The paved areas are situated on the southwestern portion of the outcrop and consist of two pebble and cobble paved terrace levels. Level 1, the makai most terrace, is 25 ft (7.62 m.)long NW/SE by 4 ft (1.219 m.) wide. Level 2 is .5 ft (.152 m.) higher than Level 1 and is separated by a singular boulder alignment. Level 2 is 15 ft (4.572 m.) long NW/SE by 5 ft (1.524 m.) wide. There is a rough boulder paving on the east and north sides of the paved terraces which varies from 5 to 10 ft (1.524 to 3.048 m.) in width. The rest of the outcrop is unmodified and includes some very large boulders (up to 5 ft or 1.524 m. in diameter).

The area surrounding site 27 has been heavily impacted by bulldozing, probably for pasture improvement. Dozing has pushed boulders and other debris onto the entire perimeter of the outcrop. There were no artifacts or midden observed and excavation potential appears fair to poor.

Site 28

Site 28, a cluster of agricultural features, is located in the SW corner of Sheet 1. The site 28 area has been heavily impacted by bulldozing, probably for pastures, and by a long sugar cane related drainage ditch. The ditch carries silt laden cane field discharge water to the "settling pond," approximately 350 ft (106.68 m.) makai (south) of the Site 28 area.

The features of Site 28 consist of a rectangular field, discontinuous linear mounds and stacked boulder walls, rock clearance mounds, and an L-shaped terrace. The rectangular field has a soil interior and measures 40 by 100 ft (12.192 by 30.48 m.) with walls ranging from 1 to 3 ft (.305 to .914 m.) in height and width. The linear mounds and stacked boulder wall remnants range from 30 to 80 ft (9.144 to 24.384 m.) long, 1 to 3 ft (.305 to .914 m.) high, and 2 to 4 ft (.610 to 1.219 m.) thick. The mounds range from 25 to 20 ft (4.572 to 6.096 m.) in diameter and are constructed by piling of rocks on bedrock outcrops. The L-shaped terrace measures 50 ft (15.24 m.) E/W by 30 ft (9.144 m.) N/W and is constructed of stacked boulders and cobbles to a maximum of 2 ft (.610 m.) high and averaging 2.5 ft (.762 m.) wide.

There were no habitation features noted in the Site 28 area. No midden or artifacts were observed and with the degree of historic disturbance excavation potential appears poor.

Site 29 (Fig. 19)

This is a habitation and agricultural site complex including a C-shape, platforms, fields and walls. This site complex is situated in the SE portion of Sheet 3 and is bounded by active

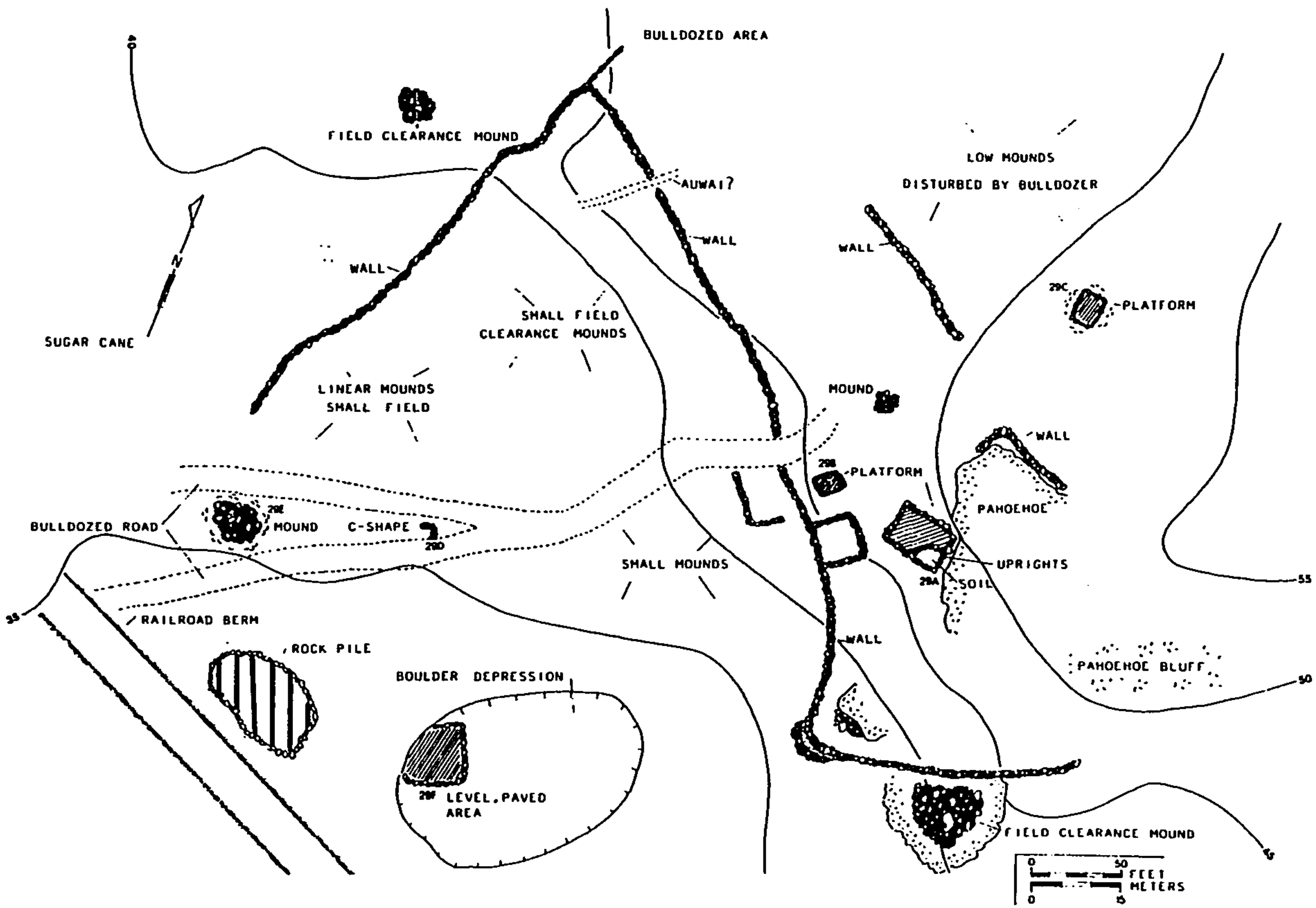

Fig 19 Site Complex 29. PLan View, (Map Sheet 3)

sugar cane cultivation and cane clearance mounds to the north and west, by a large bulldozed area to the east, and by the railroad berm to the south. A bulldozed road bisects the complex, running from NE to SW. While the general surroundings have thus been severely impacted by historic land use, wall remnants to the north and west probably bounded this as a discrete agricultural area. A possible irrigation ditch (auwai) enters the complex area from the east. This complex includes the following six features.

Site 29A is a probable habitation platform, roughly rectangular in shape and with exterior dimensions of 20 ft (6.096 m.) N/S by 34 ft (10.363 m.) E/W. This feature is bounded by stacked subangular boulders and cobbles to a maximum height of 2 ft (.610 m.). There are two uprights with a maximum height of 2 ft (.610 m.) in place in the NW corner of the platform. The interior of the feature measures 15 ft (4.572 m.) N/S by 25 ft (7.62 m.) E/W and is quite rocky with a soil pocket measuring about 6 by 8 ft (1.829 by 2.438 m.) in the NW quadrant. No midden or artifacts were observed. Excavation potential was thought to be fair to good.

Site 29B is another probable habitation platform, roughly rectangular in shape and with exterior dimensions of 11 ft (3.353 m.) E/W by 13 ft (3.962 m.) N/S situated on the edge of a pahoehoe bluff. The maximum height of the platform is 1.5 ft (.457 m.) and it is paved with boulders and cobbles. Two uprights are in the NE corner of the site and another upright is in the center

of the platform. A few pieces of coral and shell midden were observed on this feature. The excavation potential is fair to good.

Site 29C is a third habitation platform, roughly rectangular in shape, measuring 16 ft (4,877 m.) N/S by 11 ft (3.353 m.) E/W on the edge of a pahoehoe bluff. This feature has a cobble paving and would have had a 1 ft (.305 m.) high boulder facing but the site is in poor condition. No midden or artifacts were observed. The excavation potential of the probable field shelter is fair to poor.

Site 29D is a C-shape, probable habitation feature measuring 7 ft (2.134 m.) NE/SW by 6 ft (1.829 m.) NW/SE. There are three uprights in the back wall with a maximum height of 3 ft (.914 m.) and the back wall is 5 ft (1.52 m) wide. The NE (upland) side of the site consists of cobbles and boulders piled on and against a bedrock ledge. Bulldozing is evident around the site. No midden or artifacts were observed. The excavation potential of this site is fair to poor.

Site 29E is a probable rock clearance mound disturbed by bulldozing. This feature has the appearance of a rough platform measuring 35 ft (10.668 m.) E/W by 24 ft (7.315 m.) N/S. Bulldozed roads border the feature to the north and south and it has been bulldozed heavily on the north, south and west sides. No midden or artifacts were observed in association with this site remnant. The archaeological potential of 29E is poor.

Site 29F is another highly disturbed site whose exact nature is unclear. This feature consists of an apparently paved area in a rocky depression measuring 35 ft (10.668 m.) N/S by 30 ft (9.144 m.) E/W. This feature has a cobble paving with loose boulders and a possible seaward facing with an adjacent rectangular depression to the south. This modified boulder depression may have been a house site, but since bulldozing has occurred on all sides it was unclear that it was anything more than the result of the rock clearing. Archaeological potential is poor.

In addition to the six features just described, there are a number of low boulder walls piled on and against low pahoehoe bluffs and bedrock outcroppings and a number of low linear mounds, circular clearance mounds and small fields in the site complex area. The largest of these linear mounds is a meandering field boundary wall that runs for about 800 ft (243.84 m.) along the west side of the complex before turning to the SE. This wall ranges in height from 1.5 to 2 ft (.457 to .610 m.) and in width from 3 to 5 ft (.914 to 1.524 m.).

Although this site complex has been greatly disturbed by sugar cane related activities and bulldozing, the presence of a minimum of four habitation features suggests that this area was the focus of particularly intensive agricultural endeavors. It is thus recommended that all six of the designated features be tested before development of this area.

Site 30

Site 30 is a stacked wall remnant 18 ft (5.486 m.) long with

a maximum height of 3 1/4 ft (.001 m.) and width of 3 ft (.914 m). This wall is constructed of boulders stacked up to six boulders high. The SE portion of the wall has been destroyed by the roots of a huge banyan tree. This site has no archaeological potential and is regarded as no longer significant.

Site 31 (Fig. 20)

Site 31 is a habitation and agricultural site complex including two areas of cave shelters, a terrace, and associated agricultural features located in the west central portion of Sheet 3. This site complex is bounded to the north, east and west by active sugar cane lands and to the south by the railroad berm. Hence the general context of the site complex area has largely been lost. Two irrigation ditch (auwai) remnants were observed just to the west and an elevated auwai was mapped just to the east of the site complex. When coupled with the agricultural features of Site 31B, this suggests extensive irrigated agriculture in the immediate area.

Site 31A consists of a sink 25 ft (7.62 m.) in diameter and 7 ft (2.134 m.) deep, modified with piled boulders along its perimeter. Two caves radiate out from the floor of the sink to the north and to the west. The north cave extends roughly north for 11 ft (3.353 m.) with a maximum width of 15 ft (4.572 m.) and a maximum height of 3 ft (.914 m.). The average cave height of 2 ft 4 in. (.710 m.) makes it comfortable for habitation. In the back of the chamber was a cleared space of soil floor which is a

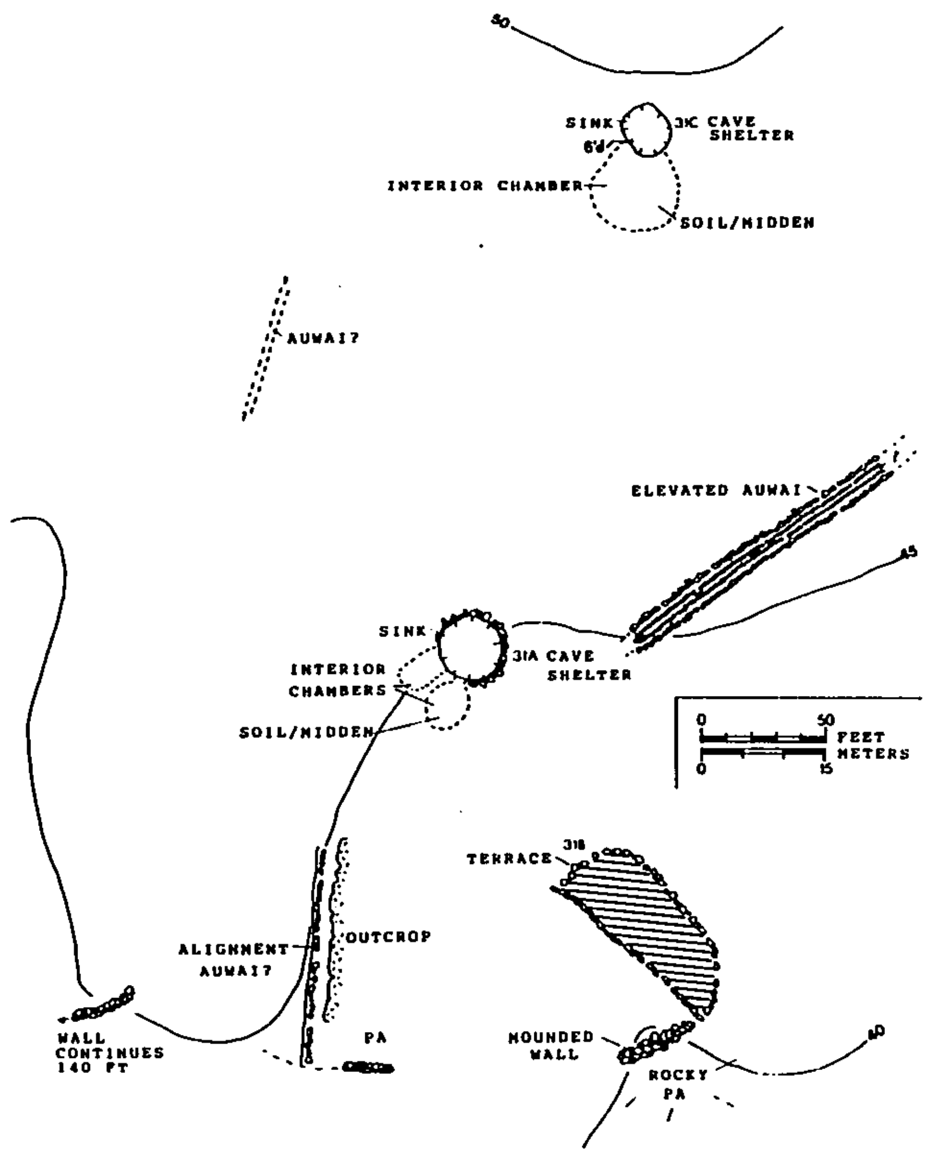

Fig 20 Site Complex 31, Plan View (Map Sheet 3)

probable sleeping area. The entrance to this cave is 2 ft (.610 m.) high by 4 ft (1.219 m.) wide. No midden or artifacts were observed on the surface of this cave, but the excavation potential is probably fair.

The western cave has an entrance only 18 in. (.457 m.) high, but extends in 12 ft (3.658 m.) with a maximum width of 17 ft (5.182 m.), a maximum height of 3 ft 4 in. (1.015 m.) and an average height of 3 ft (.914 m.). Midden consisting of Kukui nuts and marine shells were observed on the surface of the floor of this cave. It would be possible to crawl through a low passage from this cave into the north cave without going out to the sink. The excavation potential of this western cave and of the sink itself are good.

Site 31B is an agricultural complex area which includes a large rocky terrace with cupboard feature, fields, possible planting troughs, and stacked boulder walls. The most prominent component of this agricultural complex is a terrace retaining wall, on the upslope (north) side. This consists of a well faced retaining wall 2.5 ft (.762 m.) high and 3 feet (.914 m.) wide with numerous uprights and a well constructed cupboard, 2 ft (.610 m.) wide extending 6 ft (1.829 m.) into the terrace. On the south side of this terrace is a soil field measuring 30 ft (9.144 m.) N/S by 15 ft (4.572 m.) E/W and delineated by a low (6 in. or .152 m. high) mounded wall. Seaward of this is a large very rocky area with several narrow (1 to 2 ft or .305 to .610 m. wide), long (up to 20 ft or 6.096 m.) possible planting areas.

The western side of this rocky planting area is delineated by boulders piled along the edge of a exposed pahoehoe outcropping. These boulders were cleared from another field lying between this rocky agricultural area and a higher pahoehoe ridge which runs roughly parallel, 30 ft (9.144 m.) to the west.

Site 31C is another cave site located in a sink 20 ft (6.096 m.) in diameter with nearly vertical sides 8.5 ft (2.591 m.) deep. This cave measures 34 ft (10.363 m.) E/W by 30 ft (9.144 m.) N/S with a maximum height of 5.5 ft (1.676 m.) and an average height of 3.5 ft (1.067 m.). In the NW corner of the cave is a narrow shaft dropping 6 ft (1.829 m.) and continuing out of sight. Some midden was observed in this angled shaft and it may be a burial site. In the back of the cave is another narrow passage which drops some 3 ft (.914 m.) and contains some bone. Neither of these very narrow passages was fully examined. The soil floor of the cave had some bird bone, kukui nuts, and a moderate amount of shell midden. Some historic artifacts were observed near the entrance to the cave. In the south portion of the cave, water drips from the ceiling and a couple of flat stones were observed in logical places for water catchment. The excavation potential of this cave is excellent.

Site 32 (Fig. 21)

Site 32 is a habitation and agricultural complex, including C-shapes, platforms, enclosures, and fields located in the north central portion of Sheet 5. This site includes the following

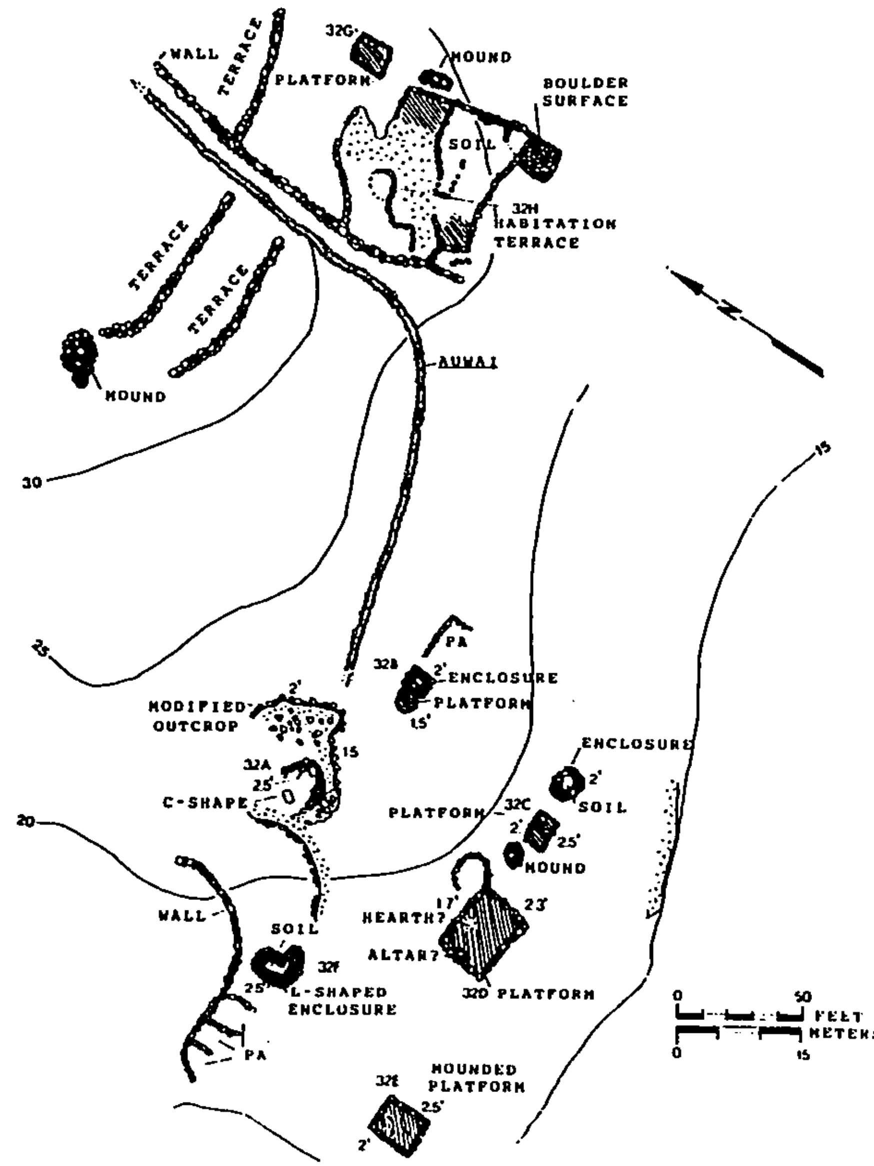

Fig 21 Site Complex 32, Plan View, (Map Sheet 5)

eight designated features.

Site 32A is a well made C-shape in good condition in a rocky pahoehoe area. This C-shape has exterior dimensions of 15 ft (4.572 m.) E/W by 15 ft (4.572 m.) N/S with an interior about 9 ft (2.743 m.) in diameter. The maximum height of the back wall is 4 ft (1.219 m.). This C-shape is open to the SW. The floor of the C-shape has a fairly thick soil deposit. In the north portion of the interior back wall is a curiously cantilevered slab which was constructed into the wall - probably to provide protection from the elements. Adjoining this C-shape to the SE is a long, slightly modified pahoehoe bedrock outcrop. Modification consists of cobbles and pebbles which have been used to fill cracks between bedrock slabs roughly leveling the area and the stacking of cobbles and boulders directly on the edge of the bedrock outcrop which has the appearance of a continuous wall, level with the bedrock surface, but 1.5 to 2 ft (.457 to .610 m.) high on the downslope side. The excavation potential of this site is good.

Site 32B is a rectangular probable habitation enclosure measuring 10 ft (3.048 m.) E/W by 11 ft (3.353 m.) N/S. This enclosure has a relatively level soil interior and walls with a maximum height of 2 ft (.610 m.), an average height of 1.5 ft (.457 m.), and a width of 3 to 4 ft (.914 to 1.219 m.). There are probable entrances in the west corner and the south end. Adjoining the enclosure on the SW side is a possible platform measuring 8 by 10 ft (2.438 by 3.048 m.) and 1.5 ft (.457 m.)

high, roughly oval shaped with a rough boulder and cobble surface. The excavation potential of this feature is good. Directly to the east of this enclosure is a large open field which appears to be the result of both prehistoric Hawaiian and historic clearing activity. To the north of the enclosûre is a fairly well defined agriculture feature consisting of linear mounds creating a roughly quadrangular 30 by 40 ft (9.144 by 12.192 m.) area of mostly soil.

Site 32C is another enclosure with exterior measurements of 15 ft (4.572 m.) E/W by 17 ft (5.182 m.) N/S. The interior of this site measures 6 ft (1.829 m.) E/W by 7 ft (2.134 m.) N/S. This enclosure is of stacked boulder construction with a maximum height of 2.5 ft (.762 m.) and an average height of 2 ft (.610 m.). The interior height of the walls is 1.5 ft (.457 m.) and the floor is soil. Seven feet (2.134 m.) to the west is an adjacent platform measuring 12 ft (3.658 m.) E/W by 11 ft (3.353 m.) N/W. It is built of boulder construction to a maximum height of 2.5 ft (.762 m.) with a relatively level surface. A 3.5 by 3.5 ft (1.067 by 1.067 m.) piece of modern plywood is on top of this traditional Hawaiian construction. This platform is a probable habitation feature, but may well be a burial. The excavation potential of Site 32C is good.

Site 32D is a roughly rectangular shaped probable habitation platform measuring 27 ft (8.230 m.) E/W by 20 ft (6.096 m.) N/W with a nearly level boulder and cobble pavement. This platform has a maximum height of 2.25 ft (.686 m.) and an average height of 1.75 ft (.533 m.). This platform is particularly well faced in the southeast corner. In the middle of the west edge of this platform is a roughly square 3 by 3 ft (.914 by .914 m.) mound of stones which was probably an altar. In the upslope central portion of the platform is a 7 by 4 ft (2.134 by 1.219 m.) cluster of Koa haole trees indicating the presence of a hearth or some other internal feature. This feature was probably a Hale mua ("Men's House") and its excavation potential is excellent.

Site 32E is a probable habitation platform measuring 17 ft (5.182 m.) E/W by 20 ft (6.096 m.) N/S of piled boulder construction. This platform has an uneven, mounded appearance with a maximum height of 2.5 ft (.762 m.) and an average height of 2 ft (.610 m.). The archaeological potential is good.

Site 32F is a possible habitation structure, but is more likely of agricultural nature. This feature is an L-shaped enclosure. The north leg of the enclosure has an exterior length of 18 ft (5.486 m.) and an interior length of 10 ft (3.048 m.). The east leg of the enclosure has an exterior length of 15 ft (4.572 m.) and an interior length of 9 ft (2.743 m.). The interior width of the enclosure is a fairly consistent 4 ft (1.219 m.). The maximum wall height is 2.5 ft (.762 m.) and the average wall height is 1.5 ft (.457 m.). The interior of the enclosure has relatively deep soil for the most part. The excavation potential for this feature is fair to poor.

Site 32G is a platform and possible burial, roughly rectangular, and measuring 10 ft (3.048 m.) E/W by 12 ft (3.658 m.)

N/W. This platform has intact vertical facing on the west side, 2.5 ft (.762 m.) high, but is mostly collapsed on the other sides. This platform is built of mostly boulder construction with some pebble and cobble fill. No midden, coral or artifacts were observed. Excavation potential is good.

Site 32H is a probable habitation site with a large habitation terrace as its main feature. The seaward wall of this terrace is 43 ft (13.106 m.) long oriented roughly east/west. The east wall of this terrace extends back 37 ft (11.278 m.) to the north. The terrace has a number of feature components. The main area of the terrace is 43 ft (13.106 m.) long by 37 ft (11.278 m.) wide. The eastern portion is mostly soil while the western portion is mostly bedrock which has been leveled with small boulders and cobbles. A few basalt flakes and pieces of coral were observed on the surface of this terrace. Excavation potential is excellent.

Site 33 (Fig. 22)

Site 33 is an agricultural and habitation complex located in the NW portion of Sheet 5 and is encompassed to the west, north, and south by active can cultivation. This complex includes an irrigation ditch, walls, platforms, mounds, and enclosures. The general area is rocky pahoehoe with a number of ditches (auwai) some of which are distinct and others of which are barely discernible.

Site 33A consists of an auwai in good condition and an

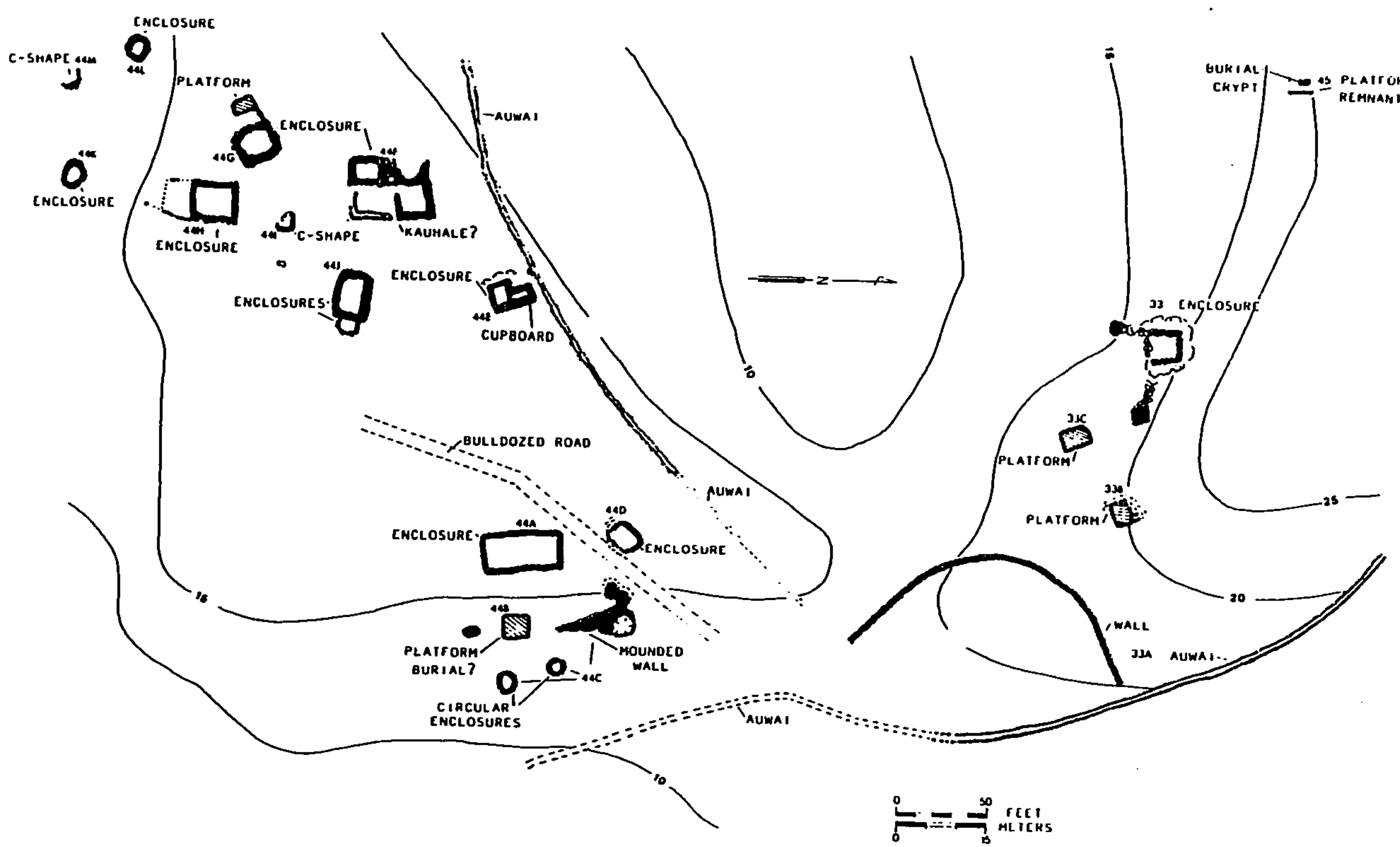

Fig 22 Site Complexes 33, 44, and Site 45, Plan View (Map Sheet 5)

adjacent large walled enclosure. The <u>auwai</u> was traced for more than 400 ft (121.92 m.) from where it was impacted by cane cultivation in the north to where it was bulldozed in the south in the vicinity of Site 44. Near the northern most extent of the <u>auwai</u> some mortar was observed which suggests that either the <u>auwai</u> is in fact historic or modification of this ditch in historic times. Just west of the <u>auwai</u> is a wall that runs for about 160 ft (48.768 m.) from the edge of the <u>auwai</u>, bowing to the west, and then turning back toward the <u>auwai</u>, so as to form an enclosure. The wall is impressive, measuring up to 5 ft (1.425 m.) high and 5 ft (1.425 m.) wide in some places. In many places the wall is well faced on both sides. The archaeological potential of Site 33A is poor to fair.

Site 33B is a probable habitation platform, roughly rectangular, and measuring 11 ft (3.353 m.) N/S by 15 ft (4.572 m.) E/W. It is constructed of stacked boulders with a rough boulder and cobble paved surface. Only the SE face shows intact facing, measuring 1.5 ft (.457 m.) high. Excavation potential is fair.

Sites 33C is another probable habitation platform, roughly rectangular, and measuring 11 ft (3.353 m.) N/S. This platform has a maximum height of 2.5 ft (.762 m.) and an average height of 2 ft (.610 m.). There is a level boulder/cobble paved surface and a possible post hole in the northwest quadrant. The excavation potential of this site is fair to good.

Site 33D is a probable habitation enclosure with exterior dimensions of 17 ft (5.182 m.)E/W by 18 ft (5.486 m.) N/S, and

Fig. 23 Site 34A Faced Bluff Showing Large Slab Facing in Northwest Corner, View to Southeast.

Fig. 24 Site 34A, Possible Altar Stone, View to South.

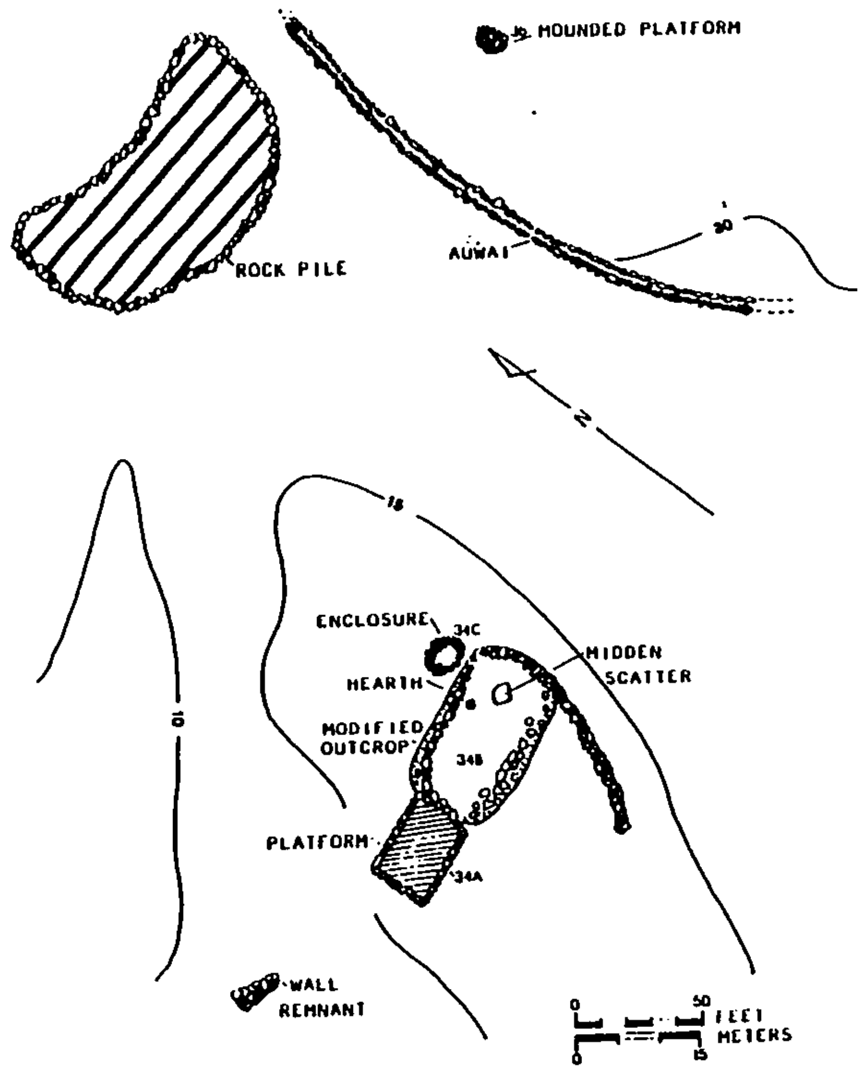

Fig 25 Site 34 and 36, Plan View, (Map Sheet 5)

interior dimensions of 6 ft (1.829 m.) by 8 ft (2.438 m.) N/S. The interior wall height averages 2 ft (.610 m.) with a width of 8-10 ft (2.44 - 3.098 m.). The interior of this site is relatively level soil. No artifacts or midden were observed here nor in any other site or feature in the Site 33 complex. The excavation potential of Site 33D is only fair. Twenty-two feet east of 33D is a probable clearance mound 8 by 7 ft (2.438 by 2.134 m.) by 2.5 ft (.762 m.) high of piled boulders.

Site 34 (Figs. 23, 24, 25)

This exciting site was almost certainly a heiau complex built on and around a large modified bedrock outcrop, adjacent to a large modified boulder filled sink, located in the NE quadrant of Sheet 5.

The rocky sink area is about 60 ft (18.288 m.) in diameter and 12 ft (3.658 m.) deep with a large banyan tree growing out of the center of it. This sink feature is almost certainly the result of a large collapsed lava tube. Similar features were observed to the NW. A short segment of constructed wall or narrow ramp descends into this pit. In all probability this pit was integrally associated with the religious function of the bluff site and was conceptually an entrance into the under world.

Site 34A refers to a large habitation feature - possibly a heiau - constructed by facing a bedrock bluff. The platform measures 30 ft (9.144 m.) E/W by 25 ft (7.62 m.) N/S and has a maximum height of facing of 4 ft (1.219 m.). It is very well faced on the north and south sides. One large upright in the NW corner is 5 ft (1.524 m.) long, averages 3 ft (.914 m.) high and 1.75 ft (.533 m.) thick. These dimensions suggest a mass of over two tons. The western and eastern sides are not well defined because the entire site is built in and on the elevated edge of the large collapsed sink. A possible cupboard, 5 by 2 ft (1.524 m. by .610 m.), is in the northwest portion of the site.

Site 34B was used to designate a modified area on the top of the bluff, 100 ft (30.48 m.) east of 34A. This consisted primarily of a small soil area 6 by 8 ft (1.829 by 2.438 m.) with sparse visible midden and a possible rectangular hearth 8 ft (2.438 m.) to the northwest.

Site 34C was used to designate a small oval enclosure, a possible lua iwi or bone pit, measuring 4 ft (1.219 m.) N/S by 7 ft (2.134 m.) E/W located just to the NE of and abutting the large modified outcrop. A possible waterworn god stone was observed 15 ft (4.572 m.) N of Site 34C. Twenty-five ft (7.62 m.) NE of Site 34C is a large roughly square boulder with a flat level top surface which had been leveled with smaller stones for use as a probable altar. The size of some of the boulders used in the construction of 34C suggests that this was both a religious and a high status site. Excavation potential is excellent. This site should be preserved.

Site 35

This is a probable habitation site or field work shelter area including two small platforms. These are located along the top of a small break in the slope in an area of kiawe trees in the NE corner of Sheet 5.

Site 35A is a roughly rectangular platform measuring 8 ft (2.438 m.) E/W by 13 ft (3.962 m.) N/S, with a roughly level surface of boulders, built onto a natural bedrock outcrop. In the SE corner of the platform is a small cupboard measuring 2.5 ft (.762 m.) by 2 ft (.620 m.) by 1 ft (.305 m.) deep. No midden or artifacts were observed. The excavation potential of this site is fair to poor.

Site 35B is another small platform that was also probably a small field shelter. This platform measures 14 ft (4.267 m.) N/S by 11 ft (3.353 m.) E/W with a fairly rough surface of boulders and cobbles. The only visible facing is on the east side, which consists of an alignment of boulders a maximum of 1.5 ft (.457 m.) high. The excavation potential of Site 35B is fair to poor. Just upslope (north) of these two field shelter features is an area of relatively level soil which was probably fields.

Site 36

Site 36 is a rather mounded platform that is probably a rock clearance feature but may be a possible burial, located in the NE corner of Sheet 5. This site is situated on the top of a bluff and measures 6 ft (1.829 m.) E/W by 12 ft (3.658 m.) N/S with a maximum height of 2.5 ft (.762 m.). No midden, artifacts, or coral were observed. The excavation potential of this site is low.

Site 37 (Figs 26, 27)

Site 37 designates the old railroad berm which runs through much of the project area, generally running from the northwest in the direction of the McBryde Mill toward the southeast and Kōloa Landing. The Kōloa Sugar Company first acquired four miles of 30 inch gauge track in 1883, however, the 1891 Monsarrat map shows track extending only east of Kōloa Hill and not in the vicinity of the project area. A 1910 Hawaiian Territorial Survey map clearly shows the present berm alignment as railroad. The railroad was built through the project area in the late 1890's by McBryde Sugar Co.

While several portions of this railroad berm have been destroyed, some of the stretches that do remain are quite impressive and are a tribute to the dry stone workers of the 19th Century. The best section of the berm construction is just seaward of a marshy area (which it retains) located in the NE side of Sheet 5 (Figs 26, 27). This consists of a berm constructed of boulders in dry stone work measuring about 30 ft (9.144 m.) across at the base, 15 to 20 ft (4.572 to 6.096 m.) high, and 18 ft (5.486 m.) across at the top. The top of the berm is quite level with a gravel surface. This portion of the berm should be preserved as it is the most impressive land-use construction within the project area. On the best preserved section at the

Fig. 26 High section of Railroad Berm (Site 37) mauka end of Prince Kuhio Park, View North.

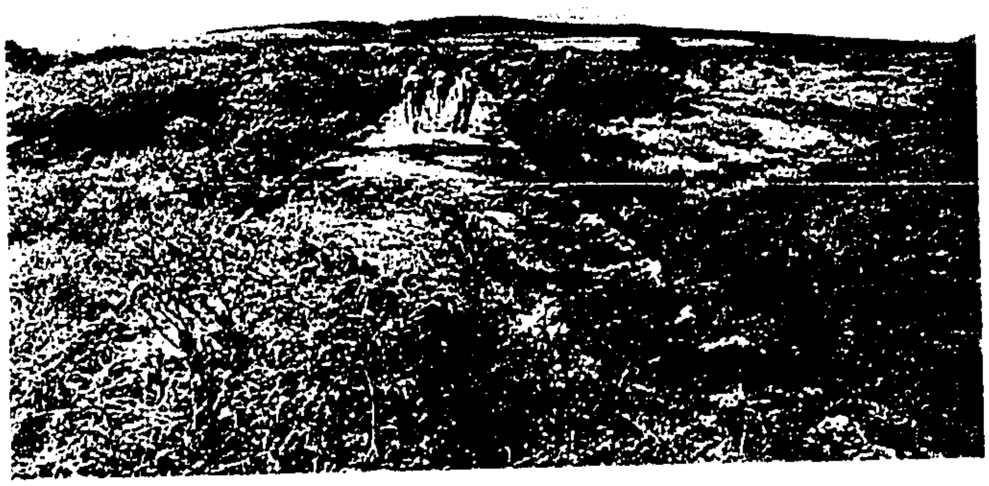

Fig. 27 Top of Railroad Berm (Site 37), View Northwest.

eastern end of Sheet 5, there is an abandoned iron train car made in Glasgow Scotland.

Site 38 (Fig. 28, 29, 30)

Site 38 is a well defined agricultural complex just upslope from Kuhio Park, located in the center of the east side of Sheet 5, consisting of terraces, retaining walls, ditches (<u>auwai</u>), fields, and a circular platform. The upper portions of this agricultural complex are characterized by narrow soil terraces with core filled retaining walls. At the lower base of the slope, the fields are larger, like 38B, with low core filled walls. A powerline road with overhead lines cuts through the seaward portion of these fields.

Site 38A (Figs 29, 30) consists of an <u>auwai</u> with raised portions (aqueduct) and associated fields. The <u>auwai</u> is 8 to 11 ft (2.438 to 3.353 m.) wide at its base with a maximum height of 3.5 ft (1.067 m.). The <u>auwai</u> is 3 to 4 ft (.914 to 1.219 m.) wide at the top and in those portions where it is lined with parallel alignments of slabs or uprights, the interior of the ditch is 2 to 3 ft (.610 to .914 m.) wide. This is an excellent example of traditional Hawaiian use of low aqueducts to maximize the efficient use of water.

Site 38B is a well defined rectangular agricultural field measuring 45 by 35 ft (13.716 by 10.668 m.). This field is bounded by low 1.5 feet (.457 m.) high and 2 foot (.610 m) wide walls. The interior of the field is rocky soil with a very large

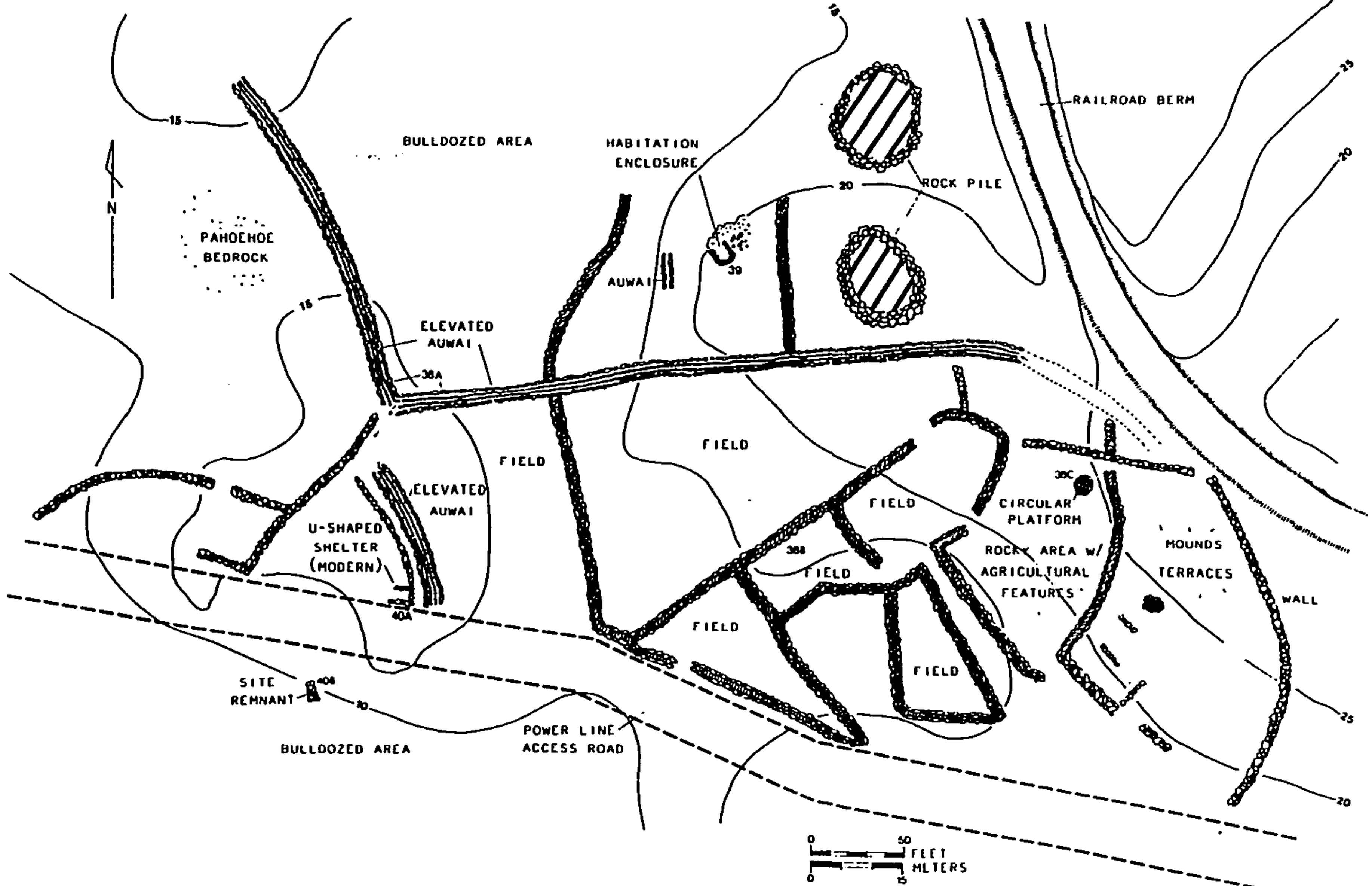

Fig 28 Sites 38-40. Plan View. (Map Sheet 5)

Fig. 29 Site 38A, Raised <u>Auwai</u>, View to West.

Fig. 30 Site 38A, View of Slab Lining on South Side of <u>Auwai</u>.

Tamarind Tree growing out of the center.

Site 38C is a roughly circular platform, 10 ft (3.048 m.) in diameter, faced with uprights on the north side to a maximum height of 2.5 ft (.762 m.). This feature appears to be situated at the bifurcation of an auwai with the probability that water could be deflected to the east or the west at this point. This platform may have been created as a clearance mound or as a water diversion feature, but its uprights (5) may be indicative of a burial and/or other religious functions. This feature is located in an agricultural terrace. Taken together, Site 38 forms one of the very best agricultural complexes in the site area and ideally would be preserved and/or rehabilitated.

Site 39 (Fig. 28)

Site 39 is a probable habitation enclosure or field shelter located in the center of the east side of Sheet 5. This takes the form of a small rectangular enclosure measuring 5 ft (1.524 m.) N/W by 8 ft (2.438 m.) E/W (interior dimensions) with a back wall 2 ft (.610 m.) high and 3 ft (.914 m) wide built on the edge of a bedrock bluff overlooking what is now a bulldozed field. Immediately adjacent to this enclosure is a rough pavement which has been somewhat leveled with cobbles and pebbles. A raised auwai passes 80 ft (24.384 m.) to the south. No midden or artifacts were observed. The excavation potential of this site is poor.

Site 40 (Fig. 28)

Site 40 is a continuation of agricultural fields and the raised auwai of Site 38. This site designation includes an U-shaped shelter and a bulldozed remnant of what was probably once a sizeable platform located in the east-central portion of Sheet 5 just north of the powerline road.

Site 40A is a U-shaped possible habitation shelter measuring 8 ft (2.438 m.) N/W by 9 ft (2.743 m.) E/W with a maximum height of 3 ft (.914 m.). The back wall (to the NE) is actually part of a well built terrace wall. The north wall, 3 ft (.914 m.) high and 3 ft (.914 m.) wide is built against this older terrace wall. The presence of many historics in the area suggest recent use of the site which is probably completely historic as the south wall of the U-shape is a bulldozer push pile. Thus the archaeological potential would seem to be nil.

The only visible remnant of Site 40B is an 11 ft (3.353 m.) facing which appears to be the SE corner of a large platform. This site was bulldozed from the north during construction of the powerline road and has been impacted from the south by resort development. The archaeological potential of this remnant is fair to poor.

Site 41 (Fig. 31)

Site 41 includes a number of minor modifications within and abutting a sink with standing water (41B) and an enclosure damaged by bulldozing 100 ft (30.48 m.) to the SW. These site

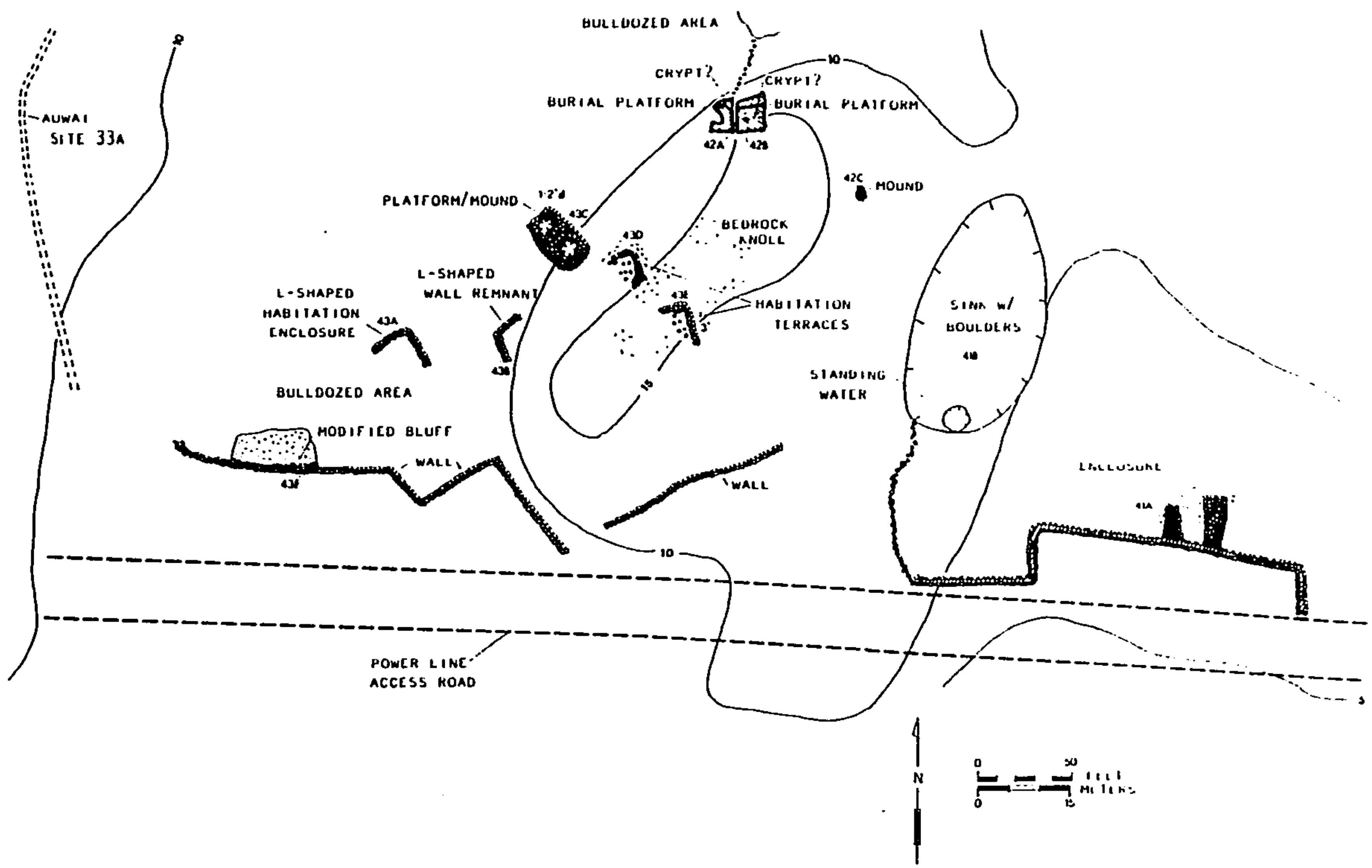

Fig 31 Site Complexes 41, 42, and 43, Plan View (Map Sheet 5)

features are located in the central portion of Sheet 5.

Site 41A was originally perceived to be two adjacent structures, however, further scrutiny suggests that they are, in fact remnants of a rectangular habitation enclosure site, constructed abutting a well built core filled wall to the south, which was later bulldozed along its north side, particularly in the NW corner. The eastern remnant of this sites appears as a platform measuring 20 ft (6.096 m.) N/S by 11 ft (3.353 m.) along the core filled wall to the south. This remnant is cobble paved and somewhat mounded with a maximum height of 2 ft (.610 m.) and a possible cupboard in the NE quadrant. The eastern and western remnants of the site are separated by a soil area about 10 ft (3.048 m.) E/W by 20 ft (6.096 m.) N/S which was probably the major habitation area. The western site remnant has the appearance of a short ramp-like feature abutting the field wall to the south. This roughly paved area is 17 ft (5.182 m.) long N/S, 8 ft (2.438 m.) wide at the wall to the south, and 5 ft (1.524 m.) wide at the north end. The south end of this remnant is level with the wall (2.5 ft or .762 m. high) while the north end is level with the ground surface. The excavation potential of Site 41A is fair.

Site 41B consists of a number of relatively minor modifications immediately to the east and north of a sink with a small pond of standing water. This large oval sink is approximately 130 ft (39.624 m.) N/S by 60 ft (18.288 m.) E/W with a standing water puddle 15 ft (4.752 m.) in diameter at the southern end.

The most notable modification is a short (about 15 ft or 4.752 m. long) terrace-like retaining wall at the SE portion of the sink. Other portions of the sink suggest some small efforts at leveling and a couple of other probable alignments were observed. While the archaeology suggests that there was no substantial modification at this sink, the presence of surface water suggests that this area may have been significant in prehistoric times and the archaeological potential of Site 41B is thus fair.

Site 42 (Fig. 31)

Site 42 consists of three platforms which are all probable burials. These three features are located in the central portion of Sheet 5 with the adjacent structures 42A and 42B being situated at the top of a low knoll.

Site 42A is the western platform of a pair of platforms. It has the appearance of a roughly rectangular platform extending out to the west to form a small C-shape open to the west. The eastern portion of this platform measures 6 ft (1.829 m.) E/W by 17 ft (5.182 m.) N/S with extensions on the north and south to the west, measuring about 5 ft (1.524 m.) E/W by 3 ft (.914 m.) N/S. The interior of the C-shape is mostly soil with the eastern portion of this feature being a paved platform. In the northern portion of this platform is a 4 ft (1.219 m.) long alignment of set in uprights with a NE/SW orientation and with a 6.5 ft (1.981 m.) long perpendicular alignment of set in uprights extending to the SE. Within these alignments the surface appears better paved, but somewhat collapsed. This is assumed to be a burial.

Other burials may be located within this platform. The excavation potential of this feature for encountering a burial is excellent.

Site 42B is the eastern platform which is roughly trapezoidal in shape, measuring 14 ft (4.267 m.) along its south wall, 7 ft (2.134 m.) along its west wall, 18 ft (5.486 m.) along its east wall, and 21 ft (6.401 m.) along its north wall which extends from NE to SW. It has a somewhat mounded appearance with a boulder paved surface and a probable crypt in the center. The SE corner of this presumed crypt suggests hollow construction. A low boulder alignment extends northward from the NE corner of the platform for 30 ft (9.144 m.) to an area of exposed pahoehoe bedrock which has been roughly leveled by filling in cracks with cobbles and pebbles. This alignment is then discontinuous for another 20 ft (6.096 m.). The northern edge of the low knoll with 42A and 42B on its summit has a small rock terrace of boulders and cobbles, but this may be the result of bulldozing.

Site 42C has the appearance of a small clearing mound, measuring 3 ft (.914 m.) N/S by 7 ft (2.134 m.) E/W and a maximum height of 1.5 ft (.457 m.). It is built of piled boulders and cobbles and has a sandstone cobble on the NW corner. However, as it is only 72 ft (21.946 m.) from 42B, the likelihood that it is also a burial is fairly high. The excavation potential of C is fair depending on A and B.

Site 43 (Fig. 31)

Site 43 consists of five designated features which probably include both habitation and agricultural constructions. These are located in the center of Sheet 5 and are situated immediately SW of Site 42 and just north of bulldozing associated with the construction of the powerline road. This bulldozing severely impacts some of the Site 43 features and probably destroyed other features that were contextually associated with what remains.

Site 43A is an L-shaped habitation site situated on a low knoll and may be the remnant of a former enclosure which was bulldozed on the south and west sides. Both the NE and NW legs of this "L-shape" measure 22 ft (6.706 m.) long. The NE portion of the site has a facing of single upright boulders. The walls of this L-shape are 1 to 2 ft (.305 to .610 m.) high and 5 ft (1.524 m.) wide. This site has fair excavation potential.

Site 43B is a probable agricultural field wall which has the appearance of an L-shaped low mounded wall. The NW and NE legs of this L-shape are both 20 ft (6.096 m.) long. This wall is 8 ft (2.438 m.) wide and 1 to 2 ft (.305 to .610 m.) high. This site was probably the corner of agricultural fields. Several small clearance mounds were observed in the immediate area.

Site 43C is a roughly rectangular mounded platform measuring 30 ft (9.144 m.) NW/SE by 20 ft (6.096 m.) NE/SW and averaging about 2 ft (.610 m.) high. This is a probable habitation feature. The NW portion of this platform is particularly well faced. At either end of the central axis of this mound there is a roughly circular depression, 4 to 5 ft (1.219 to 1.524 m.) in diameter and 1 to 2 ft (.305 to .610 m.) deep. The excavation potential of this site is fair.

Site 43D is a roughly rectangular terrace situated on the SW edge of a bedrock knoll. This probable habitation feature measures 19 ft (5.791 m.) E/W by 14 ft (4.267 m.) N/S and has a rocky surface. This site is in relatively poor condition. Excavation potential is fair.

Site 43E is a pair of probable habitation terraces. The main terrace is roughly L-shaped, measuring 11 ft (3.353 m.) SW/NE by 18 ft (5.486 m.) NW/SE. The back wall is of stacked boulders with a maximum height of 3 ft (.914 m.). In the rocky interior of this terrace is a large upright, possibly indicating a hearth. Joining this terrace on the south side is another small probable habitation terrace with an 8 ft (2.438 m.) long wall.

Site 43F is a modified bluff site which would have had a good ocean view prior to resort construction, as it stands 7 to 10 ft (2.134 to 3.048 m.) above the surrounding terrain. The modification is fairly minimal with rough facing on the south end of the bluff. The immediate area consists of soil areas in bedrock and crude facings suggesting fields. Midden was observed on the west end of the bluff. Excavation potential is fair.

Site 44 (Fig. 22)

Site 44 is another habitation and agriculture complex, including thirteen designated features, associated with the branching of a major well defined <u>auwai</u> at what must have been one of the most seaward extensions of intensive Hawaiian agriculture in the Poipu area. This site complex is located in the west central portion of Sheet 5 and extends to within about 200 ft (60.96 m.) of the sea. This is one of the most extensive habitation areas within the project area and has the appearance of a residential complex of relatively small enclosures. Most of these are single or double component type features, but a few like F, G, H are multi-component sites. To the west of this complex is a rocky disturbed area adjacent to cane fields, to the east is bulldozed, and to the south is bulldozing and modern buildings.

Site 44A is a large rectangular enclosure measuring 40 ft (12.192 m.) N/S by 18 ft (5.486 m.) E/W (interior dimensions). The east and west walls show remnants of interior uprights. The walls average 3 to 5 ft (.914 to 1.524 m.) wide and 1 to 1.5 ft (.305 to .457 m.) high. The interior is of relatively rock free soil with a Banyan tree growing in the center. This is a probable walled field, but is a possible habitation site. A fragment of water rounded stone was observed. Excavation potential is fair.

Site 44B consists of two small rough platforms. The main structure is a rectangular platform with rough cobble paving and rough facing on all four sides. This platform measures 14 ft (4.267 m.) N/S by 11 ft (3.353 m.) E/W and 1.5 to 2 ft (.457 to .610 m.) high and is a possible field shelter. A slight depression in the center of the top of this platform may indicate burials.

Fifteen feet (4.752 m.) to the south of this platform is a second smaller rough platform measuring 7 ft (2.134 m.) E/W by 10 ft (3.048 m.) N/S. This is a field clearance mound or burial. The surrounding area contains several small clearance mounds.

Site 44C was used to designate a mounded wall with two shelters or small planting areas abutting it and two separate circular enclosures. The mounded wall, 3 ft (.914 m.) high by 6-8 ft (1.83 - 2.44 m.) wide extends for 40 ft (1.219 m.) roughly N/S with two stone lined depressions abutting the wall and built into it. These may have been shelters or small planting areas. The best constructed of these depressions is on the NE corner of this feature, is 10 ft (3.048 m.) square, and has uprights on the east, north, and west sides. The other depression is in the NW corner, but is not as formal.

Twenty feet (6.096 m.) southeast of the mounded wall are two adjacent roughly circular enclosures which are approximately 12 ft (3.658 m.) apart on a N/S line. The northern shelter is approximately 6 ft (1.829 m.) in diameter (interior) with the highest portion of the wall, on the west in fair to poor condition and 1.5 ft (.457 m.) high. The southern enclosure has interior dimensions of 7 by 8 ft (2.134 by 2.438 m.) with the walls broken down to the north and east. These could be small shelter sites or planting areas. Archaeological potential is fair.

Site 44D is a small rectangular enclosure measuring 8 ft

(2.438 m.) N/S by 7 ft (2.134 m.) E/W (interior dimensions) with the west wall broken down and the south wall disturbed by bulldozing. The NE wall consists of uprights 1.5 ft (.457 m.) high and 4 ft (1.22 m.) wide. This site has banyan roots and <u>Koa haole</u> growing out of the center and was probably a field shelter. Archaeological potential is fair.

Site 44E is a probable habitation enclosure with a long cupboard on the north side. This roughly rectangular enclosure measures 13 ft (3.962 m.) N/S by 15 ft (4.752 m.) E/W in exterior dimensions with an interior of 8 by 9 ft (2.438 by 2.743 m.) with walls 5 - 6 ft (1.52 - 1.83 m.) wide. A banyan tree grows in the enclosure. The maximum height of the enclosure is 3 ft (.914 m.) in the south side. Two possible post holes are spaced along the east side. Abutting the northeast corner of the enclosure and extending to the north is a cupboard-like feature, 10 f (3.048 m.) long by 2 to 3 ft (.610 to .914 m.) wide, constructed with set interior uprights. Ten feet (3.048 m.) to the north of the cupboard is a 10 ft (3.048 m.) square paved area constructed directly on bedrock.

Site 44F is a large probable habitation enclosure with adjoining features on the west side. The main enclosure is 45 ft (13.716 m.) long N/S and about 18 ft (5.486 m.) wide E/W in exterior dimensions. This main enclosure is divided by an interior wall into a north room with interior dimensions of 12 ft (3.658 m.) N/S by 13 ft (3.962 m.) E/W and a south room with interior dimensions of 12 ft (3.658 m.) N/S by 15 ft (4.752 m.) E/W. The south room is in poor condition and appears to have been partially bulldozed. On the west side of the south room is an adjoining enclosure measuring 12 ft (3.658 m.) N/S by 6 ft (1.829 m.) E/W with a wall 4 ft (1.219 m.) wide on all sides. On the west side of the north room is an adjacent C-shape feature open to the west. This C-shape has an interior measuring 7 by 7 ft (2.134 by 2.134 m.) with walls 4 ft (1.219 m.) wide and 2 ft (.610 m.) high. The floor of the three enclosures and the C-shape is soil for the most part. No midden was observed, but a sandstone manuport was noted. Excavation potential is fair to good.

Site 44G consists of a roughly rectangular, probable habitation enclosure, a small platform, and a soil area in between them. The enclosure measures 14 ft (4.267 m.) E/W by 18 ft (5.486 m.) N/S in exterior dimensions with an interior 6 ft (1.829 m.) E/W by 10 ft (3.048 m.). This enclosure has a probable entrance (6 ft or 1.829 m. wide) on the west side and a soil interior. Several uprights were noted in the SW corner of the enclosure. Ten ft (3.048 m.) to the west is a platform 9 ft (2.743 m.) N/S by 11 ft (3.353 m.) E/W and a maximum height of 2.5 ft (.762 m.) of boulder construction. The soil expanse (about 10 ft or 3.048 m. E/W by 8 ft or 2.438 m. N/S) between the enclosure and the platform is though to have been part of the habitation structure. Excavation potential is fair.

Site 44H is a large rectangular habitation enclosure with an exterior measuring 24 ft (7.315 m.) N/S by 21 ft (6.401 m.) E/W and an interior measuring 19 ft (5.791 m.) N/S by 15 ft (4.572

m.) E/W. This enclosure has well faced interior walls, particularly on the west side, with a maximum height of 2.5 ft (.762 m.) and wall widths of 6 ft (1.83 m.). This enclosure has a level soil interior. An alignment extends ESE from the SE corner of the enclosure for 24 ft (7.315 m.) and consists of small uprights but with one large upright slab abutting the east wall of the enclosure. This alignment appears to continue to the south intermittently. A less defined alignment extends south of the west wall of the enclosure. These alignments suggest a poorly defined platform abutting the main enclosure to the south with a possible entrance in the SE corner. The large upright at the SE corner of the main enclosure may be related to a hearth or altar. The excavation potential of this feature is fair to good.

Site 44I is a C-shape probable habitation site. The exterior of this C-shape measures 9 ft (2.743 m.) E/W by 11 ft (3.353 m.) N/S and the interior is 6 ft (1.829 m.) E/W by 8 ft (2.438 m.) N.S. This C-shape is open to the west, has a maximum height at the back of 3 ft (.914 m.) and a soil interior. No artifacts or midden were observed. Excavation potential is fair to poor. Sixteen feet (4.877 m.) to the east of 44I is a leveled 4 by 3 ft (1.219 by .914 m.) slab with a piled stone alignment extending 12 ft (3.658 m.) off of its eastern side.

Site 44J consists of two adjoining enclosures. The larger enclosure is rectangular in shape with exterior dimensions of 25 ft (7.62 m.) E/W by 20 ft (6.096 m.) N/S and interior dimensions of 16 ft (4.877 m.) E/W by 11 ft (3.353 m.) N/S with 9 ft (2.74

m.) wide walls. This enclosure has a soil interior, no obvious entrance, and a maximum interior wall height of 3 ft (.914 m.). Adjoining the SE corner of this enclosure is a smaller rough enclosure with an interior of 8 by 4 ft (2.438 by 1.219 m.). The SW portion of this is in the best condition, with a maximum height of 1.5 ft (.457 m.). No midden or artifacts were observed. Excavation potential is fair.

Site 44K is a roughly oval enclosure with exterior dimensions of 13 ft (3.962 m.) N/S by 15 ft (4.572 m.) E/W and interior dimensions of 6 ft (1.829 m.) N/S by 8 ft (2.438 m.) E/W with walls 3 ft (.914 m.) high and 7 - 8 ft (2.13 - 2.44 m.) wide. It is built of stacked boulder construction, however, the interior is somewhat outlined by uprights. This probable habitation enclosure is in poor/fair condition with much interior collapse. This site is within 20 ft (6.096 m.) of major bulldozing for the powerline road. The excavation potential of this site is fair to poor.

Site 44L is a circular enclosure with an exterior diameter of 14 ft (4.267 m.) and an interior diameter of 7 ft (2.134 m.). This possible habitation enclosure has walls with a maximum height of 2 ft (.610 m.) and width of 7 ft (2.13 m.), a soil interior, and a possible entrance on the west side. No midden or artifacts were observed. The excavation potential of this site is fair to poor.

Site 44M is a possible C-shape in very poor condition. The back wall of stacked boulders is 5 ft (1.524 m.) long and 2.5 ft

(.762 m.) high and 6 ft (1.83 m.) wide. The interior of this probable habitation is 4 ft (1.219 m.) N/S by 7 ft (2.134 m.) E/W. This structure is located at the edge of a bulldozed area and was probably impacted by bulldozing. The excavation potential of this site is poor.

Site 45 (Fig. 22)

Site 45 is a platform with possible burials located in the NW corner of Sheet 5 in close proximity to active sugar cane cultivation and adjacent to a long unused, but possibly historic <u>auwai</u> (ditch). The probable platform has been greatly impacted by a large banyan tree and possibly by historic modifications and bulldozing as well. The only remnant visible is a 13 ft (3.962 m.) long alignment on the eastern side of the crypt. The crypt itself is defined by 5 set-in uprights and is approximately 4 by 6 ft (1.219 by 1.829 m.) with a slightly collapsed interior. The excavation potential for encountering a burial is good.

Site 46 (Fig. 32)

Site 46 consists of five designated features which are in reality a continuation of the Site 38 features to the west. These generally appear to be agricultural features, but some of them may have been habitation features. This site is located in the SW side of Sheet 2, just upland of Prince Kuhio Park.

Site 46A is a small rectangular enclosure with exterior dimensions of 16 ft (4.877 m.) N/S by 18 ft (5.486 m.) E/W and

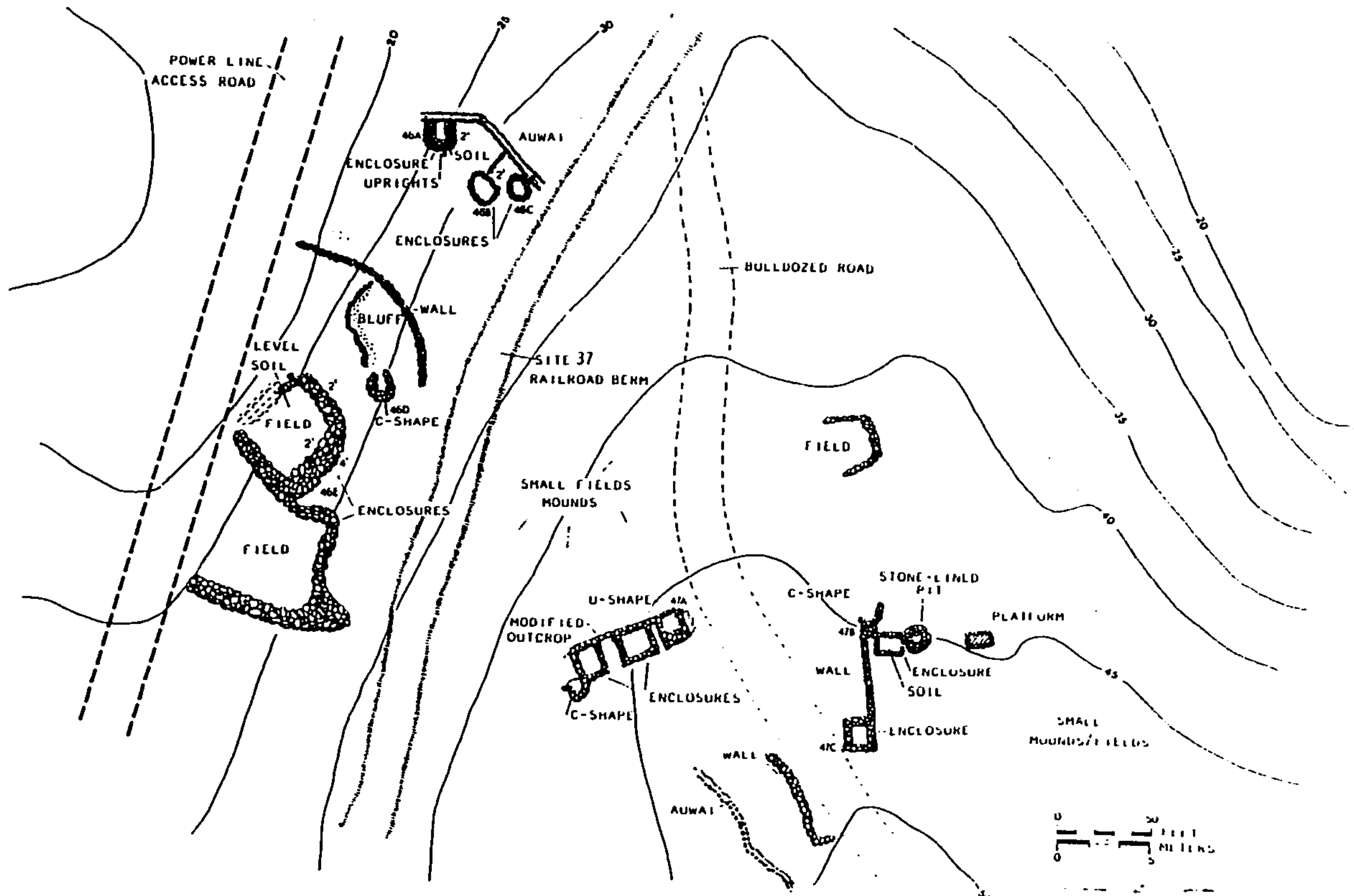

Fig 32 Site Complexes 46 and 47, Plan View, (Map Sheet 2)

Fig. 33 Site 47A, C-Shaped Shelter, View Northeast.

Fig. 34 Site 49B, Paved Rectangular Platform, View to Southwest.

interior dimensions of 6 ft (1.829 m.) by 7 ft (2.134 m.) E/W. There is a probable entrance on the west side. Three uprights delineate the eastern interior facing which has a maximum height of 1.5 ft (.457 m.). The walls are mounded and core filled with a maximum height of 2 ft (.610 m.) and widths of 8 - 11 ft (2.44 - 3.35 m.). The interior is of relatively level soil. It is unclear whether this is an agricultural or a habitation site. No artifacts or midden were observed. The excavation potential of this site is poor.

Site 46B is a small oval enclosure situated on a slope about 40 ft (12.192 m.) seaward of the railroad berm, much like 46A in that it could be either an agricultural or a habitation feature. The exterior dimensions of this enclosure are 16 ft (4.877 m.) N/S by 18 ft (4.586 m.) E/W and the interior dimensions are 9 by 9 ft (2.743 by 2.743 m.). There is a probable entrance in the SW corner. The walls are of piled boulders with a maximum exterior height of 2.5 ft (.762 m.) and a maximum interior height of 1.5 ft (.457 m.) and widths of 8 - 9 ft (2.44 - 2.74 m.). A bedrock ledge on the western side is modified with piled boulders. The excavation potential of this site is poor.

Site 46C is another small oval enclosure, very similar to 46A and 46B, adjacent to an auwai on the west. This possible habitation site has exterior dimensions of 12 ft (3.658 m.) N/S by 15 ft (4.572 m.) E/W and interior dimensions of 6 ft (1.829 m.) by 10 ft (3.048 m.) E/W. The east side wall is 4 ft (1.219 m.) wide with the west side delineated by four uprights set in the

soil. The interior is mostly soil. No artifacts or midden were observed. The excavation potential of the site is fair to poor.

Site 46D is a well constructed C-shape, open to the WSW situated on the edge of a bedrock ledge. The exterior of the structure measures 13 ft (3.962 m.) by 15 ft (4.572 m.) E/W and the interior measures 7 ft (2.134 m.) by 10 ft (3.048 m.) E/W. The back wall has a maximum height of 3.5 ft (1.967 m.), is 5 ft (1.524 m.) thick and is of stacked boulder construction. The interior is mostly soil. No artifacts or midden were observed. Excavation potential is fair.

Site 46E is a large, roughly rectangular probable agricultural field or lo'i (irrigated terrace) and two adjacent similar, but severely bulldozed fields. The best preserved field is somewhat irregular with a north wall 50 ft (15.24 m.) long, a 42 ft (12.802 m.) long east wall and a 33 ft (10.058 m.) long west wall. The south side of the enclosure has been severely impacted by bulldozing, associated with the powerline road, which has destroyed a 33 ft (10.058 m.) long section of the enclosure. The north wall is the most massive, measuring 11 ft (3.353 m.) wide with an exterior height of 1 ft (.305 m.) and an interior height of 4 ft (1.219 m.). The other walls range from 6 to 8 ft (1.829 to 2.438 m.) wide and from 2 to 4 ft (.610 to 1.219 m.) high. The walls are quite mounded and are mostly constructed of piled cobbles. The interior of this enclosure is relatively level rock free soil. Adjoining this enclosure to the east is another similar enclosure, but this is not as well defined. Both the east and south walls of this enclosure have been bulldozed. The interior of the adjacent enclosure is rock, with short terraces, 6 to 12 ft (1.829 to 3.658 m.) long of piled pebbles and cobbles following the contour. Seaward of this adjoining enclosure is another disturbed lo'i-like enclosure, but it is cut on the east by bulldozing and on the north by railroad excavation. The excavation potential of these fields is poor.

Site 47 (Figs 32, 33)

Site 47 is a complex of habitation and agricultural features including three designated features. These features are situated in the upslope apex of a large Koa haole grove with open bulldozed pasture on the east, north, and west sides. This triangle appears to coincide with a LCA to "ABM". This area has an auwai entering the area from the NE and continuing down the east side of the complex. This is the raised auwai located in the SE corner of Map #1. The general area is rocky, but with several fairly well defined linear mounds of cobbles and boulders piled on bedrock outcrops which suggest substantial agricultural activity. Site 47 is really a continuation of Sites 38 and 46.

Site 47A (Fig. 33) includes a large modified outcrop and adjoining habitation features, C-shapes, and enclosures. The major portion of 47A is 72 ft (21.946 m.) long modified outcrop running NW to SE with a small U-shape in the NW portion, a "main enclosure" in the middle, another enclosure at the SE end, and a small C-shape east of the southeast enclosure. The main enclo-

sure has exterior dimensions of 19 ft (5.791 m.) SE/NW by 17 ft (5.182 m.) NE/SW and interior dimensions of 12 ft (3.658 m.) SE/NW by 7 ft (2.134 m.) NE/SW. The interior of this enclosure is delineated by stacked boulder facings and a few uprights, ranging in height from 1 to 2 ft (.305 to .610 m.). The interior of this enclosure is of loose cobbles over soil. Adjoining the NW side of this enclosure, on a bedrock outcrop, is a small U-shaped shelter presently measuring 5 ft (1.524 m.) SE/NW by 7 ft (2.134 m.) NE/SW. However, it appears as if the back wall has collapsed and that it would probably have been 7 ft (2.134 m.) SE/NW by 11 ft (3.353 m.) NE/SW. The L-shape is open to the SW. Adjoining the SE side of the main enclosure is another enclosure (the SE enclosure) measuring 9 ft (2.743 m.) NE/SW by 12 ft (3.658 m.) SE/NW. Although no midden or artifacts were observed, the excavation potential for 47A is fair to good.

Site 47B consists of three adjacent structures, including an oval stone lined pit, a small rectangular enclosure, a C-shape, and a platform 20 ft (6.096 m.) to the south. The pit measures 5 ft (1.524 m.) E/W by 7 ft (2.134 m.) N/S in interior dimensions, with a maximum interior height of 2.5 ft (.762 m.). The interior is well faced with stacked boulders. This pit has a level soil interior. The pit has an exterior diameter of about 15 ft (4.572 m.). This is a probable agricultural product storage feature. Just south of the pit is a rectangular enclosure with an interior 8 ft (2.438 m.) E/W by 12 ft (3.658 m.) N/S, walls of stacked boulders 1 to 2 ft (.305 to .610 m.) high, and 7 ft (2.743 m.)

NE/SW by 12 ft (3.658 m.) SE/NW. There is about 10 ft (3.048 m.) of bedrock between these enclosures. The interior of the SE enclosure is mostly soil. Adjoining the ESE corner of the SE enclosure is a C-shape feature in poor condition measuring 5 ft (1.524 m.) SE/NW by 8 ft (2.438 m.) NE/SW and open to the SW. Although no midden or artifacts were observed, the excavation potential for 47A is fair to good.

Site 47B consists of three adjacent structures, including an oval stone lined pit, a small rectangular enclosure, a C-shape and a platform 20 ft (6.096 m.) to the south. The pit measures 5 ft (1.524 m.) E/W by 7 ft (2.134 m.) N/S in interior dimensions, with a maximum interior height of 2.5 ft (.762 m.). The interior is well faced with stacked boulders. This pit has a level soil interior. The pit has an exterior diameter of about 15 ft (4.572 m.). This is a probable agricultural product storage feature. Just south of the pit is a rectangular enclosure with an interior 8 ft (2.438 m.) E/W by 12 f (3.658 m.) N/S, walls of stacked boulders 1 to 2 ft (.305 to .610 m.) high, and 3 ft (.914 m.) wide, and has a level soil interior. Just SW of this enclosure is a C-shape remnant with a back wall 3.5 ft (1.067 m.) high by 4 ft (1.219 m.) thick. This C-shape appears to be open to the SW, but there is no south wall. Twenty feet (6.096 m.) to the north of the pit feature is a small boulder paved platform measuring 12 ft (3.658 m.) N/S by 7 ft (2.134 m.) E/W and with a maximum height of 1.5 ft (.457 m.). No midden or artifacts were observed at any of these structures. Excavation potential is fair.

Site 47C consists of one small rectangular enclosure with external measurements of 18 ft (5.486 m.) E/W by 16 ft (4.877 m.) N/S and internal measurements of 10 ft (3.048 m.) E/W by 11 ft (3.353 m.) N/S. The walls consist of piled cobbles with a maximum height of 2 ft (.610 m.) and widths of 5 - 8 ft (1.52 - 2.44 m.). The enclosure has an opening to the SW and a soil interior. There appears to have been some field clearance in the immediate vicinity of this probable habitation enclosure. No artifacts or midden were observed. Excavation potential is fair.

Site 48

Site 48 consists of two designated features which have both been so heavily impacted by bulldozing that it is difficult to ascertain their original function. They are located in the SE portion of Sheet 2 in a large area of extensive bulldozing.

Sites 48A has the present appearance of a linear mound, 25 ft (7.62 m.) long E/W by 7 ft (2.134 m.) wide N/S, with a circular alignment 13 ft (3.961 m.) in diameter at the west end. The linear mound, which has an average height of 1.5 ft (.457 m.), may be a result of bulldozing, but the presence of a substantial amount of midden and some historic artifacts (glass and ceramics) suggest that this was once a habitation site. The circular alignment is the probable lower course of a platform which was completely bulldozed. Excavation potential is poor.

Site 48B has the appearance of a large oval bulldozed rock pile adjacent to the NE corner of a rectangular field. The rock pile measures 70 ft (21.336 m.) E/W by 50 ft (15.24 m.) long N/S and has possible paving on the north side. The adjacent field measures 50 ft (15.24 m.) N/S by 60 ft (18.288 m.) E/W with low (1 to 2 ft or .305 to .610 m.) barely discernable mounded walls. Some coral was observed in the facing of the south field wall. Excavation potential is poor.

Site 49 (Fig. 34)

Site 49 consists of two platforms (49A and 49B), both of which have been severely impacted by bulldozing, located in the NE portion of Sheet 2. These sites are situated just east of an area of auwai, field walls, and lo'i.

Site 49A has been severely impacted by bulldozing, but the remaining feature has the appearance of a T-shape platform. This platform measures 32 ft (9.754 m.) N/S (the bottom portion of the T) by 49 ft (14.035 m.) E/W (the bar of the T). The limbs of the "T" vary in width from 8 ft (2.438 m.) to 13 ft (3.962 m.). The surface of the fairly level platform is of pebbles, cobbles, and boulders. Large boulders, up to 3.5 ft (1.967 m.) in diameter have been bulldozed onto this pavement. Indigenous artifacts observed included flakes, a broken sandstone bowl shaped vessel (possibly a mortar or a lamp), a waterworn cobble, plus numerous historic artifacts. Excavation potential is good.

Site 49B (Fig. 34) is a rectangular platform well faced on the south and east sides, but appearing to have been bulldozed on the north and west sides. The platform measures about 32 ft

(9.754 m.) E/W by 28 ft (8.534 m.) N/S and is 2 to 3 ft (.610 to .914 m.) above the surrounding terrain. The top surface of the platform is very well constructed with flat slabs, and cobble and pebble chinking between the big flat slabs which produce very nice leveling. A 1.5 ft (.305 m) square depression in the center of the platform 6 inches (15.24 cm.) deep is a probable hearth. This is one of the larger, more well-constructed platforms in the project area and may be a high status residence. Excavation potential is excellent.

Site 50

Site 50 is a large rectangular walled enclosure and adjacent enclosure remnants situated on the SE side of a main auwai and located in the NE corner of Sheet 2. The main enclosure is 110 ft (33.528 m.) square. The walls of the main enclosure average 2 ft (.610 m.) high and are from 4 to 5 ft (1.219 to 1.524 m.) wide. The NW wall, which forms the SE side of a section of the auwai has several large uprights. There are also 2 large uprights, 3 ft (.914 m.) high, set on top of the wall. These may have been used as a shrine, as a vantage point, or for water diversion. Remnants of two other enclosures are located just west and southeast of the main enclosure, but they have been extensively damaged by bulldozing and building construction. These were probably also large well constructed lo'i. The formal nature of the construction suggests that they were probably some of the last maintained agricultural features in the area. The large very well built <u>auwai</u> heads seaward towards Sites 47 and 46 and may in fact be the upslope portion of <u>auwai</u> 38A. The archaeological potential Site 50 is fair.

Site 51 (Figs 35, 36, 37)

Site 51 is a large terraced platform and probable <u>heiau</u> (Kamaloula Heiau?) measuring about 80 by 80 ft (24.384 by 24.384 m.). This site is situated just upslope of a pond/marsh and is located in the NW corner of Sheet 2. This site consists, for the most part, of five relatively discrete terrace levels which are described from base to crest. The lowest visible facing measures 88 ft (26.822 m.) long (NW to SE) and averages about 25 ft (7.62 m.) wide. This is the most indefinite of the terrace levels and the surface of this terrace slopes steeply seaward. At the eastern side of this terrace is a ramp-like feature some 12 to 15 ft (3.658 to 4.572 m.) wide, but this may in fact have been from historical modification of this whole area. Rusted railroad track was noted on this ramp-like feature.

Terrace 2 (Fig. 36) is paved with cobbles and pebbles and averages about 20 ft (6.096 fm.) wide. This terrace is fairly level, but slopes slightly to the west towards the presently large boulders piled on the terrace at both the west and east sides with a few in the central portion as well.

Terrace Level 3 (Fig. 37) is a maximum of 4.5 ft (1.372 m.) higher than terrace Level 2, is fairly level and is paved with pebbles, cobbles, and boulders. The seaward (lower) facing of

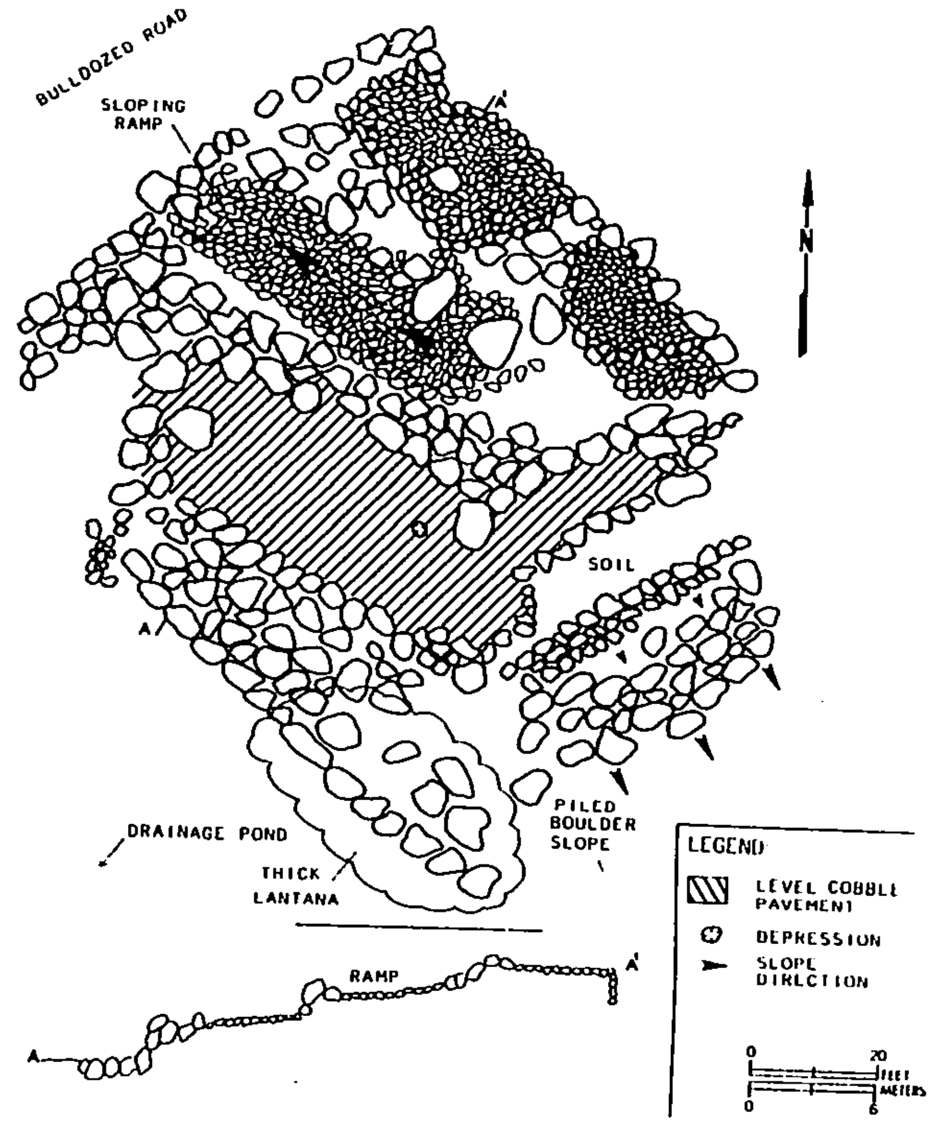

Fig 35 Site 51, Heiau, Plan View and Cross Section (Map Sheet 2)

Fig. 36 Site 51, Heiau, Level 2, View to East.

Fig. 37 Site 51, Heiau, Level 3, View to Northwest.

terrace Level 3 is mostly collapsed, but was constructed of very large boulders -some of which were probably utilized as uprights. Some of these boulders were 3 to 4 ft (1914 to 1.219 m.) in diameter. At the western end of the facing is a large slab 4 by 3 ft (1.219 by .914 m.) by 2 ft (.610 m.) thick. This terrace also has large boulders piled on the eastern side of it and slopes slightly to the west (toward the cane drainage). Terrace Level 3 also averages about 20 ft (6.096 m.) wide.

Terrace Level 4 is less well defined and is only 10 ft (3.048 m.) wide. It is paved primarily with small boulders, but also utilizes many cobbles and pebbles. Again, there are large boulders on top of the terrace surface, particularly on the eastern half. Barbed wire was observed under one boulder which suggests that all of these erratic looking boulders on the terraces are the result of historic disturbance. Terrace Level 4 is only .05 to 1 ft (.152 to .305 m.) higher than terrace Level 3.

Terrace Level 5 is divided into four relatively discrete sections. (A) The eastern section is about 20 ft (6.096 m.) E/W by 15 ft (4.572 m.) N/S and has cobble/pebble paving on the upslope side and boulder paving on the seaward side. There is a possible collapsed pit feature in the central western side. (B) The next division westward is 10 ft (3.048 m.) E/W by 15 ft (4.572 m.) N/W and is 1 ft (.305 m.) higher than the easternmost division. It is cobble and pebble paved. (C) The next division westward is 10 ft (3.048 m.) E/W by 15 ft (4.572 m.) N/S and has pebble and cobble paving on the upslope side and boulder paving

on the seaward side. (D) The western most division is about 24 ft (7.315 m.) long E/W by 20 ft (6.096 m.) N/S. It is generally pebble and cobble paved and has a 6 ft (1.829 m.) square slightly elevated pebble paved central area - which is the highest portion of the site. This site should be preserved.

Site 52 (Fig. 38)

Site 52 is a habitation and agricultural complex of seven designated features including C-shapes enclosures, platform, and mounds. These structures are situated in an area with several field remnants with extensive bulldozing to the north and south, and active cane cultivation just to the east. This complex is located in the east central portion of Sheet 6.

Site 52A includes a well constructed C-shape and field remnants just to the west. This C-shape is constructed utilizing a modified bedrock outcrop on the west side and with exterior dimensions of 11 ft (3.353 m.) N/S by 12 ft (3.658 m.) E/W and interior dimensions of 5 ft (1.524 m.) N/S by 7 ft (2.134 m.) E/W. This structure is open to the east, has a soil interior with some marine shell midden visible. This site is located in an area with sandy soil. A low wall remnant about 40 ft (12.192 m.) long lies just to the east. Excavation potential is fair.

Site 52B is a roughly rectangular habitation enclosure with three components. The primary structure has exterior dimensions of 14 ft (4.167 m.) E/W by 13 ft (3.962 m.) N/S with interior dimensions of 6 ft (1.829 m.) by 7 ft (2.134 m.) N/S. This com-

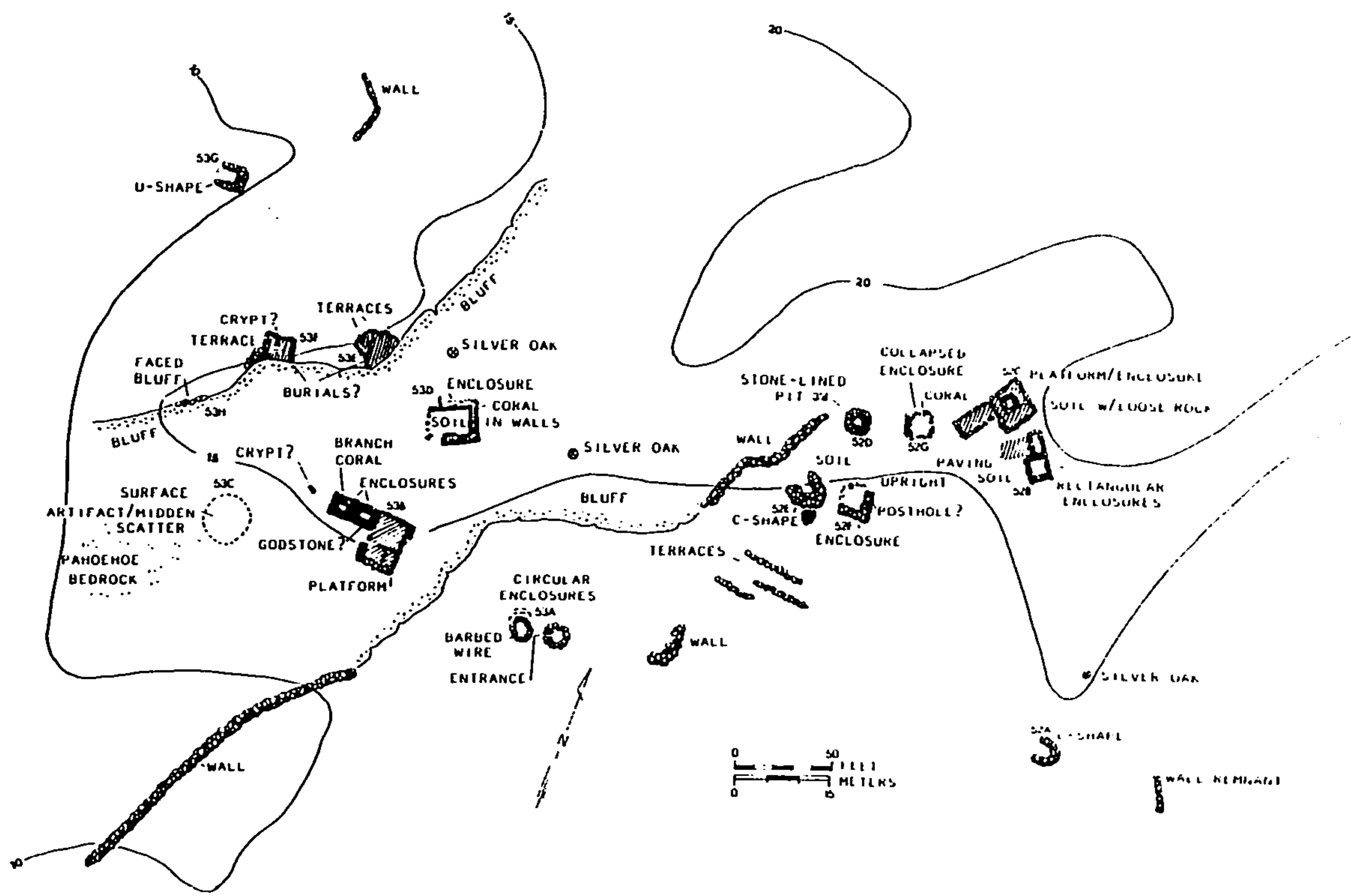

Fig 38 Site Complexes 52 and 53. Plan View. (Map Sheet 6)

partment is well faced on the east and south sides with a maximum exterior wall height of 3.5 ft (1.067 m.) and width of 6 - 8 ft (1.83 - 2.44 m.). There is a probable entrance on the west side.

Adjoining this compartment on the north side is a 6 ft (1.829 m.) N/S by 12 ft (3.658 m.) E/W rectangular enclosure with a soil interior. The NE (back wall) interior height is a maximum of 3.5 ft (1.967 m.). This enclosure is also open to the SW.

To the SW of both of these features is a low, partially paved porch-like area measuring 13 ft (3.962 m.) N/S by 8 ft (2.438 m.) E/W. Midden was observed in the northern enclosure. Excavation potential is good.

Site 52C is a rectangular platform with a low enclosure in the center and an adjoining paved terrace. The platform measures 22 ft (6.706 m.) E/W by 20 ft (6.096 m.) N/S and is roughly paved about 1.5 ft (.457 m.) high. The central interior enclosure measures 7 ft (2.134 m.) E/W by 5 ft (1.524 m.) N/S and has a soil surface with a few loose rocks. There is a low porch-like feature on the SW side measuring 10 ft (3.048 m.) E/W by 20 ft (6.096 m.) N/S. It has a level pavement of boulders with some bedrock slabs visible. There is a possible hearth in the center of this porch-like paving. The excavation potential of this feature is good.

Site 52D is a square stone lined pit of crypt-like construction with upright slabs on the sides. The interior is 4 ft (1.219 m.) square with the surrounding piled rocks roughly 11 ft (3.353 m.) square. The interior has a maximum height of 3 ft (.914 m.) and is very rocky - possibly indicating a collapsed

roof. This site was probably a cupboard. Excavation potential is fair to poor.

Site 52F is a square probable habitation enclosure with an exterior roughly 15 ft (4.572 m.) square and an interior roughly 9 ft (2.743 m.) square. The maximum interior height is 2.5 ft (.762 m.) in the NE portion. The walls of the east and south sides are 5 ft (1.524 m.) thick with the north and west sides poorly defined. There is an upright in the NW corner, a possible post hole in the NE corner, and a possible entrance in the SW corner. The interior is level soil. Excavation potential is fair to good. There are several small mounds in the area.

Site 52G is a square enclosure, 10 ft (3.048 m.) on a side, with walls in very poor condition. There are a few uprights still standing, but the walls have mostly collapsed. The interior is of level soil and exposed bedrock. A few pieces of coral were observed. Excavation potential is poor.

Site 53 (Fig. 38)

Site 53 is another habitation and agricultural complex situated in an area of good soil just SE of Site Complex 52 and located in the east central portion of Sheet 6. This complex consists of eight designated features, including enclosures, platforms, C-shapes, mounds, and walls.

Site 53A consists of two enclosures. The first is a circular probable habitation enclosure with an exterior 15 ft (4.572 m.) in diameter and an interior 7 ft (2.134 m.) in diameter. The maximum wall height is 1.5 ft (.457 m.) and width of 8 ft (2.44 m.) and there is a probable entrance in the SW side. The interior is mostly soil. Excavation potential is fair.

Five feet (1.524 m.) to the east is an oval enclosure with an exterior measuring 12 ft (3.658 m.) E/W by 13 ft (3.961 m.) N/S and an interior 6 ft (1.829 m.) in diameter. The north portion of this enclosure is largely broken down. A large bale of barbed wire rests on the eastern portion of this feature.

Site 53B consists of a rectangular platform, two adjoining low rectangular enclosures, and a cupboard. The main area is a roughly boulder paved probable habitation platform measuring 18 ft (5.486 m.) E/W by 27 ft (8.23 m.) N/S with a maximum height of 2.5 ft (.762 m.). Adjoining to the west are two rectangular enclosures, each about 12 ft (3.658 m.) E/W by 10 ft (3.048 m.) N/S with interiors about 6 ft (1.829 m.) by 4 ft (1.219 m.) and with a maximum wall height of 1.5 ft (.457 m.) and widths of 6 - 7 ft (1.83 - 2.44 m.). A possible god stone was observed on the easternmost of these enclosures. Ten feet (3.048 m.) to the west of the westernmost enclosure is a small crypt-like construction that was probably a cupboard. It is 3 ft (.914 m.) long E/W by 1.5 ft (.457 m.) wide N/S and outlined by uprights with a maximum height of 1.5 ft (.457 m.). Branch coral and midden were observed suggesting the possibility that the two enclosures are burials. Excavation potential is very good.

Site 53C is a surface scatter of midden and artifacts on pahoehoe bedrock. The observed artifacts include basalt flakes

and hammerstones suggesting a lithic work site. A variety of marine shell midden and coral was observed. A surface collection is recommended.

Site 53D is a large rectangular probable habitation enclosure. The long axis, oriented 250° TN, measures 26 ft (7.928 m.) long with a width of 22 ft (6.706 m.). The wall is in good condition on the north, east, and south sides, with the southwest wall quite broken down. The best wall is the east wall which is 4 ft (1.219 m.) wide and 3.5 ft (1.067 m.) high and is constructed with large boulder facings and a core fill. Pieces of coral are visible in the east and north walls. A few uprights are in the interior of the south wall. This site has a level soil interior. Excavation potential is fair to good. Adjoining the NW corner of the site is a possible L-shaped shelter, 7 ft (2.134 m.) long N/S by 5 ft (1.524 m.) long E/W.

Site 53E consists of two adjoining boulder paved terraces. The upper terrace abuts a bedrock bluff to the east and is 10 ft (3.048 m.)wide E/W by 15 ft (4.572 m.) long N/S. The edges of this terrace are defined on the north and west by alignments of boulders. There is a very large upright, 1 ft (.305 m.) high in the middle of the west side. The lower terrace immediately abuts the upper terrace to the east, and measures 9 ft (2.743 m.) long N/S by 6 ft (1.829 m.) wide E/W. The north, west and south edges of this lower terrace are defined by a boulder alignment a maximum of 2 ft (.610 m.) high. These are possible burials. Excavation potential is good.

Site 53F is similar to Site 53E in that it is a terrace constructed against a bluff that may well contain a burial. This boulder paved terrace is on the north side of a bluff and measures 13 ft (3.962 m.) E/W by 12 ft (3.658 m.) N/S with a maximum height of 2.5 ft (.762 m.). The east, north and west sides are delimited by boulder alignments. In the center of the terrace is a crypt-like feature 5 ft (1.524 m.) long E/W by 2.5 ft (.457 m.) wide N/S, but it could be a cupboard. Many coral fragments, including branch coral, and some midden were observed on this terrace. Excavation potential is good.

Site 53G is a U-shaped probable habitation feature, with an exterior measuring 15 ft (4.572 m.) N/S by 12 ft (3.658 m.) E/W and an interior measuring 6 by 6 ft (1.829 by 1.829 m.). This U-shape is open to the west and has a back wall with a maximum interior height of 2 ft (.610 m.) and width of 6 - 8 ft (1.83 - 2.44 m.). The interior is soil. Excavation potential is poor. The surrounding area has good agricultural soil and many linear and oval mounds.

Site 53H is a short terrace built against the same bluff as Sites 53E and 53F. This boulder paved terrace measures 4 ft (1.219 m.) long NE/SW by 5 ft (1.524 m.) NW/SE. it is faced on the NW side with boulders 1.5 ft (.457 m.) high, but is not as formal or as large as 53E or 53F. This site may be a burial. Excavation potential is fair.

Site 54

Site 54 includes two C-shaped structures, two enclosures and one paved area with a possible cupboard. The condition of these sites is poor and the excavation potential ranges from fair to poor. These site features are located in the top north corner of Sheet 6.

Site 54A is a C-shaped feature and an adjoining small platform and both are in poor condition. The C-Shape has an exterior measurement of 12 ft (3.658 m.) NE/SW by 10 ft (3.048 m.) NW/SE, an interior diameter of 5 ft (1.524 m.), and a collapsed back wall height of 2 ft (.610 m.). The 10 ft (3.048 m.) square rough boulder-paved platform is situated on the east side of the C-shape. Both features are in poor condition and have poor excavation potential.

Site 54B is a possible habitation feature located approximately 75 ft (22.86 m.) N/NE of Site 54A. The oval enclosure has an exterior diameter of 13 ft (3.962 m.), interior dimensions of 6 by 8 ft (1.829 by 2.438 m.), and a maximal height of 2 ft (.610 m.) with wall widths of 4 - 6 ft (1.22 - 1.83 m). The interior, consisting of soil, has a facing of mostly uprights which are somewhat collapsed. Excavation potential of the feature is fair to poor.

Site 54C is a boulder paved area measuring 16 ft (4.877 m.) E/W by 10 ft (3.048 m.) N/W and located approximately 65 ft (19.812 m.) N/NE of Site 54B. At the west end of the formation lies a possible cupboard. This site has poor excavation potential.

Sites 54D consists of a typical C-shape, located approximately 130 ft (39.624 m.) north of Site 54C has an exterior measurement of 12 ft (3.658 m.) NE/SW by 10 ft (3.048 m.) SE/NW and a back wall 2 ft (.610 m.) high and 4.5 ft (1.372 m.) thick. The interior, consisting of soil with loose rocks, measures 5 by 5 ft (1.524 by 1.524 m.). In the north side of the structure is a possible collapsed cupboard. The excavation potential of this feature is poor.

Site 54E is a circular enclosure which has an exterior diameter of 12 ft (3.658 m.) and an interior diameter of 6 ft (1.829 m.). Located 50 ft (15.24 m.) west of Site 54D, this habitation feature has a surrounding wall constructed of boulder/cobbles, a soil interior and with a maximum height of 1.5 ft (.457 m.), walls are 4 - 6 ft (1.22 - 1.83 m.) wide. A few uprights are incorporated into the interior facing. Excavation potential for this site is poor.

Site 54F, a rectangular probable clearance mound which measures 8 ft (2.438 m.) E/W by 20 ft (3.048 m.) NW is located 60 ft (18.288 m.) N/NE of Site 54E. This boulder cobble constructed formation has a maximum height of 2.5 ft (.762 m.).

Site 55

This habitation and agricultural complex is located in rocky pahoehoe terrain. This site includes U-shapes agricultural features, linear mounds, mounded walls, and a clearance mound.

Site 55A is a well made habitation U-Shape with an exterior measurement of 15 ft (4.572 m.) SE/NW and an interior measurement of 8 by 8 ft (2.438 by 2.438 m.). The interior which is open to the SW is constructed of large upright slabs with a maximum height of 2 ft (.610 m.) and consists of soil and loose rocks. Excavation potential for this site is good.

Site 55B consists of a probable planting U-Shape which measures 15 ft (4.572 m.) N/S by 12 ft (3.658 m.) E/W with the NE side being open. The walls have a mounded appearance, standing at 1 ft (.305 m.) high. The soil interior has an area of 7 ft (2.134 m.) N/S. This feature has the possibility of being a habitation feature but it is a probable an agricultural feature.

Site 55C is a mounded agricultural wall oriented 222° TN, which has a length of 60 ft (18.288 m.) and a maximum height of 1.5 ft (.457 m.) and width of 4 - 7 (1.22 - 2.13 m.). Associated with this wall are agricultural mounds, linear mounds and U-shapes similar to Site 55B.

Site 55D, probable rock clearance mounds are located under and next to a large plum tree. There is also a slim possibility of these being burials. The first roughly rectangular mound located on the east side of the large plum tree measures 9 ft (2.743 m.) NW by 7 ft (2.134 m.) E/W with a relatively level boulder surface. The second mound lies 12 ft (3.658 m.) to the NW under the plum tree. Both mounds, equivalent in size, are elevated 1.5 ft (.457 m.).

Site 56 (Fig. 39)

This agricultural and habitation complex lies in a rocky pahoehoe area. This site consists of C-shapes, L-shapes, U-shapes, modified outcrop, terraces, walls, a ramp-like feature or possible elevated auwai section and a stacked boulder wall (main site wall.)

Sites 56A consists of a probable habitation C-shape and a probable agricultural L-shape. The typical C-shape which is built on bedrock has an exterior measurement of 12 ft (3.658 m.) E/W by 10 ft (3.148 m.) N/S and is open to the SW. The interior measures 5 ft (1.524 m.) and has a collapsed back wall height of 2 ft (.610 m.) and a width of 4 ft (1.219 m.).

Adjacent to the east, the L-shaped agricultural feature measures 10 ft (3.048 m.) E/W by 5 ft (1.524 m.) N/S and is open to the south west.

Site 56B is a possible burial feature which lies on the west side of a prominent bedrock outcrop 30 ft (9.144 m.) NE from Site 56A. A crack in the bedrock filled in and a level boulder paved surface with an area of 7 ft (2.134 m.) E/W by 3 ft (.914 m.) N/S exemplifies a known burial technique. No midden, coral, or artifacts were observed.

Site 56C consists of two adjoining habitation shelters which are located 125 ft (38.1 m.) N/NW of site 56B. Situated on the western portion is a L-shaped structure measuring 10 ft (3.048 m.) NE/SW by 6 ft (1.829 m.) NW/SE and is open to the S/SE. Lying in the NW wall (6 ft or 1.829 m. long) are two water rounded

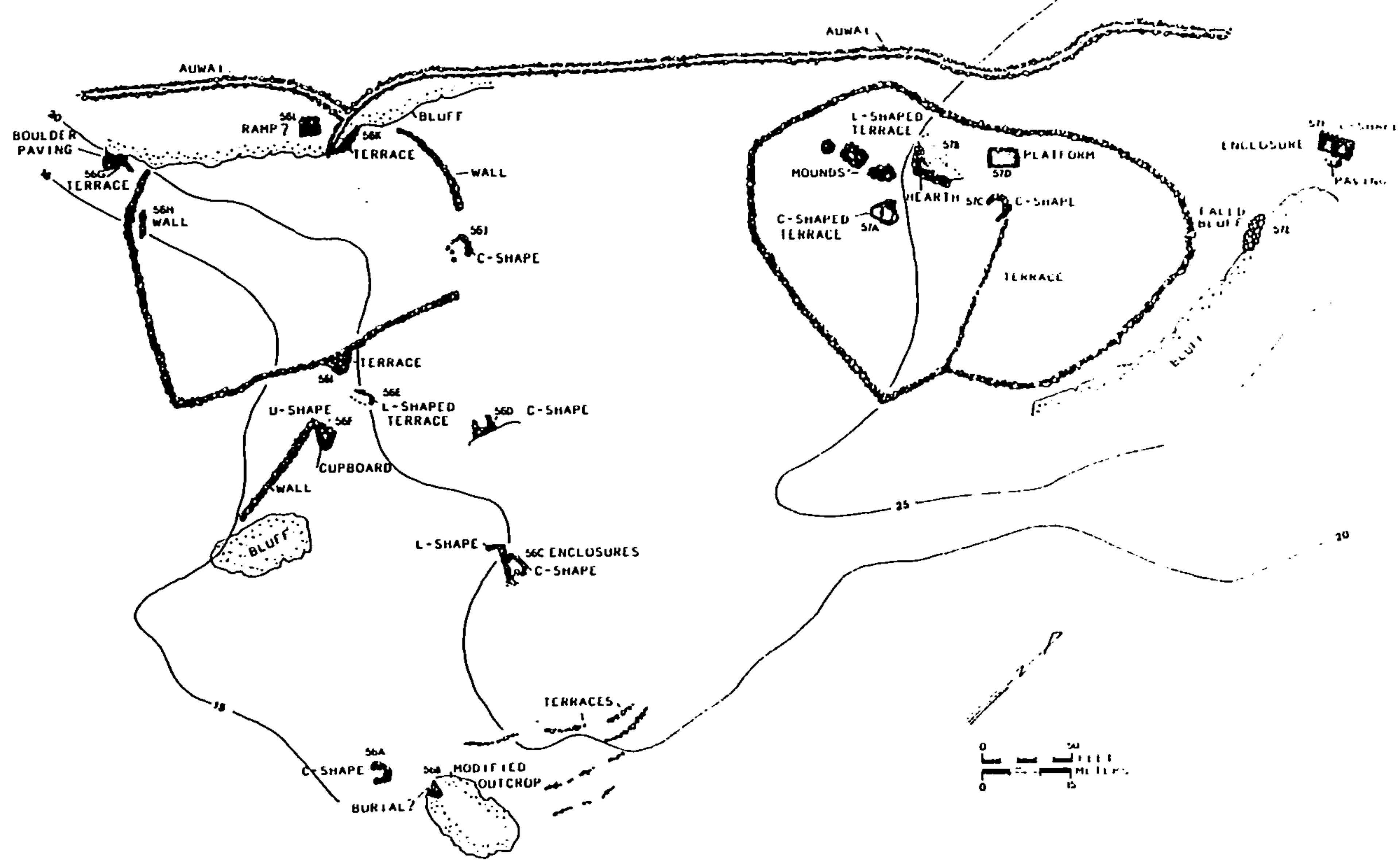

Fig 39 Site Complexes 56 and 57 Plan View (Map Sheets 6&7)

boulders, which have a maximum height of 2.5 ft (.762 m.), and also a possible cupboard. The habitation C-shape, adjoining the L-shape on the eastern side measures 12 ft (3.658 m.) NW/SE by 10 ft (3.048 m.) NE/SW exterior, 7 ft (2.134 m.) by 6 ft (1.829 m.) interior and a back wall height of 3 ft (.914 m.). The interior consists of some uprights and has a rocky surface, but could possibly be due to collapse. Situated next to the southern wall of the C-shape lies a possible hearth which has an interior diameter of 2.5 ft (.762 m.). Though no midden or artifacts were observed, excavation potential is fair.

Site 56D, located 80 ft (24.384 m.) NW of Site 56C, is a dome-like C-shaped structure built on bedrock with an exterior diameter of 9 ft (2.743 m.) and an interior diameter of 5 ft (1.524 m.). The cantilevered walls range from 3 to 4 ft (.914 to 1.219 m.) high. The entrance positioned on the W/SW side measures 1.5 ft (.457 m.) wide.

Site 56E, a probable agricultural feature is located approximately 55 ft (16.764 m.) SE of Site 56D. This L-shaped structure has a SE/NW oriented wall measuring 12 ft (3.658 m.) long with a 5 ft (1.524 m.) long wall abutting on the SE to form an L-shape. In a narrow 5 ft (1.524 m.) wide soil area on the makai side lies the probable planting area.

Site 56F, a probable habitation U-shaped structure, is located 50 ft (15.24 m.) SW of Site 56E and measures 15 ft (4.572 m.) E/W by 12 ft (3.658 m.) N/S. This boulder constructed feature has a 5 ft (1.524 m.) square interior and a wall height of

1.5 ft (.457 m.). Installed in the west side of the U-shaped structure sits a probable cupboard 2 ft (.610 m.) in diameter. A piled boulder wall extends 54 ft (16.459 m.) south from the SW corner of Site 56F. Excavation potential for this site ranges from fair to poor.

Site 56G sits against an exposed pahoehoe bluff and is a possible habitation feature. This stacked boulder terrace measures 15 ft (4.572 m.) N/S by 7 ft (2.134 m.) E/W. The south side of the feature is faced 2.5 ft (.762 m.) high with boulders stacked against the bluff on the north side. The surface of the terrace is paved with rough boulders. This feature has poor excavation potential.

Site 56H is the main wall site and extends 45 ft (13.716 m.) S/SE from the same bluff of Site 56G to Site 56H which utilizes the wall. This probable habitation shelter measures 13 ft (3.961 m.) NW/SE by 12 ft (3.658 m.) SW/NE and has interior wall heights of 3.5 ft (1.067 m.). The parallel walls stand 2.5 ft (.762 m.) distant from each other at the ends and 6 ft (1.829 m.) apart towards the center with a soil interior. The main wall stands 4 ft (1.219 m.) high and extends 100 ft (30.48 m.) SE beyond Site 56H before turning NE for 85 ft (25.908 m.) to site 56I.

Site 56I is a roughly oval terrace located approximately 150 ft (45.72 m.) east of Sites 56H. This possible shelter built against a bedrock bluff measures 12 ft (3.658 m.) N/S by 7 ft (2.134 m.) E/W. The NE portion of this site is a 3.5 ft (1.067 m.) high bluff and the SW portion is the main site stacked boulder wall which extends onto the bluff for another 90 ft (27.432 m.). Because this site appears to be situated in a water runoff area from the bluff its more probable that this site is agriculturally related.

Site 56J is constructed 90 ft (27.432 m.) north of Site 56I and is a collapsed U- or C-shaped structure. This probable habitation feature open to the SE, measures 10 ft (3.048 m.) E/W by 12 ft (3.658 m.) N/S on the exterior with an interior area of 5 ft (1.524 m.) by 7 ft (2.134 m.) and a back wall 4 ft (1.219 m.) thick. The paved interior is raised 1 to 1.5 ft (.305 to .457 m.) above the surrounding ground surface.

Site 56K is situated on the edge of a bluff. This 3 ft (.914 m.) high stacked boulder constructed terrace, measuring 7 ft (2.134 m.) north to southeast turns 6 ft (1.829 m.) to the southwest. A possible agricultural terrace, located between sites K and L, measures 7 ft (2.134 m.) N/S by 10 ft (3.048 m.) E/W. This boulder constructed formation sits 2.5 ft (.762 m.) high.

Site 56L is a small ramp-like feature measuring 7 ft (1.829 m.) E/W by 10 ft (3.048 m.) N/S. Possibly a short <u>auwai</u> section, this site is located approximately 80 ft (24.384 m.) from Site 56K. Between Sites 56K and 56L is an <u>auwai</u> installed in bedrock running N/S. Also leading to this <u>auwai</u> is another probable <u>auwai</u> running NE to SW.

Site 57 (Fig. 39)

This large oval enclosure which measures approximately 240

ft (73.152 m.) NE/SW by 140 ft (42.67 m.) SE/NW is bounded by a stacked boulder constructed wall ranging in height from 2.5 to 4 ft (.762 to 1.219 m.). Site 57 is located on a rocky soil filled depression which has been modified for traditional agricultural and habitation use. The habitation features appear in the <u>mauka</u> central area on a bedrock rise, and the agricultural features appear in the <u>makai</u> portion. This site consists of linear mounds, oval mounds, U- and L-shapes with associated soil planting areas. This is one of the better preserved agricultural and habitation complexes. There is good excavation potential as a single unit.

Site 57A, a possible habitation feature consisting of a well made C-shape and three associated mounds which are possible burials. The C-shaped structure is 5 ft (1.524 m.)in diameter and 4 ft (1.219 m.) in height. Connecting on the west side of the C-shaped rectangular enclosure which has an interior measurement of 4.5 ft (1.372 m.) square there appears to be an entrance on the west side of the enclosure. The entire structure measures 16 ft (4.877 m.) E/W by 12 ft (3.658 m.) N/S.

The three mounds are located 10 ft (3.048 m.) NW of the C-shaped structure and are situated east to west.

Mound 1, 10 ft (3.048 m.) NW of the C-shaped structure is actually two abutting mounds measuring 14 ft (4.267 m.) N/S by 7 ft (2.134 m.) E/W with a maximum height of 4 ft (1.219 m.). It is stacked boulder constructed with no well faced sides.

Mound 2 is 5 ft (1.524 m.) WNW of Mound 1. The rectangular shaped formation measures 13 ft (3.962 m.) N/S by 10 ft (3.048 m.) E/W and stands 4.25 ft (1.295 m) high. The mound appears to be somewhat hollow, which suggests the possibility of a burial crypt. All four sides of the mound are faced.

Mound 3, 5 ft (1.524 m.) west of Mound 2, is constructed of stacked boulders; it measures 6 ft (1.829 m.) square and 5 ft (1.524 m.) high. All sides are faced except for the SE corner which is partially collapsed.

These mounds are possible burial features, though agricultural features are not unlikely.

Site 57B is a habitation terrace built on a natural bedrock outcrop 10 ft (3.048 m.) by 15 ft (4.572 m.) and 3 ft (.914 m.) high. The outcrop is level with the surrounding terrain on the mauka side NW and slopes downward 3 ft (.914 m.) on the makai side and is roughly semi-circular in shape. The makai edge of the outcrop is retained by a curving wall, following the contour of the bluff. The terrace wall curves a distance of 35 ft (10.668 m.) and is a maximum of 1 ft (.305 m.) high and 1 ft (.305 m.) wide and is constructed of stacked boulders and cobbles. The wall retains a level soil area behind it 7 ft (2.134 m.) wide, which contains midden and artifacts on the surface. A 1.5 ft (.457 m.) square stone alignment in the center of the terrace may define a small hearth area. This terrace feature appears to be the main habitation (kauhale) for the walled complex of Site 57. Plentiful soil deposits, possibly up to 1 ft (.305 m.) in thickness and the occurrence of surface debris, mark

this site as an excellent possibility for excavation.

Site 57C, a probable habitation feature is a typical C-shaped structure which has an exterior measurement of 12 ft (3.658 m.) NW/SE by 10 ft (3.048 m.) NE/SW. The interior, which is mostly bedrock, measures 6 by 5 ft (1.829 by 1.524 m.). The back wall stands at 3.5 ft (1.067 m.) high and 3.5 ft (1.067 m.) thick. One piece of midden was observed.

Sites 57D is a probable habitation platform, rectangular in shape and measures 11 ft (3.353 m.) NW/SE by 17 ft (5.182 m.) NE/SW. A few uprights are utilized for perimeter alignments. This boulder/cobble paved platform measures a maximum height of 1 ft (.305 m.). No midden or artifacts were observed.

Though outside of the boundary wall of Sites 57A through 57D, Sites 57E and 57F were respected as part of Site 57. Both are situated on the mauka end of a bedrock bluff extending 200 ft (60.96 m.) N/S.

Site 57E is an 8 ft (2.438 m.) wide faced bluff edge with a possible habitation located 30 ft (9.144 m.) mauka of the boundary wall. A rough terrace wall at the base of the facing measures 10 ft (3.048 m.) E/W by 15 ft (4.572 m.) N/S with a maximum height of 2.5 ft (.762 m.) high. This site is more likely to be agriculturally related.

Site 57F is a rectangular habitation enclosure with an adjoining collapsed C-shape which is located 85 ft (25.908 m.) mauka of the boundary wall and 40 ft (12.192 m.) makai of Site 57E. The entire structure measures 17 ft (5.182 m.) NW/SE by 11 ft (3.353 m.) SW/NE Positioned on the SE side, the enclosure has an interior measurement of 5 ft (1.524 m.) by 3 ft (.914 m.). The enclosure's interior consists of soil.

Site 58

The two features comprising this site are located in a heavily disturbed area and are adjacent to cane fields to the east. Bordering the cane fields is the remnant of a long discontinuous stone cattle wall which extends eastward and south eastward along the cane pasture boundary. There is a filled lava sink 40 ft (12.192 m.) wide, used as a settling basin for excess irrigation water. The sink is 5 ft (1.524 m.) deep and filled with silt.

Site 58A feature is the remnant of a wall section 30 ft (9.144 m.) long and 5 ft (1.524 m.) wide. The maximum height of the wall is 2 ft (.610 m.). The wall runs NS and is broken at both ends. The remaining section is built of stacked boulders. The structure is assigned to the historic ear and may be a remnant of a cattle pen.

Site 58B is a heavily disturbed rough boulder platform remnant with possible burial feature. It measures 11 ft (3.353 m.) N/S by 14 ft (4.267 m.) E/W and stands 2 ft (.610 m.) high. Situated in the center is a 4 ft (1.219 m.) square and 1 ft (.305 m.) deep collapsed crypt-like feature with five uprights on the north and east sides. This feature has been bulldozed and the rocks moved from their original position. However, the subsur-

face portion of the crypt feature appears to be intact and if a burial is present, it is probably undisturbed. This is a remnant of a prehistoric feature which should be tested for a human burial.

VII. SUMMARY OF RESULTS

Summary of Background

The project area consists of approximately 1000 acres of land in the makai western portion of the Ahupua'a of Kōloa. The bulk of the acreage is presently under cane cultivation, except for steep ridges, rocky "islands" and gullies and a 300-350 acre section of pasture land in the makai eastern portion of the study area.

The project area is included in the makai portion of the Ahupua'a of Kōloa and covers a portion of the former extensive late prehistoric/ early historic irrigated taro lo'i (wetland fields) which stretched from Lāwai Valley to Weliweli. Associated with these fields are auwai (irrigation ditches), various house sites, shelters, burial features and occupied lava tubes. A portion of this complex of sites (east of Poipu Road) was documented in a survey of 400 acres performed by the author for Moana Corporation in 1978. Although the prehistoric land use in the present project area was certainly just as intense, the modern land disturbance was considerably greater then in the Kīahuna area to the east of Poipu Road. In this western region sites or complex remnants survive generally between bulldozed fields, and auwai sections can be traced only for short distances outward to disturbed areas and cane fields. However, the fact that most unbulldozed areas contain sites is an indication of past intensive settlement.

Another indication is the number and distribution of 19th

Century Land Court Awards. There were approximately 22 Awards granted in the project area, mostly concentrated along the west band of Waikomo Stream and along both sides of a main auwai extending southwestward from Waikomo Stream to the area above the present Prince Kuhio Park. The testimony for these awards mentions taro lo'i as well as kula. One of the largest awards was granted to the American Board of Commissioners of Foreign Missions.

There are three previous archaeological studies of portions of the present project area. The first was an inventory survey by William Kikuchi in 1963). Stephen Palama conducted a survey in the area of the main east-west cane haul road in 1973. More recently Mr. Jim Landrum of the Bishop Museum surveyed a portion of the makai pasture land for the Kukuiula Bay Phase I development in 1984.

Summary of Archaeological Sites

A total of 58 archaeological sites were recorded in this 1000 acre survey. Many of these sites are complexes with multiple individual features (See Section VI for detailed site descriptions). The features were given letter designations, and the total number of features is 150. These are listed and briefly described in Table 1 (Appendix) and located on the project area map (Fig. 4). As expected, the bulk of the sites (all except 4) are located in the non-cultivated land in the eastern and makai portions of the study area. This land has been periodically bulldozed for pasture improvement and there are a number of abandoned cane fields. Some areas contain large rock piles which are the result of clearing of land for cultivation from the 1840's onward. In spite of this disturbance, many archaeological sites still remain intact.

The major types of sites located and described in the Kukuiula Survey are defined and summarized as follows:

1. Heiau

A heiau is defined as a structure built exclusively for Hawaiian religious purposes. Hawaiian Heiau are associated variously with the 4 major gods or with many minor deities and can be connected with war, politics, fishing, agriculture or other activities. State of Luakini temples dedicated to the god Ku are generally large, massively built structures. In practical archaeological terms these are easily recognized on the basis of size and complexity of construction (multi-level terraces). Unless there is surviving ethnographic information on the functions of smaller temples, these are difficult to distinguish from other kinds of sites. One of the important criteria for recognizing a heiau is location - generally on a high point with a commanding view. The sites designated as heiau at Kukuiula are large, multi-level structures in prominent high points. They are too large and complex to classify as habitation sites. In one case there is an associated name.

Two heiau or temples were located within the study area

and are listed as follows:

An unnamed heiau, (Site 3) believed to be newly discovered, was not located in Bennett's 1931 Survey and is located in the western portion of the study area. This structure has been partially covered by field boulders, but the exposed portion is nearly 300 feet long and 20-60 feet wide.

Another heiau (Site 51) which may be associated with the name Kamaloula (the red malo) lies on the north side of the present reservoir/settling pond mauka of Prince Kuhio park. This structure has also been partially covered by large field boulders in modern times.

A large platform in the area above Prince Kuhio Park (Site 34) could be tentatively identified as a small heiau or men's house.

2. Agricultural Sites

The prehistoric development of irrigation systems and both ponded and dry land fields is the economic basis for the early occupation of these rocky lands. However, given the extensive historic period land modifications, only isolated areas of traditional agricultural features remain. These features are easily distinguished from the plantation cane fields in that they are smaller, are generally curved to follow the relief of the micro-topography, and almost invariably have habitation sites and shelters integrated into the field systems. The agricultural features considered in isolation consist of auwai, stone lined fields, walled fields and mounds.

a. auwai Generally these survive as sectional remnants only. The prehistoric design typically includes a stone lining on both sides of the ditch. The historic ones are often only dirt banked. In some cases there is evidence of historic modification and use. For example the auwai at Site 6, 7 complex (Northeast portion of Sheet 4) has been channeled through a pipe at the makai end.

The auwai at Site 1 is only partially stone lined and the Site 2 auwai is all dirt bank. Both of these were probably used for cane irrigation before the change to drip irrigation.

In total there were 19 auwai sections located in the survey area. The longest sections are at Site 1, Site 6 and 7 (Sheet 4), Site 26 (Sheet 1) an auwai running southwest from Site 50 (Sheet 2), and the bluff top auwai at Site 56, 57 (Sheets 6, 7). The auwai at Site 33 (Sheet 5) extends mauka/makai for nearly 400 feet and is unusual in that it is constructed through very rocky terrain. The water was channeled in between huge slabs which were lifted upright to form the sides

of the ditch. Site 38 (Sheet 5) auwai is of a unique design. It is raised on a man made bank which stands 2-4 feet (.610 to 1.219 m.) above the surrounding terrain with the water "aqueducted" above the low terrain of the top of the built bank.

A summary of the auwai features is presented below. It is generally observed that there was probably a dendritic pattern of main and subsidiary auwai(s) throughout the project area; only small portions of this system survived historic land modification. Branching of auwai was only observed in a few instances and in many cases the auwai section is present, but the fields watered by the auwai did not survive. Probably the most important auwai (and possibly the longest) was that running southwest of Site 50 on Sheet 2 (see fig. 4). Although it is difficult to discern a general pattern from such remnant lengths, the auwai seem to be aligned northeast to southwest, away from Waikomo Stream. Probably 3 or more main auwai were tapping the stream and had many secondary branches to water makai fields. Probably all recorded auwai are part of this Waikomo Stream system except for those at Sites 1 and 2, which tapped Aepo Stream during the historic era.

SUMMARY OF THE AUWAI(S)

Site Area	Location	Length	Age	DescriptiveComments
1	mauka of Kukuiula Bay	1200 ft. 366 m.	Historic poss.prehis.	Dirt lined, prob. sugar ditch, tapped from Aepo Stream.

Site Area	Location	Length	Age	DescriptiveComments
2	below Manuhonu-honu Reservoir	250 ft. 76 m.	Historic	Mostly dirt lined prob. sugar ditch.
6,7	Sheet 4	1000 ft 305 m.	Prehistoric, w/ historic use	Prob. watered pre-historic fields at Site 7.
9	Sheet 4	150 ft. 46 m.	Prehistoric	Short Section Bull-dozed at both ends, no adjacent fields.
W/ of Site 10	Sheet 4	700 ft. 213 m. Total of 2 branches	Prehistoric	Partly stone lined, partly dirt lined, has 1 200-ft side branch.
SE of Site 15	Sheet 4	200 ft/ 61 m.	prehistoric w/historic use	Oriented E/W,cut by cane fields at both ends.
16	Sheet 4	160 ft. 49 m.	Prehistoric w/ historic use	Partly stone lined, cut off both ends by cane fields.
26	Sheet 1	900 ft. 274 m.	Prehistoric	Watered fields to south, remnants of fields remaining, stone embankments.
27	Sheet 1	180 ft. 55 m.	Prehistoric?	Prob. auwai, heavily impacted
NW of Site 28	Sheet 3	250 ft. 76 m.	Prehistoric	Stone lined, bull-dozed on both sides.
31	Sheet 3	2-100 ft (31 m.) sections	Prehistoric	Stone lined, poss. historic use, bull-dozed at both ends, few field remnants left.
32	Sheet 5	450 ft. 137 m.	Prehistoric	Stone lined but not distinct.
33	Sheet 5	400 ft. 122 m.	Prehistoric	Lined w/large slabs, in very rocky ter-rain, former fields were prob. in bull-dozed area to east.
36	Sheet 5	200 ft. 61 m.	Prehistoric w/historic	cut by RR berm and bulldozing, prob. watered former cane fields to west - now bulldozed.
38	Sheet 5 Total length of main auwai and 2 branches	660 ft 201 m.	Prehistoric	Unique raised "aque-duct" design, 2 branches off main auwai, 1 discontin-uous. Watered

Site Area	Location	Length	Age	DescriptiveComments
38 cont.				existing fields to south and now bull-dozed fields to northwest.
44	Sheet 5	500 ft. 152 m.	Prehistoric	Stone lined, prob. branched off of Site 33 auwai, watered fields west - now bull-dozed.
to				
45	Sheet 5	250 ft. 76 m.	Historic	Cane fields on both sides, prob. watered historic cane fields.
47-50	Sheet 5, 6	1100 ft. 335 m.	Prehistoric prob.historic use	Major auwai, once continuous to auwai at Site 38, to water fields in Sites 38,40,46 areas Short section of this auwai at Site 47. Shown on his-toric maps, prob. used historically to water former cane field in south & central portions of Sheet 2.
56-57	Sheet 2	700 ft. 213 m.	Prehistoric	Stone lined built on pahoehoe bluff,stone lined watered fields. 56-57 complex.

b. Stone lined fields and terraces Although these should be a common component of the prehistoric agricultural network, similar to the auwai, well preserved examples are not common. Field terraces were found reasonably intact at Site 32 (Sheet 5), within Site 38 (Sheet 5), Sites 56, 57 (Sheet 6, 7), Site 7 (Sheet 4), and Site 44 (Sheet 5). Highly visible and well preserved ponded lo'i terraces appear to be generally absent. It could be that the best lo'i areas were the first to be used for the early cane fields and were modified or destroyed.

c. Walled Fields These are more common than open terraced lo'i and many of these were probably irrigated plots walled in to protect against grazing cattle in the historic period. The best preserved walled field complexes are Site 7 (Sheet 4) and Site 38 (Sheet 5). Sites 56 and 57 (Sheets 6, 7) are both topographic depressions which were enclosed with single walls. In most cases these field walls are well constructed and stand 4-5 feet (1.219 to 1.524 m) high.

d. Mounds These are naturally a universal feature of traditional agriculture in rocky terrain and the project area is no exception. Rocky areas were cleared for dry land and irrigated agriculture in the vicinity of most site complexes. The best examples are within the enclosing walls of Sites 56 and 57 (Sheets 6, 7) where the rocks were cleared to form linear piles, short terraces and oval shapes. The linear earthen mounds generally occurred in open areas (old cane fields) and are considered historic in age.

3. Habitation Sites

Habitation sites are generally integrated into the agricultural features and clustered together in higher rocky

areas above and around the fields. There are isolated habitation sites in some disturbed portions of the pasture land such as Site 49 (Sheet 2) and sites 20, 21, and 22 (Sheet 1). However, these sites were almost certainly integrated into surrounding fields before modern land modification. That is to say that all of the habitation features were at one time a component of separate, but internally integrated agriculturally based homesteads. The high status residences in the Hawaiian pattern are generally separated from agricultural areas and cluster along the shoreline. These would have been destroyed by historic shoreline development and are not represented in the project area. Within the agricultural/habitation complexes which have survived it is possible to offer a distinction between permanently occupied structures and those used for temporary shelter, although these two types are generally side by side within particular complexes.

a. Permanent habitation structures - These include paved platforms and level "house pad" terraces and larger habitation enclosures. They are recognized partly by the presence of cultural layers on and around the sites. Only rarely does only one permanent structure occur in isolation unless there has been site destruction adjacent to the site. When this destruction has not occurred these structures are centrally located on high points around fields and almost always near auwai. Good examples of these features are Sites 49A, B, Site 34 and platforms and habitation terraces at Site 32, as well as the larger habitation Sites at Site 44, 53 and 57. Note that these are generally in the makai areas, but this is probably a coincidence of selected preservation. The only comparative complex to survive in the mauka area is Site 6-7 which has one possible permanent habitation structure (Site 7B). This is considered too small a sample on which to base statements about settlement patterns. It should be noted that the sugar planters spared only the most rocky areas and incorporated the larger fields with deep soil first. Because of this we are recording the archaeolcgy of only the rocky lands.

b. Temporary habitation structures - These include smaller enclosures, as well as C- and U-Shaped shelters, the most numerous examples being C-Shapes. These also tend to be clustered, but not as tightly as the permanent housing. They are almost always located around planting areas and/or around the permanent habitation sites. Good examples of these features occur throughout the makai area at Sites 32, 42, 43, 44 (a particularly good cluster) 53, 54, 55, 56 and 57. Temporary habitation sites do occur without permanent structures, but the

opposite of this is rarely the case, unless the smaller sites have been destroyed. Some of these temporary sites are ancillary housing to the permanent ones, but in general they appear to have served as short-term shelter during planting and harvesting. These structures do contain scattered midden debris, but generally cultural deposits are thin.

3. Burial Sites

Archaeological features which are unquestionably burials are generally difficult to recognize purely on the basis of surface evidence. Many habitation features may contain burials in and around them. A few sites are interpreted as probable burial places on the basis of visible features. Site 42 features contain stone lined crypts which are almost certainly burials. The large mounds within Site 57 probably contain burials, as well features within Site 53, 44, 45, and 58. Although no burials were directly observed within the lava tubes sites these caves are very likely to contain burials underlying fine silt floor deposits.

5. Lava Tube Caves

Seven lava tube sites were recorded. The largest one (Site 15) is in the northeastern portion of the survey area (Sheet 4). The other 6 tubes are distributed on a line to the west and southwest of this large cave (Sites 14, 19, 21, 24, 11A, 31C, Sheets 1, 4, 3). All of these contain soil covered floors and plentiful evidence of Hawaiian occupation, particularly near the entrances. The large cave (Site 15) was used for civil defense purposes in the 1960's, but plentiful intact cultural material remains. The floor deposits are also likely to contain burials.

The archaeological potential of these caves is difficult to underestimate. Within them one is likely to find the best preserved stratified deposits, plentiful datable material and in some cases preserved organic artifacts. Some of the earliest evidence of Hawaiian occupation in a particular area is frequently represented in caves (see Schilt 1984 for Kona sequence).

6. Historic Sites

There are a number of sites which show evidence of historic era construction and or occupation, such as Site 50. Site 11 is, however, the best example of a historic occupation site. it is an intact house foundation with associated outbuilding and a stone bread oven. Oral history research may help in identifying the previous occupants who were probably Portuguese Plantation "luna." The most physically impressive historic structure on the property is Site 37, the railroad berm. This railroad was constructed by McBryde Sugar Company between 1890 - 1910. Some sections of rock work stand 30 feet (9.14 m.) above the surrounding

terrain (Fig. 26, 27).

Age of Sites and Depth of Subsurface Cultural Deposits

There is little comparative information on which to base an estimate of time range for the Kukuiula archaeological complexes. Although excavations were conducted in the Kīahuna area west of Waikomo Stream, the results were never presented and no quantitative ages were obtained. Therefore, the age range for the Kukuiula agricultural/habitation complex must be based on what we know of broad prehistoric early historic patterns on Kaua'i and in Hawai'i in general. To date, the earliest dated occupation on Kaua'i is at Ke'e Beach at Ha'ena, Malelea - 900 - 1000 A.D. for a fishing-based settlement (Hammatt et al.: 1978). Intensive development of irrigated lo'i came after 11-1200 A.D. and the non-flood plain pahoehoe terrain of Kōloa would have been one of the later systems in the sequence. The earliest irrigated agriculture here probably post dates 1400 A.D. and the system was probably not intensified until the late prehistoric period and continued in use to supply whaling ships in the Post-European Contact Period. The caves probably contain older cultural deposits, but most of the prehistoric surface features will post-date 1400 and will probably cluster around the 1700-1770 A.D. range.

As for the depth of deposits under sites (except for caves), based on the similar sites west of Poipu Road, maximum depth to bedrock will probably be in the range of 30-60 cm. Cultural

APPENDIX L

MARKET ASSESSMENT - PHASE II, SUMMARY

KPMG Peat Marwick

Market Assessment for the Proposed Kukuiula Development

Koloa District, Kauai

Prepared for

ALEXANDER & BALDWIN, INC.

November 1987

KPMG Peat Marwick

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November 25, 1987

Mr. William Campbell
Alexander & Baldwin, Inc.
P. O. Box 3440
Honolulu, Hawaii 96801

Dear Mr. Campbell:

As you requested, we have assessed the market support for multi- and single-family residential and commercial retail development at Alexander & Baldwin, Inc.'s property at Kukuiula, Kauai. This letter presents the background, objectives, approach and major conclusions of our study; the attached presents the detailed analysis, findings and conclusions.

STUDY BACKGROUND

Alexander & Baldwin, Inc. (A&B) proposes to develop an approximately 219-acre master-planned residential community with recreational amenities. The proposed project site is located on the southern coast of Kauai, between Kukuiula Bay and Waikomo Stream, near the Poipu/Koloa area.

In August 1981 Peat, Marwick, Mitchell & Co., now Peat Marwick Main & Co. (Peat Marwick), prepared a market assessment for the subject property which concluded that by 1995, market support could be anticipated for 1,600 residential lots, 1,400 multifamily condominium units and up to 70,000 square feet of retail space at the project. In December 1983 Peat Marwick updated the 1981 study with respect to residential lot development at the site. The 1983 report concluded that, although the outlook for residential lot development on Kauai was expected to be competitive, 1,700 lots could be expected to be sold at the project by 2002.

The State of Hawaii Land Use Commission recently reclassified the property from agricultural to urban district; A&B now seeks the County of Kauai zoning classifications necessary to permit the proposed developments. Thus in October 1987, A&B asked Peat Marwick to further update its market assessment for the project to reflect recent market trends on Kauai and a revised master plan for the development of the project.

STUDY OBJECTIVES AND APPROACH

The objectives of our study were as follows:

- To identify and assess major market and other trends on Kauai affecting residential and commercial development of the property.

- To assess the market support for the residential elements of the proposed development in terms of anticipated buyer market segments, pricing and the projected period of sales absorption.

- To assess the market support for neighborhood and general commercial development in conjunction with residential development at the project.

SUMMARY OF CONCLUSIONS

The market assessment for Kukuiula presented in the attached report indicated that the market support for multi- and single-family residential and commercial development could be as summarized in the following table:

Summary of Estimated Potential Demand
for Development at Kukuiula

1990 to 2005

	Period demand			Total
	1990-1995(1)	1996-2000	2001-2005	1990-2005
Multifamily units:				
Low(2)	550	310	290	1,150
High(2)	730	360	320	1,410
Single-family units:				
Low(3)	360	90	50	500
High(3)	530	130	80	740
Leasable commercial space (in square feet)	36,600	7,100	6,400	50,100

(1) Six-year sales period.

(2) Including resort- and resident-oriented units for 50% and 75% scenarios of regional resident market share, as discussed in Chapter II.

(3) Including single-family homes and lots for 50% and 75% scenarios of regional resident market share, as discussed in Chapter III.

REPORT ORGANIZATION

The attached report is organized in sections as follows:

I - Kauai Economic and Demographic Overview
II - Multifamily Residential Market Assessment
III - Single-Family Residential Market Assessment
IV - Commercial Retail Market Assessment

* * * * * * *

Thank you for this opportunity to assist you in the further planning for this project.

Very truly yours,

Peat Marwick Main & Co.

KPMG Peat Marwick

Management Consulting

Market Assessment for the Proposed Kukuiula Master-Planned Community Phase II

Koloa District, Kauai

Prepared for

ALEXANDER & BALDWIN, INC.

May 1988

KPMG Peat Marwick

Peat Marwick Main & Co.
PO Box 4150
Honolulu, HI 96812 4150
Telephone 808 531 7286
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May 25, 1988

Mr. William Campbell
Alexander & Baldwin, Inc.
P. O. Box 3440
Honolulu, Hawaii 96801

Dear Mr. Campbell:

Re: Kukuiula Phase II Market Assessment

As you requested, Peat Marwick Main & Co. (Peat Marwick) has completed a market assessment for Phase II of the proposed Kukuiula master-planned community on the island of Kauai, Hawaii. The attached report presents the study background and objectives, and our detailed findings, conclusions and recommendations. This letter presents the background of this study, and summarizes the major conclusions and recommendations of our market assessment.

STUDY BACKGROUND

Alexander & Baldwin, Inc. (A&B) proposes to develop a master-planned residential community of two phases, with approximately 219- and 817-acres in Phases I and II, respectively. The Kukuiula site is located on the south shore of the island of Kauai in the Poipu area of the Koloa district.

Kukuiula Phase II would offer a variety of residential products, including low-density multifamily units, ocean- and golf-front lots, patio homes and other view-oriented single-family lots and units. Phase II will also contain activity-generating uses such as a hotel or other resort-related accommodations, an 18-hole golf course and a marina offering water-oriented activities and facilities.

As documented in this report, Peat Marwick has assessed the potential market support for the low density multifamily units, patio homes and various other types of single-family units that have been proposed as well as for the proposed resort-zoned site.

SINGLE-FAMILY UNITS

Chapter II reviews the projected market support for the proposed ocean- and golf-front lots, patio homes and other view-oriented lots or units. It is expected that single-family lot and/or home sales could be positively affected by the following characteristics of the project:

- 18-hole golf course.
- Golf frontage, ocean, mountain or other views for the lots, patio homes and other units.
- Lower density development.
- Master-planned community and amenities.
- Proximity to commercial, recreational and employment centers within the community and the Koloa district.

Anticipated Buyer Markets

The expected buyer market mix for Kukuiula single-family products are summarized as follows:

Expected Buyer Market Mix for
Single-Family Units, Kukuiula Phase II

Buyer market	Golf- and oceanfront lots and patio homes	Other view lots or units
Full-time resident owner	25% - 30%	60% - 65%
Part-time resident/second home buyer	50 - 55	15 - 20
Investor and/or vacation home buyer	15 - 20	20 - 25
Total	100%	100%

Projected Market Performance of Ocean- and Golf-Front Lots

Ocean- and golf-front lots at Kukuiula Phase II are proposed to be among the first products marketed at the community with an anticipated 125 to 175 lots sold in the first five years, or 25 to 35 lots per year. Lot sales are projected to increase during the last 10 to 15 years of the projection period, resulting in total sales of 675 to 800 lots by 2015, as shown in Exhibit A.

Ocean- and golf-front lots are projected to start from about $8 per square foot. Individual lot prices could have a starting price from about $100,000 in 1988 dollars, depending on the size and location of lots.

Projected Market Performance of Patio Homes

Patio homes, also sometimes called cottages, zero-lot or Z-lot line projects, would be a new single-family product type for the the state of Hawaii. Patio homes are proposed to be introduced later in the community's development, after the year 2000. These homes are projected to represent about 10 to 15 unit sales per year initially and 15 to 20 per year by about 2011. This would indicate a projected cumulative sales absorption of about 175 to 250 patio homes over a 15-year marketing period, as shown in Exhibit A.

Two- to four-bedroom patio homes are recommended from about 2,100 net interior square feet on lots of about 4,500 square feet. Projected sales prices are estimated to have a base sales price of about $375,000 per unit, or from about $180 per interior square foot, in 1988 dollars.

Projected Market Performance of View and Other Lots

Kukuiula Phase II would also offer a number of sites designated for single-family development that would not be adjacent to golf fairways or ocean frontage. Due to the topography of the region, several of these sites would provide excellent views of the ocean as well as of the Kukuiula golf course, community and marina.

It is expected that the view and other lots/units in Phase II could achieve sales of about 820 to 1,000 units over the 20-year marketing period or about 41 to 50 units per year, as also shown in Exhibit A.

Pricing for lots in this category could start from $8 per square foot, about $60,000 per lot for a 7,500-square foot parcel. Higher priced lots should be supported by the view orientations and sizes of the individual lots.

Single-family homes could be built on those lots with more limited view opportunities. These products could be positioned at approximately the same price levels as the Kukuiula Phase I inventory in order to remain price competitive during overlapping marketing periods. Thus, the pricing for homes could start at about $140,000 per home, in 1988 dollars. Such homes could be located on about 6,000-square foot lots, with interior sizes starting from about 1,200 square feet.

LOW DENSITY MULTIFAMILY UNITS

This section summarizes the market conclusions regarding development of low-density multifamily condominium units at the site in terms of anticipated buyer markets and projected market performance.

KPMG Peat Marwick

Mr. William Campbell
May 25, 1988
4

Anticipated Buyer Market Mix

The second phase of Kukuiula is expected to attract buyers interested in first-class projects offering golf course frontage and/or excellent ocean views within a master-planned environment. Condominium buyer market segments are expected to be distributed approximately as follows:

Expected Condominium Unit Buyer Market Mix
Kukuiula Phase II

Full-time resident owner	10% - 20%
Part-time resident/second home buyer	35 - 40
Investor and/or vacation home buyer	45 - 50
Total	100%

Projected Market Performance

Condominium unit sales have been estimated based on analyses of ratios of condominium sales to visitor units, planned hotel construction in the Poipu area and projected resale and Kukuiula market shares. Kukuiula Phase II is expected to support sales of from 330 to 530 low density condominium units, as shown in Exhibit A.

The low density multifamily units are expected to have a base price of about $225 per interior square foot. Thus, individual unit prices are expected to start from about $200,000 in 1988 dollars.

RESORT MARKET ASSESSMENT

Demand for hotel accommodations on the island of Kauai has been assessed using the latest estimates from state economic projections. Islandwide hotel demand is projected to increase from about 3,700 hotel rooms in 1987 to about 8,700 rooms in 2005. Assuming an islandwide average hotel occupancy of 70% and completion of all currently planned hotels, there could still be demand for about 1,000 additional rooms by 1990, increasing to about 3,300 rooms by 2005.

Kukuiula Hotel Market Assessment

Characteristics supporting hotel development at the Kukuiula site include:

- Projected net additional demand for over 3,000 hotel units on the island of Kauai by 2005.

Exhibit A

ALEXANDER & BALDWIN, INC.

Summary of Projected Market Support for the
Kukuiula Phase II Master-Planned Community

1996 to 2015

	Incremental demand								Cumulative, 2015	
	1996 - 2000		2001 - 2005		2006 - 2010		2011 - 2015			
	Low	High	Low	High	Low	High	Low	High	Low	High
Hotel units:										
At 80% occupancy(1)	360	450	430	540	-	-	-	-	430	540
At 70% occupancy(1)	410	510	500	620	-	-	-	-	500	620
Low-density multifamily unit sales	0	20	0	20	160	240	170	250	330	530
Single-family unit sales:										
Ocean- and golf-front lots	125	175	175	200	175	200	200	225	675	800
Patio homes	-	-	50	75	50	75	75	100	175	250
View and other lots or units	260	280	190	200	190	260	180	260	820	1,000
Subtotal, single-family units	385	455	415	475	415	535	455	585	1,670	2,050
Total development	745	985	485	605	575	775	625	835	2,430	3,200

(1) Hotel room demand is stated as cumulative supportable units, based on range of islandwide visitor accommodations occupancies.

- Improvement of Kauai's hotel occupancy levels, average room rates and growth in room rates during the 1980s. In particular, the South Kauai region, in which Kukuiula is located, has out-performed the rest of the island and many of the other resort areas in the state in these respects.

- Increasing number of repeat visitors to the island of Kauai, who seek new and better quality facilities and vacation experiences.

- Site characteristics and planned facilities of the Kukuiula site could support hotel development by providing recreational and commercial facilities that attract visitors.

- A hotel could serve to anchor the activity focus of the development in the area of the proposed marina, and also attract a larger pool of potential property purchasers than could resort condominiums.

Based on the characteristics of the site, overall master plan for Kukuiula and the projected Kauai hotel room demand, the planned resort-zoned area is considered highly appropriate for hotel development.

Projected Hotel Market Performance

Target guest markets for the proposed hotel could be distributed as follows:

Kukuiula Bay Hotel
Target Guest Market Mix

	Percent of total guests
FIT	45%
Package	35
Leisure groups	10
Meeting and incentive groups	10
Total	100%

The Kukuiula hotel is estimated to capture about 4% to 5% of the Kauai hotel visitor room demand. Thus, about 400 to 600 rooms are anticipated to be supported at an islandwide 70% to 80% occupancy level, as shown by Exhibit A.

Based on factors that include the estimated market position and phasing of the hotel, projected occupancy levels for the proposed hotel are as follows:

Projected Occupancy Levels for
Kukuiula Bay Hotel

1996 to 2005

	Low	High
1996 to 2000	70%	80%
2001 to 2005	75	85

The projected average achieved room rates for the proposed hotel are based on review of selected first-class and off-beach hotels in the state of Hawaii. The published room rates for the facilities could range from $90 to $120 with an average achieved room rate of about $80 per day in 1988 dollars.

Recommended Hotel
Development Characteristics

Recommendations for the development of the hotel facilities are outlined below:

- Size and number of hotel rooms - One first-class hotel of 400 to 600 rooms that would complement, rather than dominate, the overall master plan of low density single-family and condominium developments.

- Timing - It is recommended that the hotel be developed in the mid-1990s or early 2000s in order to capitalize on the higher hotel room demand projected from 2000 and 2005.

- Development concept - The development could seek to create a first-class resort atmosphere taking as its theme its unique situation around a high activity marina and waterfront commercial/retail center.

MARINA MARKET ASSESSMENT

This section presents the anticipated demand for marina and boat slip facilities on the island of Kauai and an assessment of the marina that is proposed as part of the Kukuiula master-planned community.

Development Outlook for Kauai

Demand for marina boat slips on the island of Kauai has been assessed based on the number of currently moored boats, waiting list applications and the total number of boats registered on the island and in the state along with the Kauai and state averages for boats per 1,000 of de facto population. Kauai could be expected to require about 200 additional slips by 1995 and 340 slips by 2015, after subtracting the current inventory of boat slips and mooring areas on the island.

Other factors that could influence the development outlook for additional marina facilities on Kauai include:

- Recognition that new marina or harbor facilities could help to support and improve the growing visitor industry-related maritime activities on Kauai such as cruise ships, sightseeing and glass bottom boats, recreational fishing charters and related maritime support facilities.

- The lack of noncargo transport piers or berths that could accommodate larger dinner cruise or glass bottom boat vessels of 60 to 80 feet in length.

- Acknowledgment of Nawiliwili and Port Allen Harbors as being primarily commercial transportation centers, and the need for expanded commercial facilities.

- Safety concerns at Nawiliwili and Port Allen Harbors regarding the intermingling of heavy commercial cargo activities, with passenger arrivals and departures, private boating and smaller visitor-related commercial ventures, due to congestion and traffic between activities at both land and sea crossings.

Anticipated Target Markets

The marina is expected to generate demand from two primary target markets:

- Private boat owners who desire boat slips in a new small boat marina with the necessary support facilities.

- Visitor industry-related commercial ventures who seek to provide maritime activities such as sailing, sightseeing or glass bottom boat rides, dinner cruises, recreational fishing charters or other ocean-oriented activities.

Proposed Development Concept

The marina is proposed to be dedicated to resident- and visitor-oriented recreational maritime activities. Development and locational attributes could include:

- Modern design for marina, piers and support facilities.

- Availability of pier and docking space for visitor-related maritime commercial ventures.

- Integration with the proposed Kukuiula Phase I marina-oriented commercial center, with its shopping and food and beverage establishments.

- Good weather and generally safe navigation conditions.

- Location near the visitor destination area of Poipu and an attractive, alternative visitor port-of-call to Nawiliwili Harbor.

- Close to good land-based sightseeing areas, and south shore reef areas conducive for fishing and glass bottom boat activities.

The planned marina could positively influence both the economy and recreational advantages of the Koloa area as it gains recognition as the ocean-oriented activity center for the community and the region.

Size of Slips

Based on the review of Kauai boat slips and the anticipated target markets, slips for the private boats and smaller commercial ventures could range from about 30 feet to 60 feet in length.

The marina could also include one or two berths dedicated to serve two to four larger passenger ships, such as dinner cruise, sightseeing, glass bottom boat or passenger transport vessels.

Projected Supportable Boat Slips

Based on the projected Kauai demand for boat slips and additional factors such as growing visitor-related maritime activities and the inclusion of the marina in a master-planned community in the Koloa region, it is projected that the proposed marina could support about 100 to 120 boat slips. With future demand, the marina could possibly support a much higher capacity during the 20 year projection period of between 150 and 200 boat slips. This would be equal to about 50 to 80 additional boat slips over those initially supported.

Factors such as design considerations and physical constraints could influence the total number of boat slips developed. However, the phasing of between 100 and 120 boat slips in the first increment could be expected to be supported, with about 50 to 80 additional slips added in a second phase once lease-up has occurred in the initial increment.

Recommended Supporting Facilities and Services

Support facilities and services for the marina could include:

- Marina administrative offices
- Marine supply and other stores
- Fuel dock
- Fisherman's wharf restaurant and bar
- Comfort station
- Parking for cars and trailers
- Boat ramp and washing facilities for nonmoored boats

Some of these facilities could be located in the proposed adjacent general commercial centers. In addition, a private yacht club could fit within the master-plan of the marina and provide an additional attraction to the Kukuiula community.

Tenure and Pricing of Slip Offerings

Based on the review of state and Kauai marina slip offerings, the proposed marina could lease the boat slips on a foot per month basis with one-year lease agreements.

Pricing has been based on the current Kauai lease rates with price adjustments for a privately owned marina, new facilities, integration within a master-planned environment and the site's locational attributes. These factors could indicate a range of between $2.40 and $2.60 per foot per month in 1988 dollars, not including electricity or water expenses.

The smaller number of commercial-oriented boat slips could be priced higher than the private boat rates due to the revenue-generating activity of the vessels and the marina's proposed location, in close proximity to a large visitor population located at the nearby Poipu area and the adjacent Kukuiula community. This could indicate a pricing of about $3.40 to $3.60 per foot per month in 1988 dollars, and would not include electricity or water charges.

Projected Absorption Period

Lease-up of the boat slips is expected to take about one year per increment. This would project to about eight to ten boat slips per month for the first increment and about four to seven slips per month for the second increment.

The market for boat slips could be strong due to pent-up demand, as was shown by the rapid absorption at Nawiliwili Harbor of 28 slips in less than two months. A professional marketing and preleasing effort for both increments could accelerate these absorption rates following completion of the facilities.

* * * * * * *

Thank you for this opportunity to assist you in the planning for this community. We have enjoyed the opportunity to work with you and the other members of your planning team.

Very truly yours,

Peat Marwick Main & Co.

APPENDIX M

ECONOMIC AND FISCAL IMPACT ASSESSMENT
PHASES I AND II

Economic and Fiscal Impact Assessment for the Proposed Kukuiula Master-Planned Community

Phases I and II

Koloa District, Kauai

Prepared for

ALEXANDER & BALDWIN, INC.

June 1988

ALEXANDER & BALDWIN, INC.

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ALEXANDER & BALDWIN, INC.

Table of Contents, Continued

ALEXANDER & BALDWIN, INC.

Table of Contents, Continued

I - INTRODUCTION AND EXECUTIVE SUMMARY

This chapter presents the background and objectives of the assistance provided to Alexander & Baldwin, Inc. (A&B) by Peat Marwick Main & Co. (Peat Marwick) in this engagement and summarizes the conclusions of our economic and fiscal impact assessment. More detailed findings and conclusions are presented in the following chapters.

STUDY BACKGROUND AND OBJECTIVE

A&B is planning to develop a master-planned residential community of two phases on about 1,000 acres of land at Kukuiula Bay in the Koloa district on the island of Kauai.

In November of 1987, Peat Marwick Main & Co. issued a report entitled "Market Assessment for the Proposed Kukuiula Development," concerning the anticipated market support for the Phase I portion of the master-planned community. Phase I is planned to include about 1,200 to 1,400 multifamily units, 500 to 700 single-family units and areas for general and neighborhood commercial space by the year 2005. Phase I of Kukuiula has been recommended for approval by the County of Kauai Planning Department and has been submitted to the Kauai County Council for the necessary county zoning changes.

Subsequently in May of 1988, Peat Marwick was engaged by A&B to prepare a market assessment for Phase II of the Kukuiula project. This study assessed the market for various multifamily and single-family products and projected that the Phase II portion of Kukuiula could experience market support for about 330 to 530 multifamily units, 675 to 800 ocean- and golf-front lots, 175 to 250 patio homes, 820 to 1,000 view-oriented and other lots or units and a 430 to 620 unit hotel.

The objective of the current study has been to evaluate the anticipated economic and fiscal impacts of the proposed development in the County of Kauai and the State of Hawaii. Thus, following the market study for Kukuiula Phase II, Peat Marwick assessed the economic and fiscal impacts of the overall Kukuiula master-planned community encompassing both Phases I and II.

This report assumes that Phase I is developed according to the County of Kauai Planning Department land use recommendations and that Phase II is developed within the ranges of market support as described in our market assessment report for Phase II, as referenced above.

SITE AND PROJECT DESCRIPTION

The 1,000-acre project site is located in the Koloa district of Kauai at Kukuiula Bay, as mentioned previously. The site is distinguished by rising heights at the back and oceanfront cliffs on parts of the front of the property that will offer spectacular sunset and ocean views of the island's south coast.

Visitors to and residents of the community would have minimal traveling time by car to the area's white, sandy beaches and the nearby Poipu visitor destination area. The community's guests and residents would have access to a variety of activities including golf, tennis, sailing and other water-oriented activities and shopping at the project's various facilities.

As mentioned previously, the Kukuiula master-planned community would have a variety of residential products along with a proposed hotel or other resort-related accommodations, commercial/retail facilities and an 18-hole golf course. In addition, a marina at Kukuiula Bay with ocean-related facilities and activities will be included in the development.

The residential units offered include low- and medium-density multifamily units, ocean- and golf-front lots, patio homes and other view-oriented single-family lots and units that could appeal to a variety of buyer markets. The proposed hotel could offer a first-class resort environment and could primarily attract the free and independent traveler (FIT) market.

The development has been proposed in two phases. Phase I is expected to have a 16-year development and marketing period from 1990 to 2005 while Phase II is expected to have a 20-year buildout from 1996 to 2015. Thus, Phases I and II of Kukuiula have been proposed for cumulative development from 1990 to 2015. By the benchmark year of 2015, the cumulative unit sales absorption and development of the facilities are projected to be as shown in the table as follows:

Cumulative Development Summary
at Kukuiula Phases I and II

1995, 2005 and 2015

Facility type	1995 Low	1995 High	2005 Low	2005 High	2015 Low	2015 High
Phase I:						
Multifamily units:						
Medium density	180	180	560	560	560	560
Low density	370	440	440	440	440	440
Single-family units	528	598	738	738	738	738
Commercial:						
Neighborhood (square feet)	36,600	36,600	50,100	50,100	50,100	50,100
General (square feet)	-	-	25,000	35,000	25,000	35,000
Phase II:						
Low density multifamily units	-	-	-	-	330	530
Single-family units:						
Ocean- and golf-front lots	-	-	300	375	675	800
Patio homes	-	-	50	75	175	250
View and other lots or units	-	-	450	480	820	1,000
Hotel units	-	-	430	620	430	620
Golf course	-	-	1	1	1	1

ECONOMIC IMPACTS

The proposed development could be expected to impact the state and county economy by generating additional expenditures, construction and operational employment, personal income and population growth.

Visitor Expenditures

Including the visitor expenditures for food, beverages and retail items at the various facilities of the development, the community could be expected to generate $17.6 million to $18.0 million at Phase I and about $30.3 million to $45.9 million at Phase II in direct annual expenditures by 2015 with an overall total of about $47.9 million to $63.9 million for the entire community, in 1988 dollars.

Including their anticipated multiplier effects throughout the state's economy, these direct expenditures could be expected to support additional spending in Hawaii of about $12.1 million in Phase I and $20.6 million to $31.2 million in Phase II. Thus, an overall total of $80.5 million to $107.3 million could be generated by direct, indirect and induced visitor expenditures by 2015, in 1988 dollars.

Construction and Operational Employment

The project would generate both construction and operational employment in the state. Direct employment effects would be those supported directly by construction, or consumer expenditures generated by the project. However, the total employment effects of the project would include its indirect and induced effects, supported through spending multipliers throughout the state.

Demands for construction employment at the project could be expected to be strongest in the first increment of marketing and development though construction employment will be generated throughout the projection period up to 2015. Operational employment would be generated throughout the projected periods and is expected to stabilize by 2015. The anticipated direct, indirect and induced total construction and operational employment effects of the project are expected to range from about 1,600 to 1,900 average annual person-years in 1995, from 2,300 to 3,200 person-years in 2005 and about 2,100 to 3,000 person-years by 2015, as also summarized in Exhibit I-A.

Personal Income

Wages and salaries paid to direct employees of the project could be anticipated to represent about $10.2 million to $12.0 million and $3.6 million to $4.7 million per year for Phases I and II, respectively, for a total of $13.8 million to $16.7 million by 1995. By 2005, $8.2 million to $9.9 million for Phase I, $10.7 million to $16.1 million per year for Phase II and an overall total of about $18.9 million to $26.0 million in personal income could be generated. By 2015, $4.8 million to $6.5 million for Phase I and $11.3 million to $17.3 million per year for Phase II could be generated in personal income for a total of $16.1 million to $23.8 million.

Exhibit I-A

ALEXANDER & BALDWIN, INC.

Projected Direct, Indirect and Induced Employment for Facility Construction and Operations

Average Annual Person-Years
1990 to 2015

Phase/ type of employment	1995		2005		2015	
	Low	High	Low	High	Low	High
Construction:						
Phase I	790	890	370	450	30	90
Phase II	370	470	420	650	470	750
Subtotal, rounded	1,160	1,360	790	1,100	500	840
Operational:						
Phase I	430	520	750	920	750	920
Phase II	-	-	790	1,190	830	1,260
Subtotal, rounded	430	520	1,540	2,110	1,580	2,180
Total	1,590	1,880	2,330	3,210	2,080	3,020

The above do not include the potential wages and salaries paid to those employed through the project's indirect and induced economic effects, and does not include proprietary income. Thus, the total household income effects of the project's development could be considerably greater than the direct personal income effects shown above.

Population

The project could be expected to impact population in the immediate area by generating three types of population growth:

- Visitors using the project's proposed hotel or other guest accommodations.
- Full- and part-time residents at the multifamily and single-family units.
- Direct employees of the project, including their dependent household members.

Visitors to the project and employees who commute into the region would impact only the de facto population of the region, that is, the average daily number of persons present, including visitors and residents. In contrast, residents of the multifamily and single-family units and employees who choose to move into the region because of the employment generated by the project would contribute to the region's resident population growth.

The population impact for the island as a whole would be somewhat less than for the Koloa region, since some visitors, employees and residents attracted to the project may already reside on Kauai. Thus, all of the above mechanisms also impact the population of the island of Kauai, but only in the cases where visitors to or residents of the project are attracted from off-island.

Total new in-migrant population impacts of the project's development are projected to range from about 900 to 1,000 in 1995, 1,800 to 2,300 by 2005 and 2,200 to 3,300 by 2015, as also presented in Exhibit I-B.

FISCAL IMPACTS

The fiscal impacts of the proposed development are evaluated by comparing the tax revenues and operating expenditures that could be expected to be incurred by the governments of the County of Kauai and the State of Hawaii.

Government Revenues and Expenditures

Potential fiscal benefits of the project's development, in terms of additional tax revenues to both the county and state governments, are anticipated to exceed the government operating expenditures generated by additional demands for state and county services as a result of the project's development. Projected net additional revenues, and the ratio of projected new government revenues to new government operating expenditures by project completion at 2015 are expected to be from about $3.4 million to $5.5 million with a 3.1 to 3.4 revenue/expenditures ratio for the county, respectively, and state net additional revenues between $9.0 million and $14.9 million with a revenue/expenditure of about $2.9 million to $3.1 million, as summarized in Exhibit I-C.

Exhibit I-B

ALEXANDER & BALDWIN, INC.

Projected Total Population In-Migrant Impact
for the Island of Kauai

1995, 2005 and 2015

In-migrant place of residence and project phase	1995 Low	1995 High	2005 Low	2005 High	2015 Low	2015 High
On-site:(1)						
Phase I	600	690	880	980	880	980
Phase II	-	-	410	680	930	1,680
Subtotal	600	690	1,290	1,660	1,810	2,660
Off-site:(2)						
Phase I	220	240	220	260	160	220
Phase II	60	60	240	360	240	380
Subtotal	280	300	460	620	400	600
Total	880	990	1,750	2,280	2,210	3,260

(1) Based on cumulative development summary in Exhibit III-A and unit usage assumptions in Exhibit III-J.

(2) Off-site in-migrant operational and construction employees estimated at 20% of employees and projected to have one dependent each.

Exhibit I-C

ALEXANDER & BALDWIN, INC.

County of Kauai and State of Hawaii
Revenue/Expenditure Comparison
at Project Completion

(1988 dollars, in millions)

	2015 Low	2015 High
County government:		
Net additional revenues:		
Phase I	$ 1.7(1)	1.6
Phase II	1.7	4.0
Revenue/expenditure ratios:		
Phase I	3.4	3.0
Phase II	2.9	3.7
Total net additional revenues, rounded	$ 3.4	5.5
Total revenue/expenditure ratio	3.1	3.4
State government:		
Net additional revenues:		
Phase I	4.6	7.1
Phase II	4.4	7.9
Revenue/expenditure ratios:		
Phase I	3.0	3.8
Phase II	2.7	2.8
Total net additional revenues, rounded	$ 9.0	14.9
Total revenue/expenditure ratio	2.9	3.1

(1) The $1.7 million projection is due to a low county expenditures total. The result is a slightly higher net additional revenue figure for the projection low when compared to the projection high figure of $1.6 million.

II - PROJECT OVERVIEW AND REGIONAL SETTING

This chapter reviews the planned community project at Kukuiula and surveys economic and demographic trends for the island of Kauai as a whole and the Koloa area of Kauai in particular, as pertinent to the outlook for development at the project site.

PROJECT OVERVIEW

This section presents the preliminary development plans for the master-planned community and the characteristics of the project site.

Preliminary Development Concept

A&B plans to develop a master-planned community of two phases on about 1,000 acres of land in the Koloa district of Kauai, as shown in Exhibit II-A.

The Kukuiula master-planned community would have a variety of residential products along with a proposed hotel or other resort-related accommodations, commercial/retail facilities and an 18-hole golf course, as shown in Exhibit II-B. In addition, a marina at Kukuiula Bay with water-oriented facilities and activities will be included in the development, as shown in the overall Kukuiula development plan in Exhibit II-C.

The residential units offered include low density multifamily units, ocean- and golf-front lots, patio homes and other view-oriented single-family lots and units that could appeal to a variety of buyer markets. In addition, the proposed hotel or other resort-related accommodations could offer a first-class resort environment and could primarily attract the free and independent traveler (FIT) market.

Site Location and Description

The project site is located on the south shore of Kauai in the Koloa district area around Kukuiula Bay. The site is distinguished by rising heights at the back and oceanfront cliffs on parts of the front of the property that will offer spectacular sunset and ocean views of the south coast of the island.

Visitors to and residents of the community would have minimal traveling time by car to the area's white, sandy beaches and the nearby Poipu visitor destination area. The community's guests and residents would have access to a variety of activities including golf, tennis, sailing and other water-oriented activities and shopping at the project's various facilities.

ISLAND OF KAUAI

Kauai, the fourth largest island in Hawaii, covers a land area of about 549 square miles and has the town of Lihue as its center of business and government. This section briefly reviews the demographic characteristics of residents and visitors to the island of Kauai.

Exhibit II-A

ALEXANDER & BALDWIN, INC.

Location Map of the Proposed
Kukuiula Master-Planned Community

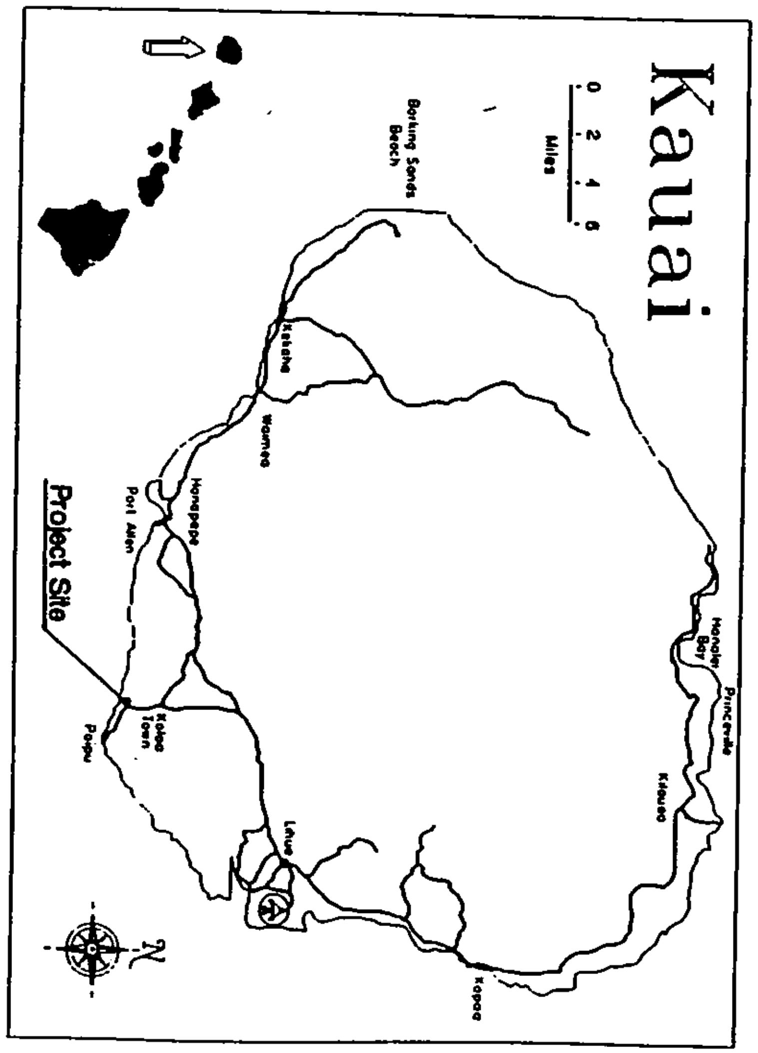


Exhibit II-B

ALEXANDER & BALDWIN, INC.

Cumulative Development Summary at Kukuiula Phases I and II

1995, 2005 and 2015

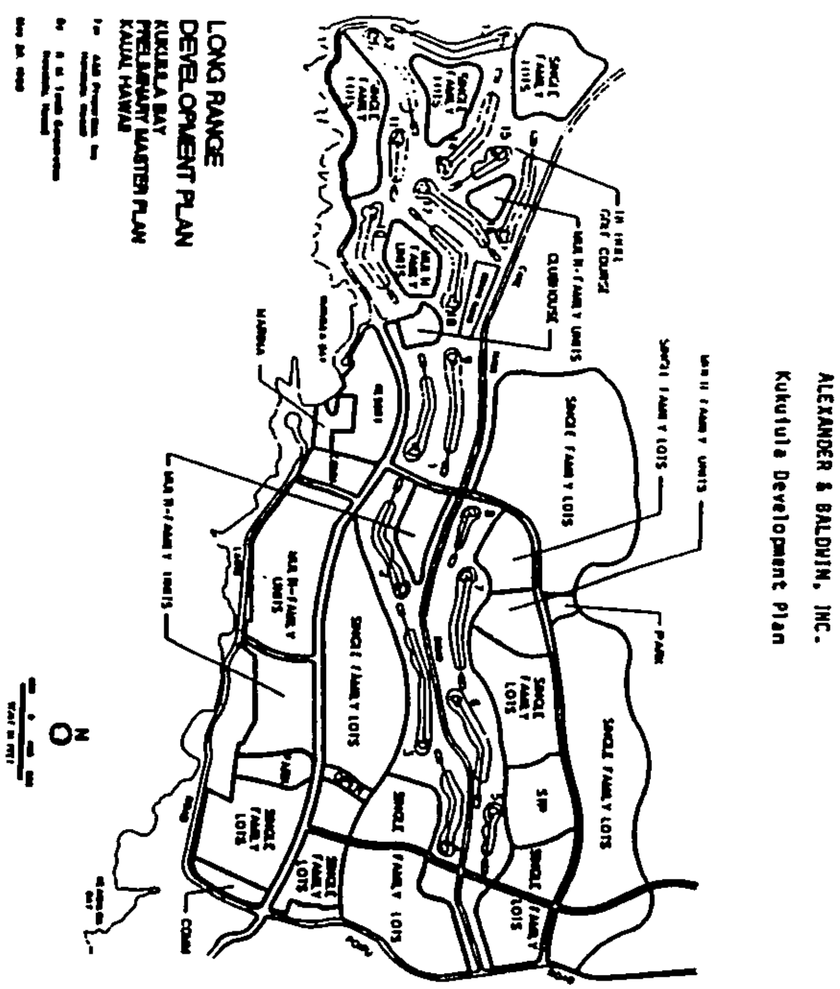
Facility type	1995(1) Low	1995(1) High	2005 Low	2005 High	2015 Low	2015 High
Phase I(2):						
Multifamily units:						
Medium density	180	180	560	560	560	560
Low density	370	440	440	440	440	440
Single-family units	528	598	738	738	738	738
Commercial:						
Neighborhood (square feet)	36,600	36,600	50,100	50,100	50,100	50,100
General (square feet)	-	-	25,000	35,000	25,000	35,000
Phase II(3):						
Low density multifamily units	-	-	-	-	330	530
Single-family units:						
Ocean- and golf-front lots	-	-	300	375	675	800
Patio homes	-	-	50	75	175	250
View and other lots or units	-	-	450	480	820	1,000
Hotel units	-	-	430	620	430	620
Golf course	-	-	1	1	1	1

(1) Six-year time period, subsequent increments are ten-year periods.

(2) Phase I development based on recommended land use designations from Kauai County Planning Department, 1988.

(3) Phase II development based on "Market Assessment for the Proposed Kukuiula Master-Planned Community Phase II," Peat Marwick Main & Co., 1988.

Exhibit II-C



Resident Population

In July of 1986 Kauai was estimated to have a resident population of 46,300 including military personnel. Resident population growth on the island has been projected by the Hawaii State Department of Business and Economic Development (DBED) in the Series M-K (1988) projections. The resident population on Kauai is expected to increase to 59,500 by 1995, 67,900 by the year 2000, 76,800 in 2005 and 86,900 in the last projection period of 2010, as shown in Exhibit II-D.

In 1987 westbound visitor arrivals reached one million for the second consecutive year, representing a compounded annual increase of 4.1% from 1980. Eastbound visitors, primarily Japanese visitors, represent a small but growing proportion of total visitors to Kauai and are estimated to spend an average of $367 per day, or over three times more than westbound travelers.

KOLOA REGION

The Koloa region is defined as census districts 406 and 407 which includes the visitor destination area of Poipu and the Kukuiula Bay area where the project site is located.

This section reviews the economic and population trends of the Koloa district.

Economic Trends

The region is evolving from an agriculturally based area to one that now also includes one of Kauai's major visitor destinations, the Poipu area.

The Koloa region could have increased tourism and drive-through visitors in the years ahead as the Poipu and surrounding area expands and as the area's favorable weather conditions and varied attractions continue to draw visitors.

Resident Population

The 1980 resident population of the Koloa region was 8,700, as also shown in Exhibit II-D. This represents an annually compounded growth rate of 2.5% since 1970 for the region.

Employment Patterns

Civilian labor force participation rates have changed somewhat as has been the case for the County of Kauai between 1970 and 1980 as shown in Exhibit II-E. Male and female labor force participation rates for the region in 1980 has averaged 55%, about 10% lower than the county-wide average.

Information on labor force characteristics since 1980 is not available by regions, but the State of Hawaii, Department of Labor and Industrial Relations (DLIR) prepares labor force estimates for the county as a whole. The DLIR estimates that from 1980 to 1987 the civilian labor force has increased by 3.6% per year to about 25,000 persons in 1987 as shown in Exhibit II-F. In addition, county employment appears to have stabilized with the labor force growth resulting in an estimated 4.4% rate of unemployment in 1987, about 0.3% gain from 1980.

Exhibit II-D

ALEXANDER & BALDWIN & INC.

Historical and Projected Resident Population of the Koloa District and County of Kauai

1970 to 2010

Year	Koloa	Kauai
Historical:		
1970	6,801	29,800
1980	8,734	39,400
Projected:		
1990	N/A	51,800
1995	N/A	59,500
2000	N/A	67,900
2005	N/A	76,800
2010	N/A	86,900
Compounded annual percentage increase:		
1970 to 1980	2.5%	2.8%
1980 to 1990	-	2.8
1990 to 2000	-	2.7
2000 to 2010	-	2.5

N/A Not available.

Sources: U. S. Bureau of the Census, 1980 Census of Population and Housing, Census Tracts, Hawaii, 1981; U. S. Bureau of the Census, 1970 Census of Population, General Social and Economic Characteristics, Hawaii, 1971; Department of Business and Economic Development, Revised Long-Range Economic and Population Projections to 2010 State of Hawaii (Series M-K), 1988.

Exhibit II-E

ALEXANDER AND BALDWIN, INC.

Labor Force Characteristics of Koloa and the County of Kauai

1970 and 1980

	Koloa		County of Kauai	
	1970	1980	1970	1980
Potential labor force (persons aged 16+)	4,650	6,458	20,034	28,629
Civilian labor force	2,838	4,254	12,447	18,789
Percentage distribution:				
Civilian labor force	61.0%	65.9%	62.1%	65.6%
Not in labor force	39.0	34.1	37.9	34.4
Total	100.0%	100.0%	100.0%	100.0%
Civilian labor force participation rates:				
Male	72.4	53.0	73.8	72.8
Female	48.4	56.4	47.4	58.1
Average	60.4%	54.7%	60.6%	65.5%

Source: U. S. Bureau of the Census, Census of Population and Housing, 1970, Census Tracts (Final Report, PHC(1)88, Honolulu, Hawaii, SMSA), 1972.

Exhibit II-F

ALEXANDER AND BALDWIN, INC.

Average Annual Labor Force Estimates
of the County of Kauai

1980 and 1987

	1980	1987	Average annual percent change 1980 - 1987
Civilian labor force	19,550	25,000	3.6 %
Percent unemployed	4.3%	4.4%	(0.3)
Nonagricultural wage and salary jobs by industry:			
Construction	1,100	750	(5.3)
Manufacturing	1,300	1,150	(1.7)
Transportation, communications and utilities	1,600	2,050	3.6
Trade:			
Wholesale	350	400	1.9
Retail	3,400	5,050	5.8
Finance, insurance and real estate	950	1,150	2.8
Services and miscellaneous	1,900	2,650	4.9
Hotels	1,850	3,200	8.1
Government	2,750	2,900	.8
Total	15,200	19,300	3.5 %

Source: State of Hawaii, Department of Labor and Industrial Relations, Labor Force Data Book, annually updated.

Job losses since 1980 have occurred in the construction and manufacturing industries while job increases were noted in the areas of transportation, trade, finance, services and government as also shown in Exhibit II-F.

Household Income

Median household incomes in the Koloa district at $20,401 were higher than the county and lower than the state averages of $19,066 and $20,500, as reported in the 1980 census and as shown in Exhibit II-G.

Social Characteristics

Education, ethnicity and age characteristics of the regional population in 1970 and 1980 are summarized in Exhibit II-H. Kauai has exhibited increasing levels of educational achievement over the intercensal decade, as shown in the exhibit. The Koloa district and the island of Kauai also showed increases in the share of population of working force and retirement age categories along with overall decreases in the 17 years and below age categories.

Comparison of 1970 and 1980 U. S. Bureau of the Census data on ethnicity, unfortunately, is not productive because of the significant differences in the means of classifying ethnicity at the two enumerations.

Exhibit II-G

ALEXANDER & BALDWIN, INC.

Median Household Income in Koloa District
and the County of Kauai

1980

Area	Median household income(1)
Koloa	$ 20,401
Kauai	19,066
State of Hawaii	20,500

(1) Income of households in 1979.

Source: U. S. Bureau of the Census, 1980 Census of Population, Hawaii, 1981.

Exhibit II-H

ALEXANDER & BALDWIN, INC.

Social Characteristics of the Koloa District
and the County of Kauai

1970 and 1980

	Koloa 1970	Koloa 1980	County of Kauai 1970	County of Kauai 1980
Total population	-	8,734	-	39,082
Education (population aged 25+)(1):				
Less than 8 years	N/A%	25.7%	45.3%	9.9%
12 years	N/A	27.3	27.3	28.3
16 or more years	N/A	17.7	7.2	15.7
Ethnicity(1):				
Hawaiian	5.7	4.6	10.2	14.6
Japanese	37.9	25.2	32.9	25.0
Caucasian	18.2	37.6	25.9	28.5
Chinese	2.1	1.0	1.8	1.3
Filipino	34.9	22.1	27.4	26.2
Other	1.2	-	1.8	4.4
Age:				
Under 5 years	8.7	8.7	8.9	8.9
5 to 19 years	31.1	23.2	30.3	24.4
20 to 64 years	50.7	56.7	51.9	55.6
65 or older	9.5	11.4	8.9	11.1

N/A Not available.
(1) Estimates based on 15% sample.

Sources: Census of Population and Housing, 1980, Census Tracts (PHC 80(2)13), 1983; summary tape files 1-A and 3-A, 1980; State of Hawaii, Department of Business and Economic Development, Community Profiles for Hawaii, 1973.

III - ECONOMIC IMPACTS

This chapter describes the expected economic impacts of the planned developments at Kukuiula Phases I and II in terms of visitor expenditures, employment, income and population.

The economic projections have been based on densities recommended for Phase I by the Kauai County Planning Department and projected high and low market supportable unit counts for Phase II based on the assessments prepared by Peat Marwick. The low end of the projection figures in this report could be considered a reasonable estimate of A&B's development plan, while the high end projections could be considered the maximum development that the community could support.

The impacts are discussed in the report in terms of the overall community. However, the exhibits that accompany the report have been segmented to present the impacts of the development by its two phases.

VISITOR EXPENDITURES

The Kukuiula master-planned community would contribute to direct, indirect and induced visitor expenditures in Hawaii. Visitors to the community would make direct expenditures for food, accommodations, gift items and other goods and services. These expenditures would, in turn, require those establishments serving direct visitor demands to purchase goods and services from other establishments in the state. The latter expenditures are considered indirect effects of the original visitor expenditures. Induced expenditures are those made by employees and proprietors with income derived from establishments benefiting from these new direct and indirect expenditures.

Direct

Direct visitor expenditures are projected based on the expected average daily visitor population and visitor expenditure patterns as reported by the Hawaii Visitors Bureau (HVB). The HVB reports that in 1987, the average hotel guest in the state spent $105 per day, while the average condominium visitor spent $90 per day. Single-family unit visitors were also assumed to have a nonhotel guest expenditure level of about $90 per day.

Thus in 1988 dollars, direct expenditures could range from about $8.8 million to $9.5 million per year by 1995, $42.8 million to $54.8 million at 2005 and increasing to $47.8 million to $63.9 million per year at project stabilization in 2015 as shown in Exhibit III-A.

Indirect and Induced

THe Hawaii State Department of Business and Economic Development (DBED) State input/output model estimates the economic activity generated in the state by various types of visitor-related direct expenditures. The all-industries multiplier of $0.68 per $1 direct expenditure was used from the most recent (1986) DBED model.

Exhibit III-A

ALEXANDER & BALDWIN, INC.

Projected Direct Annual Visitor Expenditures

Millions of 1988 Dollars(1)

Unit type	1995(2) Low	1995(2) High	2005 Low	2005 High	2015 Low	2015 High
Direct(1):						
Phase I:						
Multifamily units(3):						
Medium density	$ 3.7	3.7	11.5	11.5	11.5	11.5
Low density	4.4	5.1	5.1	5.1	5.1	5.1
Single-family units(3)	0.7	0.7	1.0	1.4	1.0	1.4
Phase II:						
Low density multifamily units(3)	-	-	-	-	4.1	6.4
Single-family units(3):						
Ocean- and golf-front lots	-	-	0.7	1.4	1.0	2.7
Patio homes	-	-	0.0	0.3	0.3	0.7
View and other lots or units	-	-	0.7	0.7	1.0	1.7
Hotel units(5)	-	-	23.8	34.4	23.8	34.4
Subtotal	8.8	9.5	42.8	54.8	47.8	63.9
Indirect and Induced(4):						
Phase I	6.0	6.5	12.0	12.2	12.0	12.2
Phase II	-	-	17.1	25.0	20.6	31.2
Subtotal	6.0	6.5	29.1	37.2	32.6	43.4
Total, rounded	$ 14.8	16.0	72.0	92.0	80.5	107.3

(1) 1987 average daily expenditures updated to 1988 dollars.

(2) Six-year time period.

(3) Nonhotel visitors assumed to have daily expenditure of $93 per day in 1988 dollars, based on HVB expenditure survey.

(4) Projected at $0.68 per $1 direct expenditure. Based on Department of Business and and Economic Development Input-Output Model, 1986.

(5) Average daily expenditure for hotel guests estimated at $107 in 1988 dollars, based on HVB expenditure survey.

The projected direct expenditures could be expected to generate indirect and induced expenditures throughout the state, totaling about $6.0 million by 1995, $29.1 million to $37.2 million in 2005 and ranging up to $32.6 million to $43.4 million by 2015, as also shown in Exhibit III-A.

Total

Including direct, indirect and induced effects, visitor expenditures attributable to the community are projected in 1988 dollars to total between $14.8 million and $16.0 million per year in 1995, increasing to about $72.0 million and $92.0 million per year in 2005 and ranging from $80.5 million and $107.3 million by 2015, as shown in the same exhibit.

EMPLOYMENT

Planned development at Kukuiula will generate short-term employment during the construction of new facilities and long-term employment in the operation and support of those facilities. Employment effects may also be classified as being direct, indirect or induced. Direct employment is that supported by expenditures at the community, such as the employment at hotels and other establishments that serve visitors. Most of the direct employment effects would occur at the Kukuiula community. As for expenditures, however, indirect and induced employment resulting from the development may be supported throughout the state's economy.

This section projects the direct, indirect and induced effects of the proposed development on construction and operational employment.

Direct Construction Employment

Direct construction employment is that which would be supported directly by the construction of the various facilities. Such employment includes on-site laborers, operatives and craftsmen, as well as the professional, managerial, sales and clerical workers whose usual places of employment may be elsewhere on the island or in the state.

Construction employment would be highest during the first phase of development, during and before facilities are fully operational, when the major portion of the infrastructure and the initial phase of multifamily and single-family units are constructed. Construction employment is estimated to average about 410 to 490 person-years per year as shown in Exhibit III-B. Construction employment could then average about 280 to 390 person-years per year by 2005 and decrease further from 180 to 300 person-years per year by 2015, as also shown in the exhibit.

Indirect and Induced Construction Employment

The direct employment of construction workers at the development will stimulate additional purchases of goods and services on the island and elsewhere in the state. In its most recent (1987) revisions to a model of the construction industry in Hawaii, the DBED calculated that 1.8 full-time jobs are created in the state for every full-time job in the building construction industry. This multiplier is used to project the indirect and induced employment to be supported by the direct construction employment as shown in Exhibit III-C.

Exhibit III-B

ALEXANDER & BALDWIN, INC.

Projected Direct Employment for Facility Construction

Average Annual Person-Years: 1990 to 2015

Facility type	1995(1) Low	1995(1) High	2005 Low	2005 High	2015 Low	2015 High
Phase I:						
Multifamily units(2):						
Medium density	30	30	40	40	-	-
Low density	60	80	0	10	-	-
Single-family units:						
Lot development(3)	4	4	13	12	-	-
Home construction(4)	140	160	80	90	10	30
Commercial(5):						
Neighborhood (square feet)	4	4	1	1	-	-
General (square feet)	-	-	2	2	-	-
Infrastructure(6)	-	40	40	-	-	-
Phase I subtotal, rounded	280	320	130	160	10	30
Phase II:						
Hotel units(7)	100	140	-	-	-	-
Low density multifamily units(2)	-	-	-	-	35	35
Ocean- and golf-front lots:						
Lot development(3)	-	-	3	7	4	8
Home construction(4)	-	-	30	70	40	80
Patio homes(8)	-	-	10	20	30	40
View and other lot or units:						
Lot development(3)	-	-	7	9	6	10
Home construction(4)	-	-	70	90	60	100
Infrastructure(6)	30	30	30	30	-	-
Phase II subtotal, rounded	130	170	150	230	170	270
Total employment	410	490	280	390	180	300

(1) Six-year time period.

(2) Demand calculated at 0.7 full-time equivalent jobs per year per unit, and average 18-month construction period per project.

ALEXANDER & BALDWIN, INC.

Projected Direct Employment for Facility Construction, Continued

(3) Demand calculated at 0.2 full-time equivalent jobs per year per lot, and average one-year construction period per lot.

(4) Demand calculated at 2.0 full-time equivalent jobs per year per home, and average one-year construction period per home.

(5) Demand calculated at 0.6 person-years per 1,000 square feet gross leasable space.

(6) Based on estimated construction costs provided by R.M. Towill Corporation $44.6 to $51.3 million estimate for Phase I and $82 to $94.3 million for Phase II. Infrastructural improvements include roads, drainage, sewer, water, power, communications, grading, landscaping and golf course.

(7) Demand calculated at 0.7 full-time equivalent jobs per year per unit and an average two-year construction period.

(8) Demand calculated at 2.0 full-time equivalent jobs per year per home, 0.2 full-time equivalent jobs per year per lot and average one-year construction period.

ALEXANDER & BALDWIN, INC.

Projected Indirect and Induced Employment for Facility Construction

Average Annual Person-Years: 1990 to 2015

Type of employment	1995(1) Low	1995(1) High	2005 Low	2005 High	2015 Low	2015 High
Direct(2):						
Phase I	280	320	130	160	10	30
Phase II	130	170	150	230	170	270
Subtotal	410	490	280	390	180	300
Indirect and induced(3):						
Phase I:						
On island(4)	60	60	30	30	-	10
Elsewhere in state	450	510	210	260	20	50
Phase II:						
On island(4)	30	30	30	50	30	50
Elsewhere in state	210	270	240	370	270	430
Subtotal	750	870	510	710	320	540
Total, rounded	1,160	1,360	790	1,100	500	840

(1) Six-year time period.

(2) From Exhibit III-B.

(3) Indirect and induced estimated at 1.8 full-time equivalent positions per direct position as reported by the State of Hawaii Department of Business and Economic Development (DBED) based on the DBED Hawaii Construction Model, 1987.

(4) Direct employment multiplied by 0.2. Anderson, et al., Kauai Socioeconomic Profile, 1975.

As with direct construction, the greatest employment would occur in the first period when indirect and induced construction employment effects are expected to provide employment opportunities for about 750 to 870 persons per year. Indirect and induced construction employment could then reduce to about 510 to 710 and from 320 to 540 annual person-years by 2005 and 2015, respectively and as also shown in the exhibit.

Direct Operational Employment

The majority of direct operational employment at the development would occur in the visitor-related facilities. Thus, Kukuiula could be expected to have generated about 240 to 290 full-time equivalent direct operational positions by 1995, about 860 to 1,170 full-time equivalent direct operational positions by 2005 and from 880 to 1,210 full-time equivalent positions by 2015, as shown in Exhibit III-D.

Indirect and Induced Operational Employment

The direct operational positions created would also indirectly generate employment elsewhere in the state. Recent studies on the total economic impacts of direct, indirect and induced employment multipliers in the hotel/real estate, other services and other retail trade industries by the DBED suggest that the activities at the community could be expected to support a total of 0.8 indirect and induced full-time equivalent positions elsewhere in the state for each direct job created. In addition, a study of Kauai's economy suggested a regional capture rate of total indirect and induced employment amounting to about 20% of direct employment.

Thus, indirect and induced operational employment could be expected to amount to about 190 to 230 full-time equivalent positions by 1995, increasing to about 680 to 940 by 2005 and totaling by 2015 to 700 to 970 full-time equivalent positions, as shown in Exhibit III-E.

Total Operational Employment

Total direct, indirect and induced operational employment are estimated to represent about 430 to 520 full-time equivalent positions by 1995 increasing to 1,540 and 2,110 positions by 2005 and 1,580 to 2,180 total full-time equivalent positions at 2015, as also shown in Exhibit III-E.

PERSONAL INCOME

The planned development would have an impact on personal income for residents of the island and state through employee wages, salaries and fringe benefits, as well as through revenue to its proprietors. Personal income is defined as the wages and salaries paid to the direct construction and operational employees of the development. Personal income is projected on the basis of average industry wages and salaries for the various types of employment anticipated and on the projected future employment demands.

Personal income paid to Hawaii residents could be expected to range from $13.8 million to $16.7 million per year through 1995, increasing to $18.9 million and $26.0 million at 2005 and stabilizing at about $16.1 million and $23.8 million per year by 2015. These figures are presented in Exhibit III-F.

Exhibit III-D

ALEXANDER & BALDWIN, INC.

Projected Direct Employment for Development Operations

1995, 2005 and 2015

Phase/location of employment	1995(1) Low	1995(1) High	2005 Low	2005 High	2015 Low	2015 High
Phase I:						
Medium density multifamily units(2)	20	20	50	50	50	50
Low density multifamily units(2)	20	20	20	20	20	20
Neighborhood commercial(3)	150	150	200	200	200	200
General commercial(3)	-	-	100	140	100	140
Facilities administration(4)	50	100	50	100	50	100
Subtotal	240	290	420	510	420	510
Phase II:						
Hotel units(5)	-	-	390	560	390	560
Low density multifamily units(2)	-	-	-	-	20	40
Facilities administration(4)	-	-	50	100	50	100
Subtotal	-	-	440	660	460	700
Total	240	290	860	1,170	880	1,210

(1) Six-year time period.

(2) Projected at 0.15 full-time equivalent jobs per condominium unit in the rental pool.

(3) Projected at 1.0 job per 250 gross leasable square feet of commercial space.

(4) Category includes other employment such as miscellaneous facilities, resort administration, property development, sales and management, grounds-keeping and maintenance of infrastructural facilities for both Phases I and II.

(5) Projected at 0.9 full-time equivalent jobs per hotel unit.

Exhibit III-E

ALEXANDER & BALDWIN, INC.

Projected Direct, Indirect and Induced Operational Employment for the Kukuiula Development

Type of employment	1995(1) Low	1995(1) High	2005 Low	2005 High	2015 Low	2015 High
Direct(2):						
Phase I	240	290	420	510	420	510
Phase II	-	-	440	660	460	700
Subtotal	240	290	860	1,170	880	1,210
Indirect and induced(3):						
Phase I:						
On island(4)	50	60	80	100	80	100
Elsewhere in state	140	170	250	310	250	310
Phase II:						
On island(4)	-	-	90	130	90	140
Elsewhere in state	-	-	260	400	280	420
Subtotal	190	230	680	940	700	970
Total	430	520	1,540	2,110	1,580	2,180

(1) Six-year time period.

(2) As shown in Exhibit III-D.

(3) Indirect and induced estimated at 0.8 full-time equivalent positions per direct position. Based on weighted average of multipliers for the hotel/real estate, other retail and other services industries as reported by the Hawaii State Department of Business and Economic Development (DBED), Input-Output Model, 1986.

(4) On-island indirect and induced employment derived from 0.2 multiplier of direct employment, Anderson, et al., Kauai Socioeconomic Profile, 1975.

Exhibit III-F

ALEXANDER & BALDWIN, INC.

Projected Annual Personal Income From Direct Employment

1990 to 2015

Thousands of 1988 Dollars(1)

Type of employment	1995(2) Low	1995(2) High	2005 Low	2005 High	2015 Low	2015 High
Phase I:						
Construction(3)	$ 7,620	8,740	3,710	4,270	280	830
Operational(4)	1,040	1,790	1,490	2,230	1,490	2,230
Commercial(5)	1,510	1,510	3,020	3,420	3,020	3,420
Subtotal	10,170	12,040	8,220	9,920	4,790	6,480
Phase II:						
Construction(3)	3,580	4,680	4,120	6,220	4,790	7,500
Operational(4)	-	-	6,550	9,830	6,550	9,830
Subtotal	3,580	4,680	10,670	16,050	11,340	17,330
Total	$ 13,750	16,720	18,890	25,970	16,130	23,810

(1) 1986 Department of Labor and Industrial Relations (DLIR) data updated to 1988 dollars.

(2) Six-year time period.

(3) Average annual wage of $27,509 for construction workers for the County of Kauai.

(4) Operational wages of $14,890 estimated for the County of Kauai.

(5) Commercial sector wages projected at $10,055 based on average wages in retail industries on the island, selected industry classifications (Department of Labor and Industrial Relations, 1987, page 12).

Sources: Department of Labor and Industrial Relations, September 1987; and 1986 Employment and Payrolls in Hawaii.

POPULATION

The development of the community will lead to a population increase at the site and elsewhere on the island. People will be residing during most or parts of each year in the residential portion of the community, while visitors at the hotel and other guest accommodations will contribute to the average daily population. Operational and construction employees could also add to the off-site population of the region and the island.

Visitor Population Impact

The Kukuiula daily visitor population projection is derived from the proposed facilities as shown in Exhibit II-B unit usage, average occupancy and party size assumptions as shown in Exhibit III-G and buildout rates for the single-family lots as shown in Exhibit III-H.

All of the hotel units and a range of 35% to 60% for the multifamily units and 5% to 10% for single-family units are projected for use as guest accommodations. The projected occupancy rate for hotel units was assumed to be 75% while the projected occupancy rates for condominium and single-family units are expected to average about 50%. Average party size was estimated at 1.9 for hotel units and 2.0 for the multifamily and single-family units.

Based on these assumptions, the projected visitor population at Kukuiula could be expected to range from about 260 to 280 in 1995, increase to about 1,200 to 1,500 in 2005 with the opening of the proposed hotel, and then stabilize between 1,320 and 1,750 in 2015, as shown in Exhibit III-I.

On-Site Resident Population Impact

Resident population at the community was projected using the assumptions concerning multifamily and single-family development shown previously in Exhibit II-B, assumptions about unit usage and buildout rates shown in Exhibit III-G and as summarized by Exhibit III-H.

Resident population at the community is projected to range from about 1,400 to 1,600 by 1995, increasing to about 2,800 to 3,600 in 2005, and 3,900 to 5,600 by 2015 for the overall Kukuiula master-planned community, as shown in Exhibit III-J.

Total On-Site Population Impact

The total on-site population impact is the summation of the projected visitor and resident population at Kukuiula. The community population could range from 1,600 to 1,800 in 1995. In the second time period ending in 2005 when Phases I and II will be overlapping, the on-site population is projected to increase to 4,000 to 5,000 with the population in the 2015 period expected to stabilize between 5,200 and 7,400, as shown in the summary in Exhibit III-K.

The percentage distribution between the visitor and resident population shows that the the visitor population will range from a low of about 15% to a high of about 30% of the total on-site population, as also shown in Exhibit III-K. Thus, the resident population of the community is expected to comprise from about 70% to 85% of the total population through the entire projection period.

Exhibit III-G

ALEXANDER & BALDWIN, INC.

Assumptions for On-Site Population Projections

	Percent distri-bution(1)	Average unit occu-pancy	Average party size(2)	Lot build-out after Five years	Lot build-out after Ten years
Phase I:					
Medium density multifamily units:					
Retirees	10%	95%	1.9		
Other full-time residents	5	95	2.5		
Part-time residents	25	20	1.9		
Guest accommodations	60	50	2.0		
Total	100%			N/A	N/A
Low density multifamily units:					
Retirees	15	95	1.9		
Other full-time residents	35	95	2.5		
Part-time residents	15	20	1.9		
Guest accommodations	35	50	2.0		
Total	100			N/A	N/A
Single-family units:					
Retirees	20	95	1.9		
Other full-time residents	60	95	2.8		
Part-time residents	15	20	2.8		
Guest accommodations	5	50	2.0		
Total	100			80%	95%
Phase II:					
Low density multifamily units:					
Retirees	10	95	1.9		
Other full-time residents	10	95	2.5		
Part-time residents	35	20	1.9		
Guest accommodations	45	50	2.0		
Total	100			N/A	N/A
Ocean- and golf-front lots and patio homes:					
Retirees	20	95	1.9		
Other full-time residents	20	95	2.8		
Part-time residents	50	20	2.8		
Guest accommodations	10	50	2.0		
Total	100			50%	95%

Exhibit III-G, Cont.

ALEXANDER & BALDWIN, INC.

Assumptions for On-Site Population Projections, Continued

	Percent distri-bution(1)	Average unit occu-pancy	Average party size(2)	Lot build-out after Five years	Lot build-out after Ten years
Phase II, continued:					
View and other lots or units:					
Retirees	15	95%	1.9		
Other full-time residents	65	95	2.8		
Part-time residents	15	20	2.8		
Guest accommodations	5	50	2.0		
Total	100%			75%	95%
Hotel units - guest accommodations	100%	75	1.9	N/A	N/A

N/A Not applicable.
(1) Distribution of uses within facility type.
(2) Occupied units only.

Source: Peat Marwick Main & Co. based on discussions with developers and realtors at similar developments.

Exhibit III-H

ALEXANDER & BALDWIN, INC.

Projected Single-Family Lot Build-Out

1995, 2005 and 2015

Facility type	1995(1) Low	1995(1) High	2005 Low	2005 High	2015 Low	2015 High
Phase I:						
Single-family units:						
Homes(2)	422	478	590	701	738	738
Lots(2)	106	120	148	37	-	-
Total	528	598	738	738	738	738
Phase II:						
Single-family units:						
Ocean- and golf-front lots:						
Homes(2)	-	-	150	356	338	760
Lots(2)	-	-	150	19	338	40
Total	-	-	300	375	676	800
View and other lots or units						
Homes(2)	-	-	338	456	615	950
Lots(2)	-	-	113	24	205	50
Total	-	-	451	480	820	1,000

(1) Six-year time period.

(2) From Exhibit III-G lot buildout projections that were based on lot build-out at comparable developments.

Exhibit III-I

ALEXANDER & BALDWIN, INC.

Projected Visitor Population

Facility type and use	1995(1) Low	1995(1) High	2005 Low	2005 High	2015 Low	2015 High
Phase I (2):						
Multifamily units:						
Medium density	110	110	340	340	340	340
Low density	130	150	150	150	150	150
Single-family units	20	20	30	40	30	40
Subtotal	260	280	520	530	520	530
Phase II(2):						
Low density multifamily units	-	-	-	-	120	190
Single-family units:						
Ocean- and golf-front lots	-	-	20	40	30	80
Patio homes	-	-	-	10	10	20
View and other lots or units	-	-	20	20	30	50
Hotel units	-	-	610	880	610	880
Subtotal	-	-	650	950	800	1,220
Total	260	280	1,170	1,480	1,320	1,750

(1) Six-year time period.

(2) Based on cumulative development summary in Exhibit II-B, guest accomodations unit usage assumptions in Exhibit III-G and lot buildout rates in Exhibit III-H.

Exhibit III-J

ALEXANDER & BALDWIN, INC.

Projected Resident Population

Facility type and use	1995(1) Low	1995(1) High	2005 Low	2005 High	2015 Low	2015 High
Phase I(2):						
Multifamily units:						
Medium density	70	70	220	220	220	220
Low density	430	510	510	510	510	510
Single-family units	860	980	1,210	1,430	1,210	1,430
Subtotal	1,360	1,560	1,940	2,160	1,940	2,160
Phase II(2):						
Low density multifamily units	-	-	-	-	180	290
Single-family units:						
Ocean- and golf-front lots	-	-	180	420	400	890
Patio homes	-	-	30	80	100	280
View and other lots or units	-	-	700	950	1,280	1,980
Subtotal	-	-	910	1,450	1,960	3,440
Total	1,360	1,560	2,850	3,610	3,900	5,600

(1) Six-year time period.

(2) Based on cumulative development summary in Exhibit II-A, resident unit usage assumptions in Exhibit III-G and lot buildout rates in Exhibit III-H.

Exhibit III-K

ALEXANDER & BALDWIN, INC.

Summary of Visitor and Resident On-Site Population

Kukuiula Phases I and II

Phase/population type	1995(1) Low	1995(1) High	2005 Low	2005 High	2015 Low	2015 High
Phase I(2):						
Visitor	260	280	520	530	520	530
Resident	1,360	1,560	1,940	2,160	1,940	2,160
Subtotal	1,620	1,840	2,460	2,690	2,460	2,690
Phase II(2):						
Visitor	-	-	650	950	800	1,220
Resident	-	-	910	1,450	1,960	3,440
Subtotal	-	-	1,560	2,400	2,760	4,660
Total	1,620	1,840	4,020	5,090	5,220	7,350
Percent distribution:						
Phase I population	100%	100%	61%	53%	47%	37%
Phase II population	-	-	39	47	53	63
Total	100%	100%	100%	100%	100%	100%
Visitor population	16	15	29	29	25	24
Resident population	84	85	71	71	75	76
Total	100%	100%	100%	100%	100%	100%

(1) Six-year time period.

(2) Based on cumulative development summary in Exhibit II-B, unit usage assumptions in Exhibit III-G and lot build-out rate in Exhibit III-H.

As mentioned earlier in the chapter, the projections for this report have been based on recommended densities for Phase I and projected high and low market supportable unit counts for Phase II. The total unit count proposed by A&B is more comparable to the low end of the projected range. Thus, the low end population figures presented in this report could be considered a reasonable estimate of A&B's development plan with the high end of the range considered the maximum that the community could support.

In-migrant Population Impact

In-migrant on-site residents are based on the resident population figures adjusted to project that 80% of retirees, 30% of other full-time residents and 100% of part-time residents are expected to be in-migrant residents. Thus, about 600 to 700 on-site residents could be expected to have moved to the island by 1995, 1,300 to 1,700 by 2005 and 1,800 to 2,700 by 2015, as shown in Exhibit III-L.

In terms of new off-site in-migrant residents generated from construction and operational employment, it has been estimated that personnel moving to the region from other parts of the state could represent about 20% of total employment. The operational and construction in-migrant employee impact, including a projected one additional person per household, could be about 280 to 300 persons in 1995, increasing to about 500 and 600 persons by 2005 and about 400 to 600 by 2015, as shown in Exhibit III-M.

The total in-migrant impact for the island of Kauai would be the sum of the on- and off-site in-migrant residents. Thus, the projected overall in-migrant population could range from about 900 to 1,000 persons in 1995, increasing from 1,800 to 2,300 persons in 2005 and stabilizing at about 2,200 to 3,300 persons by 2015, as also shown in Exhibit III-M.

Exhibit III-L

ALEXANDER & BALDWIN, INC.

Projected In-Migrant On-Site Residents

In-migrant type	1995(1) Low	1995(1) High	2005 Low	2005 High	2015 Low	2015 High
Phase I:						
Multifamily units:						
Medium density	50	50	150	150	150	150
Low density	190	230	230	230	230	230
Single-family units	360	410	500	600	500	600
Subtotal	600	690	880	980	880	980
Phase II(2):						
Low density multifamily units	-	-	-	-	120	180
Single-family units:						
Ocean- and golf-front lots	-	-	110	260	250	550
Patio homes	-	-	20	50	60	170
View and other lots or units	-	-	280	370	500	780
Subtotal	-	-	410	680	930	1,680
Total	600	690	1,290	1,660	1,810	2,660

(1) Six-year time period.

(2) Based on cumulative development summary in Exhibit II-B, resident unit usage assumptions in Exhibit III-G and lot buildout rate in Exhibit III-H. Eighty percent of retirees, 30% of other full-time residents and 100% of part-time residents projected to be in-migrant residents.

Exhibit III-M

ALEXANDER & BALDWIN, INC.

Projected Total Population In-Migrant Impact
for the Island of Kauai

Place of residence and project phase	1995(1) Low	1995(1) High	2005 Low	2005 High	2015 Low	2015 High
On-site community residents(1):						
Phase I	600	690	880	980	880	980
Phase II	-	-	410	680	930	1,680
Subtotal	600	690	1,290	1,660	1,810	2,660
Off-site residents:						
Phase I:						
Operational employees(2)	50	60	80	100	80	100
Dependents(2)	50	60	80	100	80	100
Construction employees(2)	60	60	30	30	-	10
Dependents(2)	60	60	30	30	-	10
Phase II:						
Operational employees(2)	-	-	90	130	90	140
Dependents(2)	-	-	90	130	90	140
Construction employees(2)	30	30	30	50	30	50
Dependents(2)	30	30	30	50	30	50
Subtotal	280	300	460	620	400	600
Total	880	990	1,750	2,280	2,210	3,260

(1) Based on cumulative development summary in Exhibit III-A and unit usage assumptions in Exhibit III-J.

(2) In-migrant operational and construction employees estimated at 20% of employees and projected to have one dependent each.

IV - FISCAL IMPACTS

The fiscal impacts of the proposed development are evaluated by comparing the tax revenues and operating expenditures that could be incurred by the governments of the County of Kauai and the State of Hawaii.

GOVERNMENT REVENUES

Development at the Kukuiula site would bring additional tax revenues to the county and state governments. County government revenues would be principally in the form of real property taxes on the new facilities. Revenues to the state government would be composed principally of general and specific excise taxes and personal income taxes paid by new state residents and the general excise tax on sales revenues attributable to day visitors to the community.

The sections following project the additional revenues that could be generated for the county and state governments as a result of the development.

County

Real property in the County of Kauai is currently taxed at $5.81 to $8.70 per $1,000 of assessed value depending on the class of land and improvement.

Net additional real property taxes were estimated according to the average projected prices of the various units and assessed or sold values for other comparable facilities in the state for hotels and golf courses, less the current property taxes generated by the undeveloped site.

Based on these rates and estimated assessed values, Kukuiula Phases I and II could be expected to generate in 1988 dollars, net new property tax revenues for the County of Kauai of about $1.2 million per year by 1995, increasing to about $3.2 million to $4.7 million in 2005 and between $5.0 million and $7.8 million in 2015, as shown in Exhibit IV-A.

State

New revenues to the state government would be generated by the 4% general excise tax on direct, indirect and induced expenditures by visitors to the community and the 5% transient accommodations tax on hotel and condominium unit rental revenues at Kukuiula.

In addition, new residents attracted to the state by the residential opportunities of the project would bring in additional excise sales taxes, individual income taxes and other state taxes such as liquor, tobacco, fuel, inheritance, estate and conveyance taxes.

On state tax receipts in fiscal 1986, the individual income and other taxes mentioned above, averaged about $1,500 in 1988 dollars per state resident. Thus, new tax revenues to the state government attributable to the community's development are expected to be from about $2.9 million to $3.5 million per year in 1988 dollars by 1995, increasing to about $10.2 million to $14.1 million by 2005 and between $13.8 million and $22.0 million by 2010, as shown in Exhibit IV-B.

ALEXANDER & BALDWIN, INC.

Projected Real Property Tax Revenues Attributable to Development at Kukuiula

(1988 dollars, in millions)

Source of property tax revenue	1995(1) Low	1995(1) High	2005 Low	2005 High	2015 Low	2015 High
Phase I:						
Multifamily units:						
Medium density(2)	$ 0.37	0.37	1.14	1.14	1.14	1.14
Low density(3)	0.31	0.37	0.37	0.37	0.37	0.37
Single-family units:						
Homes(4)	0.46	0.53	0.65	0.77	0.81	0.81
Lots(5)	0.05	0.06	0.02	0.08	-	-
Commercial(6):						
Neighborhood (square feet)	0.02	0.02	0.03	0.03	0.03	0.03
General (square feet)	-	-	0.01	0.02	0.01	0.02
Subtotal	1.21	1.35	2.22	2.41	2.36	2.37
Less current property taxes(7)	0.01	0.01	0.01	0.01	0.01	0.01
Phase I net additional tax revenues	1.20	1.34	2.21	2.40	2.35	2.36
Phase II:						
Low density multifamily units(8)	-	-	-	-	0.84	1.35
Single-family units:						
Ocean- and golf-front lots:						
Homes(9)	-	-	0.21	0.49	0.46	1.04
Lots(10)	-	-	0.06	0.49	0.13	1.10
Patio homes(11)	-	-	0.15	0.22	0.52	0.75
View and other lots or units						
Homes(12)	-	-	0.22	0.29	0.39	0.61
Lots(13)	-	-	0.03	0.25	0.00	0.06
Hotel units(14)	-	-	0.29	0.53	0.29	0.53
Golf course(15)	-	-	0.01	0.02	0.01	0.02
Subtotal	-	-	0.97	2.29	2.64	5.46
Less current property taxes (7)	-	-	0.01	0.01	0.01	0.01
Phase II net additional tax revenues	-	-	0.96	2.28	2.63	5.45
Total new property tax revenues, rounded	$ 1.20	1.34	3.17	4.68	4.98	7.81

Exhibit IV-A, Cont.

ALEXANDER & BALDWIN, INC.

Projected Real Property Tax Revenues Attributable to Development at Kukuiula, Continued

(1) Six-year time period.

(2) Estimated value of $240,000 per unit and a combined land and building tax rate of $8.50 per $1,000 assessed value.

(3) Estimated value $100,000 per unit and a combined land and building tax rate of $8.50 per $1,000 assessed value.

(4) Estimated value of $180,000 per house and lot and a combined land and building tax rate of $6.10 per $1,000 assessed value.

(5) Estimated value of $80,000 per lot and a tax rate of $6.50 per $1,000 assessed value.

(6) Estimated value of $60.00 per net leasable square foot and a combined land and building tax rate of $8.50 per $1,000 assessed value.

(7) Less current property tax revenues of $8,706 per year for Phase I and $6,459 per year for Phase II as provided by Alexander & Baldwin, Inc.

(8) Estimated value of $300,000 per unit and a combined land and building tax rate of $8.50 per $1,000 assessed value.

(9) Estimated value of $500,000 per house and lot and a combined land and building tax rate of $6.10 per $1,000 assessed value.

(10) Estimated value of $225,000 per lot and a tax rate of $6.50 per $1,000 assessed value.

(11) Estimated value of $490,000 per house and lot and a combined land and building tax rate of $6.10 per $1,000 assessed value.

(12) Estimated value of $190,000 per house and lot and a combined land and building tax rate of $6.10 per $1,000 assessed value.

(13) Estimated value of $105,000 per lot and a tax rate of $6.10 per $1,000 assessed value.

(14) Estimated value of $80,000 to $100,000 per unit and a combined land and building tax rate of $8.50 per $1,000 assessed value.

(15) Estimated value of $1.5 to $2.0 million for the golf course and a tax rate of $8.50 per $1,000 assessed value.

Exhibit IV-B

ALEXANDER & BALDWIN, INC.

Projected New Annual Revenues to the State Government Attributable to Development at Kukuiula

(1988 dollars; in millions)

Revenue source	1995(1) Low	1995(1) High	2005 Low	2005 High	2015 Low	2015 High
Phase I:						
Visitors:						
Transient accommodations tax(2)	$ 0.87	0.96	1.79	1.79	1.79	1.79
General excise tax(2)	0.59	0.64	1.19	1.21	1.19	1.21
New community and off-site in-migrant residents:						
General excise tax(3)	0.41	0.68	0.83	1.57	1.14	2.48
Individual income and other taxes(4)	1.07	1.22	2.10	2.69	2.84	4.16
Subtotal	2.94	3.50	5.91	7.26	6.95	9.64
Phase II:						
Visitors:						
Transient accommodations tax(2)	-	-	0.44	0.53	0.49	0.62
General excise tax(2)	-	-	1.69	2.47	2.03	3.08
New community and off-site in-migrant residents:						
General excise tax(3)	-	-	0.61	1.40	1.25	3.22
Individual income and other taxes(4)	-	-	1.50	2.40	3.10	5.40
Subtotal	-	-	4.24	6.80	6.86	12.33
Total, rounded	$ 2.94	3.50	10.15	14.06	13.83	21.96

(1) Six-year time period.

(2) General excise tax based on 4% of direct, indirect, and induced visitor expenditures. Transient accommodations tax based on 5% of estimated hotel and condominium unit rental revenues.

(3) Based on 4% of selected household budget items. New community household incomes expected to have an average range of $40,000 to $60,000 for residents based on a survey of developers and real estate brokers at comparable communities by Peat Marwick Main & Co. Household incomes projected to be $30,000 for off-site in-migrant residents by Peat Marwick Main & Co.

(4) Estimated at $1,500 per year per full-time resident equivalent based on state revenues from individual income and other taxes, resident population and average household size.

Sources: State of Hawaii Department of Business and Economic Development, The State of Hawaii Data Bo..., 1987 and Tax Foundation of Hawaii, Government in Hawaii, 1987.

GOVERNMENT OPERATING EXPENDITURES

New visitors and residents attracted by the project would also necessitate additional expenditures of state and county public resources. In-migrant residents would incur public costs in terms of public safety, maintenance of highways, recreational facilities and natural resources, health and sanitation measures, special cash capital improvements, education, retirement and pension funds, public welfare and other government functions.

Visitors also increase the average daily population of the community and also require public expenditures in terms of public safety, maintenance of highways, health and sanitation, recreation and special cash capital improvements.

Potential additional public expenditures for sanitation measures are lessened because A&B is proposing to construct a sewage treatment plant.

County

The various county government operating expenditures for fiscal year 1986 were analyzed with respect to the relevant population served by each of the government functions. This analysis indicates that Kauai County government expenditures in 1986 totaled about $540 per resident and $250 per visitor as shown in Exhibit IV-C. A 5% increase, equal to the rise in the Honolulu Consumer Price Index between 1986 and 1988 would be equivalent to expenditures in 1988 dollars of about $570 and $260 per capita for residents and visitors, respectively.

Based on these county government outlays, public expenditures by the county on behalf of the service population for the Kukuiula community could be expected to total about $0.6 million per year by 1995, increasing to about $1.3 million to $1.7 million per year in 2005 and $1.6 million to $2.3 million by 2015 in 1988 dollars, as shown in Exhibit IV-D.

State

A similar analysis of state government operating expenditures and the relevant populations for the various government services indicate that expenditures in 1986 totaled about $2,280 per resident and $285 per visitor, as shown in Exhibit IV-E. This is equivalent to about $2,440 per resident and $310 per full-time equivalent visitor when adjusted to 1988 dollars.

Based on these operating costs, state government expenditures are projected to total about $1.5 million to $1.8 million per year by 1995, increasing to about $3.5 million to $4.5 million per year in 2005 and about $4.8 million to $7.0 million by 2015, as shown in Exhibit IV-F.

REVENUE AND EXPENDITURE ANALYSIS

The net fiscal impacts of the planned development to the county and state operating budgets are estimated by comparison of the projected revenues and expenditures.

Exhibit IV-C

ALEXANDER & BALDWIN, INC.

County of Kauai Per Capita Government Operating Expenditures

1986

Function	Expenditures (000s)(1)	Service population(2)	1986 annual expenditure Per resident	Per visitor
General government	$ 5,766	46,300	$ 124.54	-
Public safety	8,020	60,500	132.56	132.56
Highways	2,862	60,500	47.31	47.31
Health and sanitation	1,331	60,500	22.00	22.00
Public welfare	948	46,300	20.48	-
Education	117	46,300	2.53	-
Recreation	2,078	60,500	34.35	34.35
Interest	1,436	46,300	-	-
Bond redemption	1,233	46,300	-	-
Retirement and pension	3,291	46,300	71.08	-
Cash capital improvements	697	60,500	11.52	11.52
Miscellaneous	3,364	46,300	72.66	-
Total	$ 31,143		539.03	247.74
Per capita expenditure adjusted for inflation(3)			$ 570.00	260.00

(1) County government operating expenditures for fiscal year ended June 30, 1986 as reported in Tax Foundation of Hawaii, Government in Hawaii, 1987.

(2) Resident or de facto population estimates for the county as of January 1, 1986.

(3) Adjusted to reflect 1988 dollars.

Source: Tax Foundation of Hawaii, Government in Hawaii 1987.

Exhibit IV-D

ALEXANDER & BALDWIN, INC.

Projected Annual County Government Operating
Expenditures Attributable to Kukuiula

(1988 dollars; in millions)

Population and expenditure type	1995(1) Low	1995(1) High	2005 Low	2005 High	2015 Low	2015 High
Phase I:						
Population:						
On-site visitors	260	280	520	530	520	530
On-site in-migrant residents	600	690	880	980	880	980
Off-site in-migrant residents	220	240	220	260	160	220
Subtotal	1,080	1,210	1,620	1,770	1,560	1,730
Expenditures:						
On-site visitors(1)	$ 0.07	0.07	0.14	0.14	0.14	0.14
On-site in-migrant residents(2)	0.34	0.39	0.50	0.56	0.50	0.56
Off-site in-migrant residents(2)	0.13	0.14	0.13	0.15	0.09	0.13
Subtotal	0.54	0.60	0.77	0.85	0.73	0.83
Phase II:						
Population:						
On-site visitors	-	-	650	950	800	1,220
On-site in-migrant residents	-	-	410	680	930	1,680
Off-site in-migrant residents	60	60	240	360	240	380
Subtotal	60	60	1,300	1,990	1,970	3,280
Expenditures:						
On-site visitors(1)	$ -	-	0.17	0.25	0.21	0.32
On-site in-migrant residents(2)	-	-	0.23	0.39	0.53	0.96
Off-site in-migrant residents(2)	0.03	0.03	0.14	0.21	0.14	0.22
Subtotal	0.03	0.03	0.54	0.85	0.88	1.50
Total visitors and in-migrant residents	1,140	1,270	2,920	3,760	3,530	5,010
Total expenditures, rounded	$ 0.57	0.63	1.31	1.70	1.61	2.33

(1) Visitors estimated to require $260 per capita in county government expenditures.

(2) Residents estimated to require $570 per capita in county government expenditures

Exhibit IV-E

ALEXANDER & BALDWIN, INC.

State of Hawaii Government Operating
Expenditures Per Capita

1986

	Expenditures ($000)(1)	Service population(2)	Per resident	Per visitor
General government	$ 194,678	1,056,900	$ 184.20	-
Public safety	92,618	1,163,900	79.58	79.58
Highways	104,534	1,163,900	89.81	89.81
Natural resources	21,411	1,163,900	18.40	18.40
Health and sanitation	83,782	1,163,900	71.98	71.98
Hospitals and institutions	120,827	1,056,900	114.32	-
Public welfare	322,461	1,056,900	305.10	-
Education	773,223	1,056,900	731.60	-
Recreation	16,751	1,163,900	14.39	14.39
Utilities and other enterprises	90,262	1,056,900	85.40	-
Debt service	262,385	1,056,900	248.26	-
Retirement and pension	141,454	1,056,900	133.84	-
Employees' health insurance	659	1,056,900	0.62	-
Unemployment compensation	63,072	1,056,900	59.68	-
Urban redevelopment and housing	94,762	1,056,900	89.66	-
Cash capital improvements	13,480	1,163,900	11.58	11.58
Miscellaneous	41,587	1,056,900	39.35	-
Total	$ 2,437,946		2,277.77	285.74
Per capita expenditure adjusted for inflation(3)			$ 2,440.00	310.00

(1) State government operating expenditures for fiscal year ending July 30, 1986 as reported in Tax Foundation of Hawaii, Government in Hawaii, 1987.

(2) Resident or de facto (resident and visitor) population estimates as of January 1, 1986.

(3) Adjusted to reflect 1988 dollars.

Source: Tax Foundation of Hawaii, Government in Hawaii 1987.

Exhibit IV-F

ALEXANDER & BALDWIN, INC.

Projected Annual State Government Operating Expenditures
Attributable to On-Site Visitors and Residents

(1988 dollars; in millions)

Population and expenditure type	1995(1) Low	1995(1) High	2005 Low	2005 High	2015 Low	2015 High
Phase I:						
Population:						
On-site visitors	260	280	520	530	520	530
On-site in-migrant residents	600	690	880	980	880	980
Subtotal	860	970	1,400	1,510	1,400	1,510
Expenditures:						
On-site visitors(1)	$ 0.08	0.09	0.16	0.16	0.16	0.16
On-site in-migrant residents(2)	1.46	1.68	2.15	2.39	2.15	2.39
Subtotal	1.54	1.77	2.31	2.55	2.31	2.55
Phase II:						
Population:						
On-site visitors	-	-	650	950	800	1,220
On-site in-migrant residents	-	-	410	680	930	1,680
Subtotal	-	-	1,060	1,630	1,730	2,900
Expenditures:						
On-site visitors(1)	$ -	-	0.20	0.29	0.24	0.37
On-site in-migrant residents(2)	-	-	1.00	1.66	2.27	4.10
Subtotal	-	-	1.20	1.95	2.51	4.47
Total visitors and in-migrant residents	860	970	2,460	3,140	3,130	4,410
Total expenditures, rounded	$ 1.54	1.77	3.51	4.50	4.82	7.02

(1) Visitors estimated to require $310 per capita in state government expenditures.

(2) Residents estimated to require $2,440 per capita in state government expenditures.

County

Comparison of projected public revenues and expenditures attributable to the community's development indicates that the county government could expect to net about $0.6 million in 1988 dollars per year by 1995, ranging from about $2.0 million and $3.0 million in 2005 and increasing to $3.4 million and $5.5 million by 2015, as shown in Exhibit IV-G. The analysis also indicates that additional county government revenues generated by the community and its facilities would be about 2.0 to 2.2 times the operating expenditures incurred by the county government by 1995, ranging from about 2.5 to 2.8 times these expenditures by 2005 and increasing to about 3.1 to 3.4 in 2015 at project completion, as also shown in the exhibit.

State

Based on a similar analysis, net fiscal benefits to the state government in 1988 dollars are projected to be about $1.4 million to $1.7 million per year by 1995, increasing to $6.6 million to $9.6 million per year by 2005 and increasing further to $9.0 million and $14.9 million by the year 2015, as shown in Exhibit IV-H. Also, additional state government revenues generated by the development could range from about 2.0 times the expenditures incurred by the state government in 1995, increasing to 2.9 to 3.1 times the expenditures in 2005 and also totaling about 2.9 to 3.1 by 2015, as also shown in the exhibit.

Exhibit IV-G

ALEXANDER & BALDWIN, INC.

County Government Revenue
and Expenditure Comparison

(1988 dollars; in millions)

	1995 Low	1995 High	2005 Low	2005 High	2015 Low	2015 High
Phase I:						
New revenues	$ 1.2	1.3	2.2	2.4	2.4	2.4
New expenditures	0.5	0.6	0.8	0.9	0.7	0.8
Net additional revenues	0.7	0.7	1.4	1.5	1.7	1.6
Revenue/expenditure ratio(1)	2.4	2.2	2.8	2.7	3.4	3.0
Phase II:						
New revenues	$ -	-	1.0	2.3	2.6	5.5
New expenditures	-(2)	-(2)	0.5	0.9	0.9	1.5
Net additional revenues	-	-	0.5	1.4	1.7	4.0
Revenue/expenditure ratio(1)	N/A	N/A	2.0	2.6	2.9	3.7
Total Project, Phases I and II:						
New revenues	$ 1.2	1.3	3.2	4.7	5.0	7.8
New expenditures	0.6(2)	0.6(2)	1.3	1.7	1.6	2.3
Net additional revenues, rounded	$ 0.6	0.7	1.9	3.0	3.4	5.5
Revenue/expenditure ratio(1)	2.0	2.2	2.5	2.8	3.1	3.4

N/A Not applicable.

(1) New revenues divided by new expenditures.

(2) Phase II new expenditures in 1995 projected at $0.03 million, to be reflected in new expenditures for the total project, Phases I and II.

Exhibit IV-H

ALEXANDER & BALDWIN, INC.

State Government Revenue
and Expenditure Comparison

	1995 Low	1995 High	2005 Low	2005 High	2015 Low	2015 High
Phase I:						
New revenues	$ 2.9	3.5	5.9	7.3	7.0	9.6
New expenditures	1.5	1.8	2.3	2.6	2.3	2.6
Net additional revenues	1.4	1.7	3.6	4.7	4.6	7.1
Revenue/expenditure ratio(1)	1.9	2.0	2.6	2.8	3.0	3.8
Phase II:						
New revenues	$ -	-	4.2	6.8	6.9	12.3
New expenditures	-	-	1.2	2.0	2.5	4.5
Net additional revenues	-	-	3.0	4.9	4.4	7.9
Revenue/expenditure ratio(1)	-	-	3.5	3.5	2.7	2.8
Total Project, Phases I and II:						
New revenues	$ 2.9	3.5	10.1	14.1	13.8	22.0
New expenditures	1.5	1.8	3.5	4.5	4.8	7.0
Net additional revenues	$ 1.4	1.7	6.6	9.6	9.0	14.9
Revenue/expenditure ratio(1)	1.9	2.0	2.9	3.1	2.9	3.1

(1) New revenues divided by new expenditures.

APPENDIX N

TRAFFIC IMPACT REPORT

TRAFFIC IMPACT STUDY

KUKUIULA PLANNED COMMUNITY
Kukuiula, Kauai, Hawaii

Prepared for:
ALEXANDER & BALDWIN, INC.

Prepared by:
PARSONS BRINCKERHOFF QUADE & DOUGLAS, INC.

July 1988

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KUKUIULA PLANNED COMMUNITY

INTRODUCTION

Alexander & Baldwin, Inc. proposes to develop about 1,000 acres in Kukuiula, Kauai. The planned development would include single and multi-family units, a resort and marina, two commercial areas, a golf course, parks and open space. The development consists of two phases which will be developed over a period of twenty to thirty years. An earlier study[1] identified the traffic impacts of Phase 1 of this project. A second phase would complete this planned development. This report summarizes an evaluation of the cumulative traffic impact of Phases 1 and 2 of the Kukuiula Planned Community project.

The study analyzed existing traffic conditions, estimated future traffic demands, and evaluated future traffic conditions with the project during the morning and afternoon peak hours. The impacts of the project on traffic conditions were identified. Mitigation measures, where appropriate, are described. An evaluation of the adequacy of the site's roadway system was also conducted.

EXISTING CONDITIONS

The existing condition provides a basis for projecting future traffic demand and for evaluating future conditions. The descriptions of existing traffic conditions are based on manual traffic counts and field observations taken in October 1987. Machine counts taken by the State Department of Transportation provided additional information.

Roadway System

Figure 1 is a vicinity map of the area. Poipu, Koloa and Maluhia Roads are two-lane highways that form the major road network in the Poipu-Koloa area. Poipu Road is the only public route between Poipu and Koloa town. The existing physical environment and the Poipu Road alignment limit the ability to pass, as evidenced by the double solid center line striping (no passing zones) along most of this road between Lawai Road in Poipu and Koloa Road.

Poipu Road and Lawai Road meet near the east limit of the project's Phase 1 area in a Y-shaped intersection. Poipu Road traffic has the right-of-way and traffic entering from Lawai Road is controlled by a stop sign. The Lawai Road approach is striped for separate left and right turn lanes.

The Y-configuration of this intersection and the wide pavement area at the Lawai Road approach and departure lanes causes some confusion and some motorists, especially visitors unfamiliar with this area, have a difficult time determining where their vehicle should stop prior to executing a turn movement into or out of Lawai Road. Field observations noted that some drivers travelled in the opposing lane when entering or exiting Lawai Road.

Approximately 1.3 miles to the north of the site in Koloa town, Poipu Road meets Koloa Road in a T-intersection with Poipu Road being the stem of the 'T'. A separate left turn lane is provided for Koloa Road westbound traffic wishing to turn onto Poipu Road. For northbound Poipu Road traffic, a small traffic island channelizes the left and right turn movements, which are controlled by a stop sign; however, only a few vehicles waiting to turn left can be accommodated without blocking vehicles desiring to turn right.

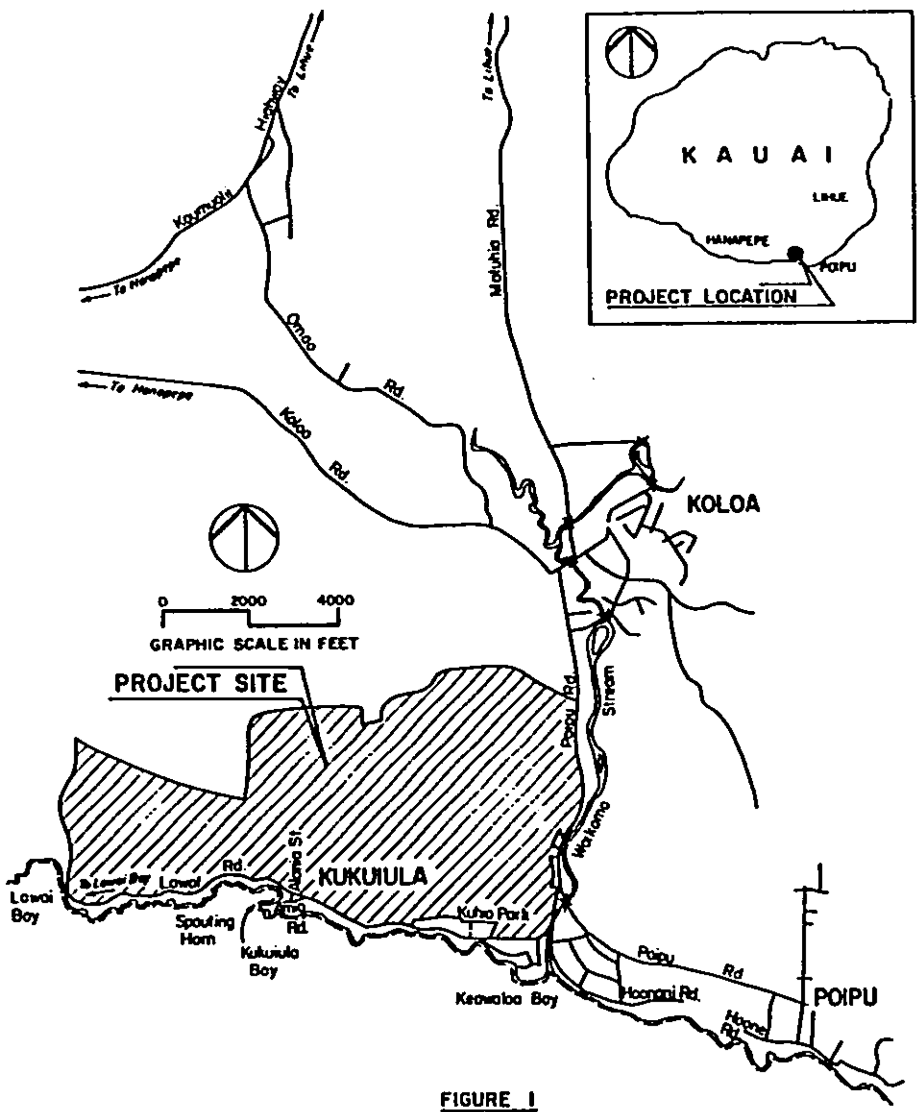

FIGURE I
VICINITY MAP

At the nearby T-intersection of Maluhia Road and Koloa Road, the stop-controlled southbound Maluhia Road approach has been widened to allow separate left and right turn lanes. On the through road, Koloa Road, a separate lane is provided for eastbound traffic desiring to turn left onto Maluhia Road.

Traffic Conditions

Traffic volumes in the Poipu-Koloa area begin to increase in the morning and continue to rise with the highest hourly volumes occuring during the afternoon (PM) peak hour. A morning (AM) peak hour occurs between 7:00 and 8:00 a.m., and the higher PM peak hour is from 3:45 to 4:45 p.m. These peak hours reflect the shift change of employees in the resort facilities in Poipu and the visitor traffic circulating in the area. Peak hour conditions at the existing unsignalized intersections were analyzed using the unsignalized methodology described in the 1985 Highway Capacity Manual[2] (HCM).

The existing traffic assignment is illustrated in Figure 2. The Levels of Service (LOS) for the minor street left turns at the existing unsignalized intersections of Poipu and Lawai Roads, Poipu and Koloa Roads, and Maluhia and Koloa Roads are provided along with an overall rating in Table 1. At present, each intersection operates under capacity during the AM peak hour; in the PM peak hour, however, demand exceeds capacity for left turns from Poipu Road onto Koloa Road. Field observations confirm the poor PM peak hour operating conditions. Traffic signals or other improvements would alleviate existing poor operating conditions and adequately serve the existing traffic demands at these intersections.

Table 1
EXISTING CONDITIONS - UNSIGNALIZED INTERSECTIONS

Intersection	AM Peak Hour	PM Peak Hour
Poipu and Lawai Roads	C (under capacity)	E (near capacity)
Poipu and Koloa Roads	C (under capacity)	F (over capacity)
Maluhia and Koloa Roads	A (under capacity)	D (under capacity)

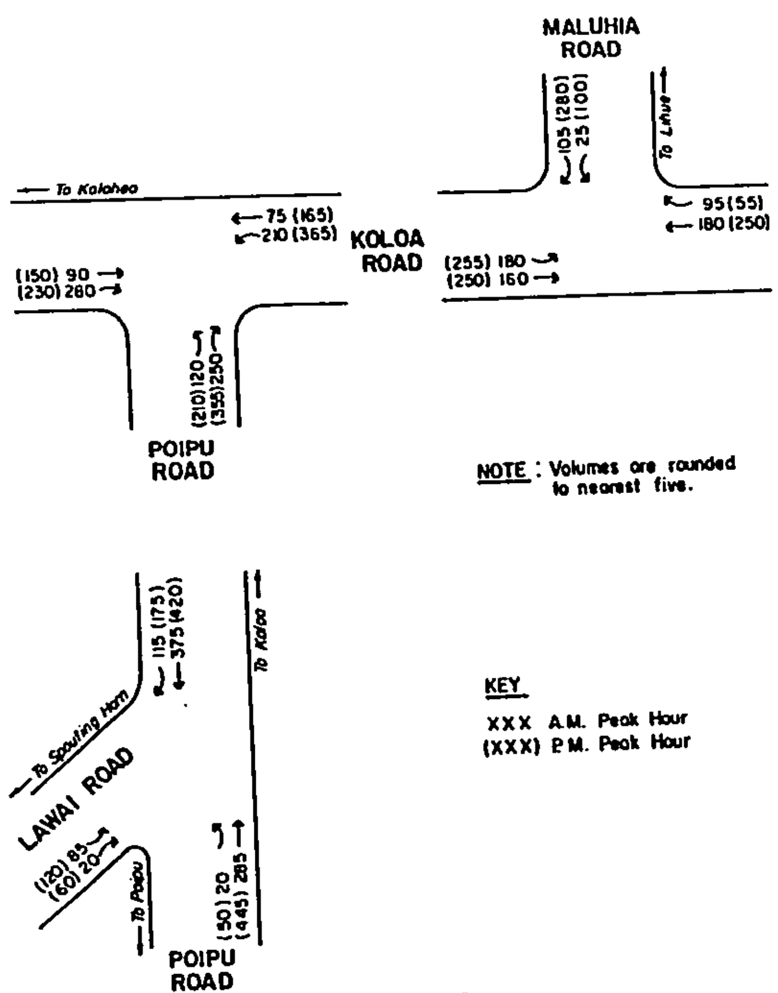

FIGURE 2
EXISTING TRAFFIC ASSIGNMENT

PROJECT DESCRIPTION

The proposed project includes single family lots and multi-family units, a resort hotel, two commercial areas, a marina, two parks and a golf course. Figure 3 shows the locations of these uses and the major project roadways. Phase 1 of the project would convert the existing Y-shaped intersection of Poipu and Lawai Roads into a standard cross-intersection with the addition of the new Road A. Road B would be constructed in Phase 2 and be connected to Poipu Road. Road C would provide an eastern mauka-makai link within the project site.

In order to estimate traffic demands, evaluate travel patterns, and develop traffic assignments, the project area was divided into nine traffic analysis zones, as shown in Figure 4. The uses within each zone and their development schedules are shown in Table 2.

Trip Generation

Trip generation determines the number of vehicles that would be produced by or attracted to the project. The trip generation estimate is based on specific rates for various activities compiled from national data by the Institute of Transportation Engineers (ITE) in its report Trip Generation[3]. Descriptions of the various types of dwelling units, estimates of the number of residents and retirees expected to reside in each area, and the projected occupancy rates of visitor-related accommodations in the resort area were used to develop trip generation rates for each use; these rates, for each traffic analysis zone, are shown in Table 3A.

Any large project with mixed uses would generate traffic at a lower rate than the sum calculated for each use, because some trips could be satisfied within the project site; for instance, residents could be expected to do some of their shopping at the neighborhood or general commercial areas rather than travel to Koloa or Poipu. The net traffic generated by the project was derived by estimating and accounting for these "internal" trips. The total and net traffic generated by Phases 1 and 2 during the AM peak hour, PM peak hour and on a daily basis are shown in Tables 3B and 3C.

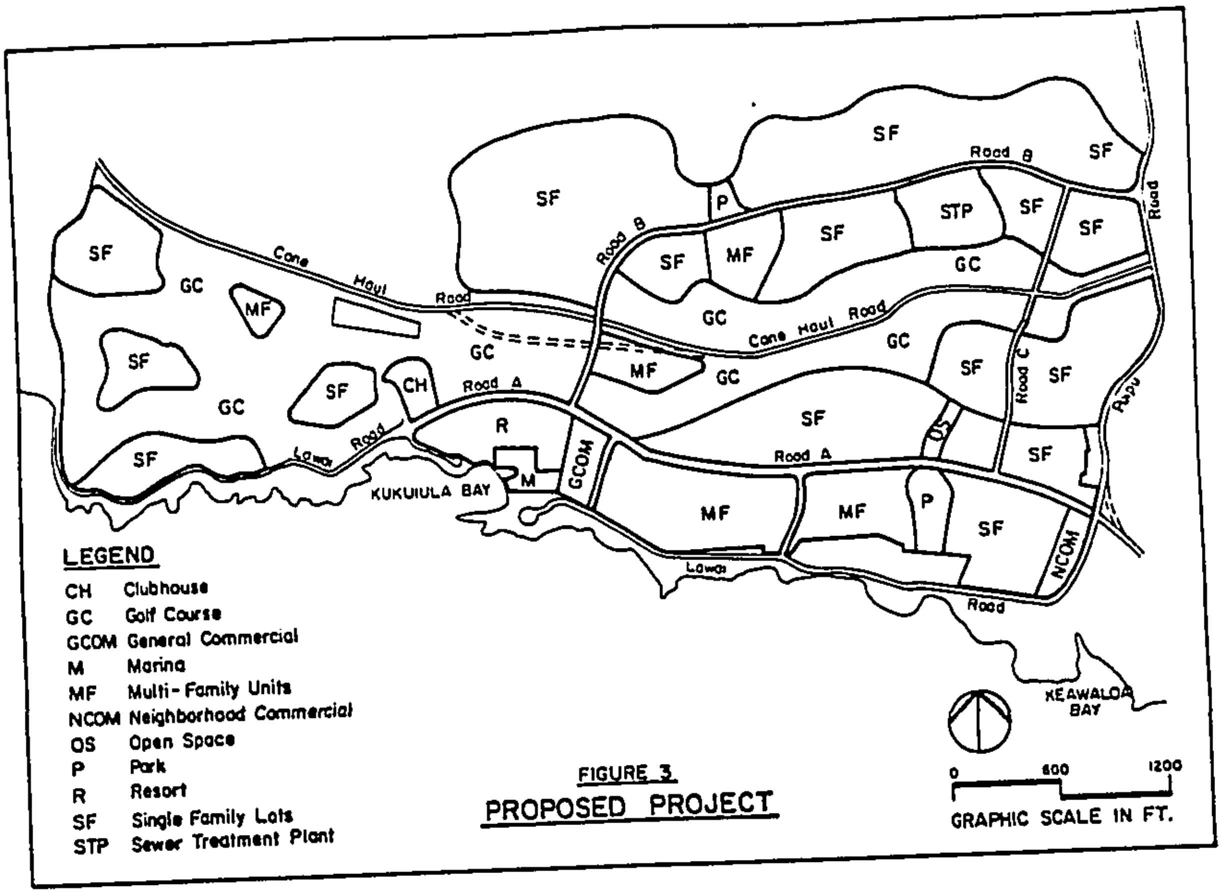

FIGURE 3
PROPOSED PROJECT

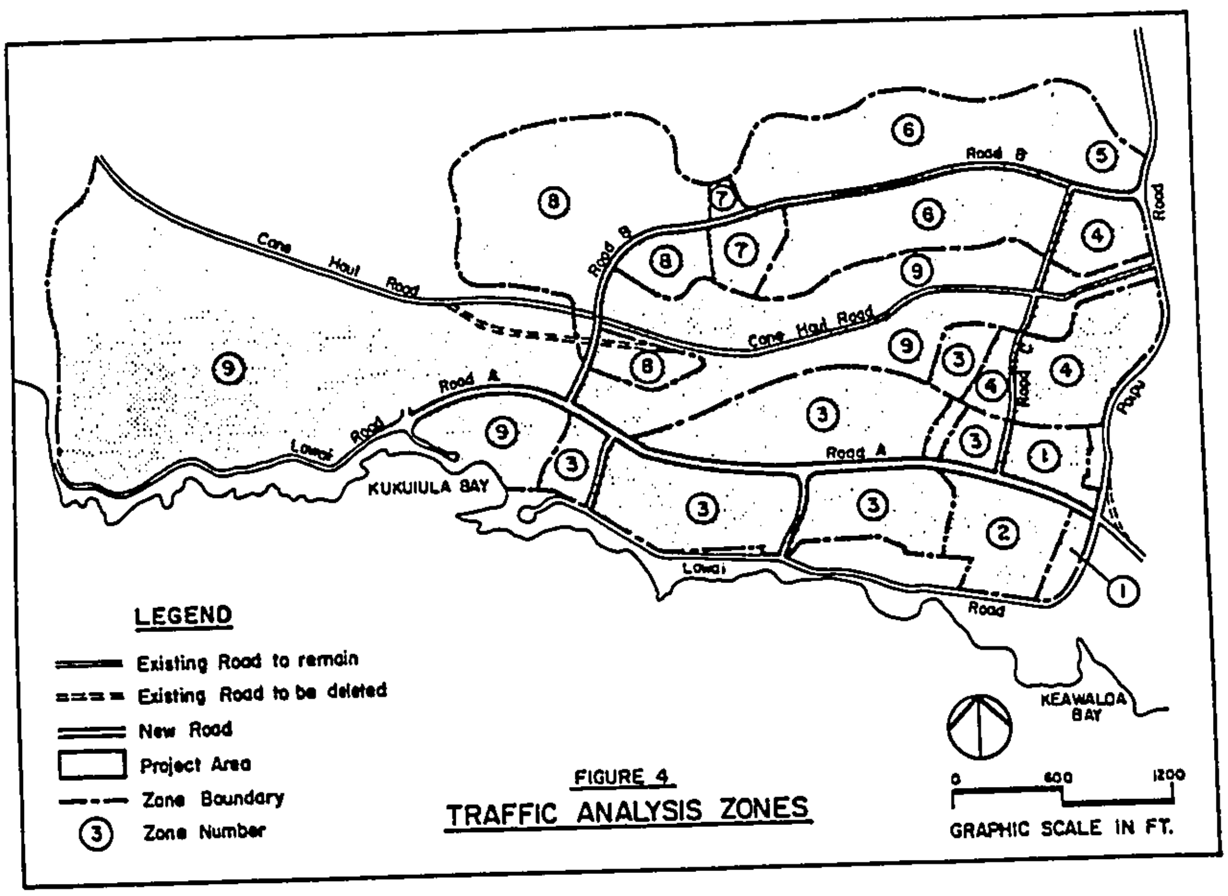

FIGURE 4
TRAFFIC ANALYSIS ZONES

Table 2
PROJECT LAND USES

Zone	Land Use	Phase 1	Phase 2	Total
1	Commercial	50	--	50 thousand square feet gross leasable area
	Single-family	96	--	96 dwelling units
2	Single-family	204	--	204 dwelling units
3	Commercial	--	35	35 thousand square feet gross leasable area
	Marina	--	105	105 berths
	Multi-family	1,000	--	1,000 dwelling units
	Park	8	--	8 acres
	Single-family	438	72	510 dwelling units
4	Single-family	--	408	408 dwelling units
5	Single-family	--	72	72 dwelling units
6	Single-family	--	570	570 dwelling units
7	Multi-family	--	140	140 dwelling units
	Park	--	4	4 acres
8	Single-family	--	483	483 dwelling units
	Multi-family	--	110	110 dwelling units
9	Golf Course	--	200	200 acres
	Marina	--	52	52 berths
	Multi-family	--	180	180 dwelling units
	Resort hotel	--	500	500 rooms
	Single-family	--	290	290 dwellings units

Table 3A
TRIP GENERATION RATES

Zone	Land Use	Daily Traffic Enter & Exit	AM Peak Hour Enter	AM Peak Hour Exit	PM Peak Hour Enter	PM Peak Hour Exit
1	Commercial	94.8	1.47	0.83	4.26	4.44
	Single-family	7.42	0.18	0.37	0.44	0.28
2	Single-family	7.42	0.18	0.37	0.44	0.28
3	Commercial	107.4	2.21	0.45	4.64	5.67
	Marina	3.00	0.07	0.02	0.05	0.12
	Multi-family	6.20	0.27	0.22	0.30	0.22
	Park	27.5	2.73	2.73	1.10	4.42
	Single-family	7.42	0.18	0.37	0.44	0.28
4	Single-family	7.42	0.18	0.37	0.44	0.28
5	Single-family	7.77	0.18	0.39	0.47	0.29
6	Single-family	7.77	0.18	0.39	0.47	0.29
7	Multi-family	5.58	0.25	0.19	0.26	0.20
	Park	27.5	2.73	2.73	1.10	4.42
8	Single-family	7.77	0.18	0.39	0.47	0.29
	Multi-family	5.58	0.25	0.19	0.26	0.20
9	Golf Course	4.60	0.21	0.05	0.03	0.36
	Marina	3.00	0.07	0.02	0.05	0.12
	Multi-family	5.58	0.25	0.19	0.26	0.20
	Resort hotel	8.70	0.46	0.24	0.36	0.31
	Single-family	4.57	0.14	0.20	0.26	0.17

Table 3B
PHASE 1 TRAFFIC GENERATION

Zone	Land Use	Daily Traffic Enter & Exit	AM Peak Hour Enter	AM Peak Hour Exit	PM Peak Hour Enter	PM Peak Hour Exit
1	Commercial	4,740	74	41	213	222
	Single-family	710	17	36	42	27
2	Single-family	1,510	37	75	90	57
3	Commercial	0	0	0	0	0
	Marina	0	0	0	0	0
	Multi-family	6,200	270	220	300	220
	Park	220	22	22	9	35
	Single-family	3,250	79	162	193	123
4	Single-family	0	0	0	0	0
5	Single-family	0	0	0	0	0
6	Single-family	0	0	0	0	0
7	Multi-family	0	0	0	0	0
	Park	0	0	0	0	0
8	Single-family	0	0	0	0	0
	Multi-family	0	0	0	0	0
9	Golf Course	0	0	0	0	0
	Marina	0	0	0	0	0
	Multi-family	0	0	0	0	0
	Resort hotel	0	0	0	0	0
	Single-family	0	0	0	0	0
		------	---	---	---	---
	Total	16,630	499	556	847	684
	Net	13,000	391	448	646	483

Table 3C
PHASE 2 TRAFFIC GENERATION

Zone	Land Use	Daily Traffic Enter & Exit	AM Peak Hour Enter	AM Peak Hour Exit	PM Peak Hour Enter	PM Peak Hour Exit
1	Commercial	0	0	0	0	0
	Single-family	0	0	0	0	0
2	Single-family	0	0	0	0	0
3	Commercial	3,760	77	16	162	199
	Marina	310	7	2	5	13
	Multi-family	0	0	0	0	0
	Park	0	0	0	0	0
	Single-family	530	13	27	32	20
4	Single-family	3,030	73	151	180	114
5	Single-family	560	13	27	34	21
6	Single-family	4,430	103	222	268	165
7	Multi-family	780	35	27	36	28
	Park	110	11	11	4	18
8	Single-family	3,750	87	188	227	140
	Multi-family	610	27	21	29	22
9	Golf Course	920	42	10	6	72
	Marina	160	4	1	3	6
	Multi-family	1,000	45	34	47	36
	Resort	4,350	230	120	180	155
	Single-family	1,330	41	58	74	49
		------	---	---	-----	-----
	Total	25,630	808	915	1,288	1,058
	Net	21,800	663	770	1,051	821

Trip Distribution

The distribution of the net traffic generated was based on the locations of employment, visitor facilities and attractions, and residential population on the island of Kauai. Trips were distributed according to the type of land use generating the trips. The net average trip distribution for Phases 1 and 2 is provided in Table 4.

Table 4
TRIP DISTRIBUTION FACTORS
(EXTERNAL TRIPS)

	AM Peak Hour		PM Peak Hour	
	Outgoing	Incoming	Outgoing	Incoming
Phase 1				
Poipu	0.30	0.31	0.35	0.33
Koloa	0.14	0.19	0.16	0.15
Lihue	0.43	0.36	0.36	0.39
Kalaheo	0.13	0.14	0.13	0.13
	1.00	1.00	1.00	1.00
Phase 2				
Poipu	0.28	0.31	0.33	0.30
Koloa	0.14	0.18	0.16	0.14
Lihue	0.45	0.36	0.37	0.42
Kalaheo	0.13	0.15	0.14	0.14
	1.00	1.00	1.00	1.00

Traffic Assignment

Project traffic demand for each peak hour was assigned onto the major project roadways and the surrounding road network using a trip table based on the trip distribution factors and the internal trip estimates. Where applicable, estimates of relative travel times were used to split travel demand between two parallel roadways.

YEAR 2000 WITH PHASE 1

The "Year 2000 with Phase 1" case was evaluated as part of the Phase 1 study; since revisions to the land use plan have occurred, a new estimate of year 2000 traffic, shown in Figure 5, was made based on the revised plan to serve as a baseline condition for evaluating conditions without Phase 2. The revised traffic assignment is minimally different from the earlier assignment and the conclusions of the earlier study are still valid.

The analyses of the unsignalized intersections of Koloa Road/Maluhia Road, Koloa Road/Poipu Road, and Poipu Road/Lawai Road/Road A indicate that there will be insufficient capacities at these stop-controlled intersections. The signalization of these intersections could provide adequate control of these intersections at reasonable costs. The analyses of traffic conditions with signals were based on the HCM Planning Application, which identifies conditions as under, near, or over capacity, using the sum of conflicting traffic volumes.

The Phase 1 traffic study identified the impacts of and the improvements needed for the project's access connection to the existing roadway network. With full development of Phase 1, the intersection formed by the project's Road A, Poipu Road, and Lawai Road would need traffic signals and dedicated turn lanes. The reconfiguration of the existing Y-shaped intersection into a more traditional cross-intersection would improve safety, especially for the many visitors driving in the area. The Phase 1 traffic study also concluded that the existing two-lane Poipu Road would be able to handle the expected growth in traffic volumes.

Improvements to Koloa Road and at its intersections with Poipu Road and Maluhia Road would be needed to accommodate the expected increase in traffic, even without the Kukuiula Phase 1 project. The northbound approach on Poipu Road should be widened to provide an extended lane for right turns onto Koloa Road; in addition, traffic signals at this intersection and at the nearby intersection of Maluhia Road and Koloa Road would be needed to alleviate over-capacity conditions for traffic wishing to turn left onto Koloa Road. A separate right turn lane for Koloa Road traffic should also be provided at

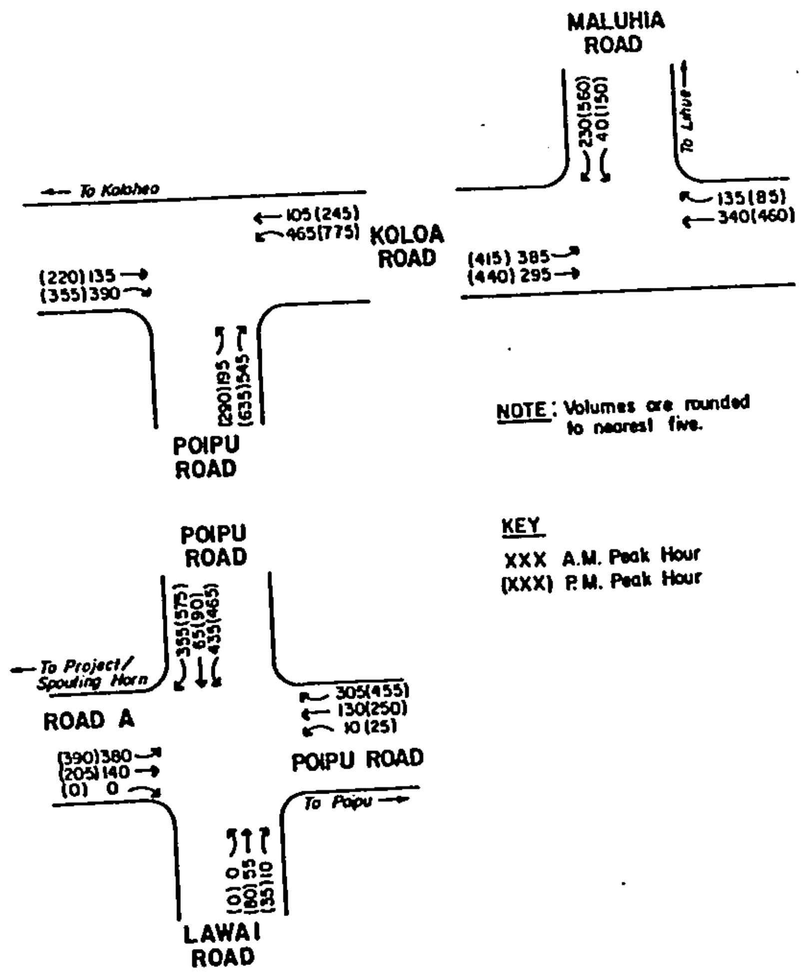

FIGURE 5

YEAR 2000 WITH PHASE I TRAFFIC ASSIGNMENT

both intersections. The analyses found that these improvements would be adequate to serve projected traffic demands for year 2000 with the Phase 1 project. Table 5 summarizes the findings from the signalized intersection analysis.

Table 5
YEAR 2000 WITH PHASE 1
INTERSECTION CONDITIONS

Intersection	AM Peak Hour	PM Peak Hour
Road A/Poipu Rd./Lawai Rd.		
unsignalized	over capacity	over capacity
signalized	under capacity	near capacity
Poipu/Koloa Roads		
unsignalized	over capacity	over capacity
signalized	under capacity	near capacity
Maluhia/Koloa Roads		
unsignalized	near capacity	over capacity
signalized	under capacity	under capacity

YEAR 2000 WITH PHASES 1 AND 2

The impacts of the traffic generated by Phase 2 of the Kukuiula project were determined by analyzing conditions at four intersections for a traffic assignment, shown in Figure 6, which represents the estimated future traffic demands in the area due to full development of the Kukuiula project (Phases 1 and 2) and County's development plan for the Koloa-Poipu-Kalaheo area. This case is designated "Year 2000 with Phases 1 and 2" because the County's development plan has only identified a growth rate to year 1998.

The analyses indicate that in addition to providing traffic signals at the intersections of Poipu and Koloa Roads, Maluhia and Koloa Roads, Road A and Poipu Road, and Road B and Poipu Road, other improvements which would be needed include the widening of the existing two-lane Poipu and Koloa Roads.

The widening of Poipu Road from two to four lanes, between the Road B intersection and Koloa Road, would provide the additional capacity needed to accommodate the projected future traffic demands. At all intersections, the heavy volumes of turning traffic indicate that dedicated turn lanes and protected signal phases would allow for efficient use of the available roadways. The provision of two left turn lanes onto Poipu Road from Koloa Road and from Road B would increase capacities and improve conditions at these intersections. Four lanes will also be needed on Koloa Road, on the approaches to and between its intersections with Poipu Road and Maluhia Road. Table 6 presents the results of the intersection analyses for the widening of Poipu Road.

Additional north-south capacity could alternatively be provided by constructing a new roadway parallel to Poipu Road, which would reduce peak hour volumes on Poipu Road. Traffic assignments indicate that a two-lane Poipu Road, with relatively minor intersection improvements, could have sufficient capacity to accommodate the lowered volumes. An islandwide transportation study which would consider all plans for development on the entire island of Kauai could better identify the type of and location of such a new roadway.

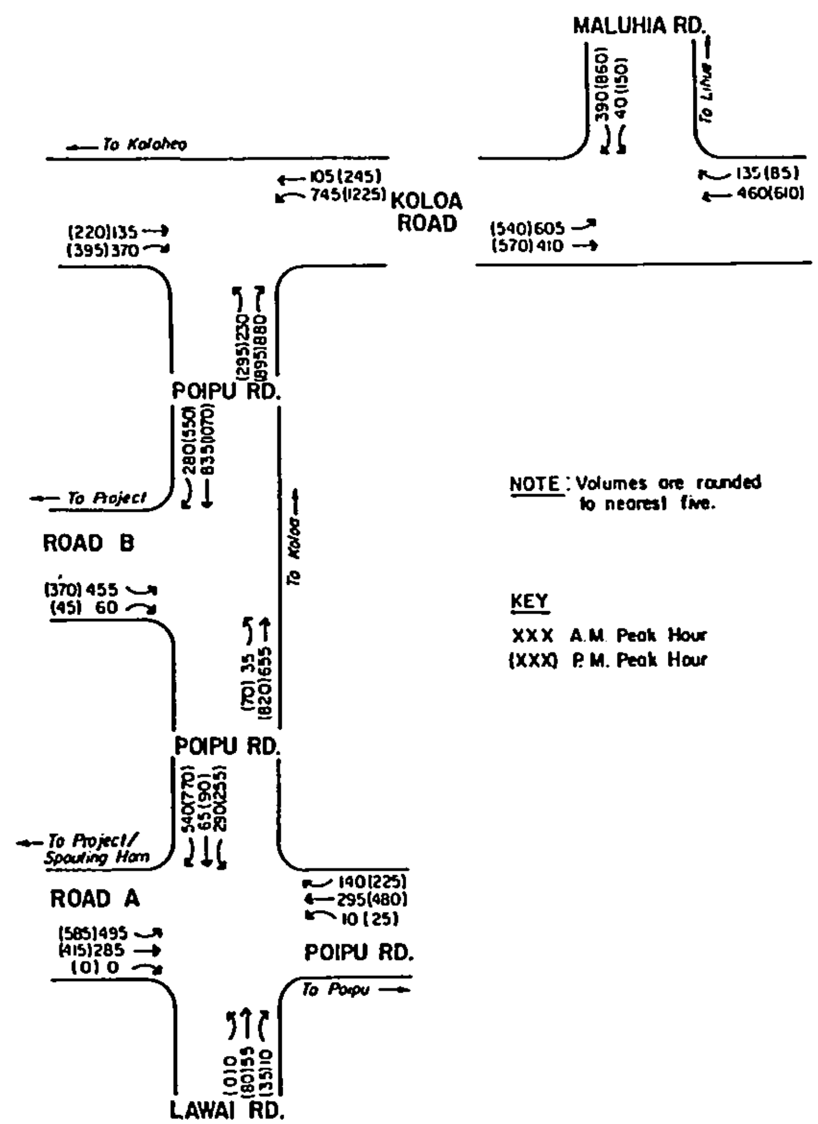

FIGURE 6

YEAR 2000 WITH PHASES 1 & 2 TRAFFIC ASSIGNMENT

Table 6
YEAR 2000 WITH PHASES 1 AND 2
INTERSECTION CONDITIONS

Intersection	AM Peak Hour	PM Peak Hour
Road A/Poipu Rd./Lawai Rd. signalized	under capacity	near capacity
Road B/Poipu Road signalized	under capacity	near capacity
Poipu/Koloa Roads signalized	under capacity	under capacity
Maluhia/Koloa Roads signalized	under capacity	near capacity

YEAR 2015 WITH PHASES 1 AND 2

The project master plan indicates that full development of the Kukuiula community is expected to occur no sooner than year 2015. The Poipu-Koloa-Kalaheo Development Plan, however, identified a growth rate for a shorter horizon, to year 1998. Because other development may be proposed in the area, non-project traffic was increased 25% over year 2000 levels to account for traffic generated by other growth. The traffic assignment for year 2015, without a new north-south parallel to Poipu Road, is shown in Figure 7.

External Intersections

Table 7 summarizes the results of the analyses of the year 2015 traffic assignment, using the year 2000 roadway system. The widening and separate turn lanes at intersections identified in the year 2000 evaluation would not provide adequate capacities for the year 2015 traffic demands; additional widening along Poipu Road, between Road B and Road A, would be needed to alleviate over capacity conditions at those intersections. The analyses indicate that as additional growth in the area occurs, traffic demand reduction strategies or the new north-south road will be necessary.

Internal Intersections

The intersections of the major internal roadways Road A, Road B, and Road C were analyzed to determine the number of lanes which should be provided and if signalization would be necessary. Each of these unsignalized intersections would have adequate capacity, operating well below capacity. At full development, a four-lane Road A between Poipu Road and the Phase 1 limit, with two lanes serving traffic in each direction, would provide good operating characteristics within the project. Two-lane Roads B and C would have sufficient capacities; however, separate lanes for left turns at major intersections would reduce unnecessary interruptions to other traffic flows.

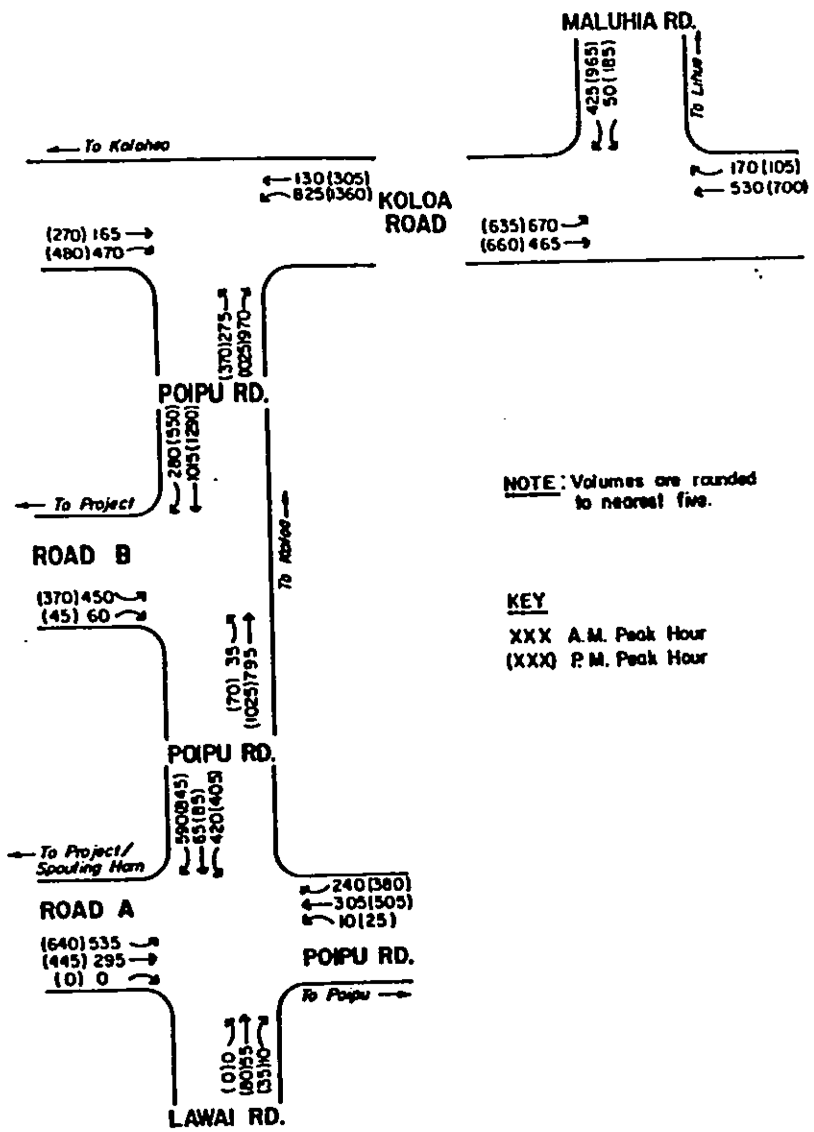

FIGURE 7

YEAR 2015 WITH PHASES 1 & 2 TRAFFIC ASSIGNMENT

Table 7
YEAR 2015 WITH PHASES 1 AND 2
INTERSECTION CONDITIONS

Intersection	AM Peak Hour	PM Peak Hour
Road A/Poipu Rd./Lawai Rd. signalized	near capacity	over capacity
Road B/Poipu Road signalized	near capacity	over capacity
Poipu/Koloa Roads signalized	under capacity	near capacity
Maluhia/Koloa Roads signalized	under capacity	near capacity

CONCLUSIONS AND RECOMMENDATIONS

The proposed Kukuiula Planned Community will be located in an area served by a limited roadway network. The project, which will be developed over a period of twenty to thirty years, would add to the existing traffic volumes on this road system. During this time, the development of other projects will also increase traffic demands. The Kukuiula project will contribute to and is expected to accelerate the rate of growth in traffic demand in the area. Improvements to the roadway system should be implemented to allow for the accommodation of the expected traffic volumes with minimal congestion or delays.

The widening of Poipu Road and intersection improvements at the project access road connections to Poipu Road and within Koloa town could provide the roadway capacities needed to serve the proposed project. As growth continues beyond the present planning horizon of year 2000, however, a new north-south roadway parallel to Poipu Road, other roadway improvements, or alternative transportation modes will be necessary to serve the increasing travel demand.

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1. Parsons Brinckerhoff Quade & Douglas, Inc., Traffic Impact Study, Kukuiula, Phase 1, prepared for Alexander & Baldwin, Inc., October 1987.

2. Transportation Research Board, National Research Council, Highway Capacity Manual, Special Report 209, Washington, D.C., 1985.

3. Institute of Transportation Engineers, Trip Generation (Fourth Edition), Washington, D.C, 1987.

deposits within caves are expected to be one meter or deeper depending on the amount of historic illuviation.

<u>Significance</u>

In spite of extensive historical and modern land modifications for cane cultivation and pasture improvement, a large number of significant archaeological sites still remain in the uncultivated portion of the project area. These sites are evaluated for significance according to the broad criteria established for the National and State Registers (see Table 1). The seven criteria are listed and briefly applied to the archaeological sites in the project area as follows:

A. Site reflects major trends or events in the history of the state or nation.

-There are certainly major economic trends reflected in the sites, namely prehistoric adaptations in the Kona District of Kaua'i and the transformation from a subsistence based traditional agriculture to a commercial plantation economy. This criterion seems relevant to the entire project area, but does not apply to specific sites.

B. Site is associated with the lives of persons significant in our past.

No sites fall into this category. This would apply in cases in which there is a possibility of associating a feature to specific important indivi-

duals. There are no sites in the project area which fall into this category.

C. Site is an excellent example of a site type.

This criterion addresses quality of construction and design, as well as state of preservation. Many of the <u>auwai</u>, habitation features, as well as whole complexes fit into this category. Outstanding examples are the Site 57 Complex (Sheet 7), Site 38 Agricultural Complex (Sheet 5) and Site 32 Complex (Sheet 5). There are 14 sites in all which fit into this category.

D. Site may be likely to yield information important in prehistory or history.

Included in this category are sites which contain cultural deposits and therefore have excavation potential or have well defined surface features which could yield information from further study are included in this category. Included are habitation sites as well as agricultural features whose excavation and further mapping and recording can shed light on chronology, and sequence of prehistoric land development. Prime examples of sites in this category are the lava tube caves.

E. Site has cultural significance to the Hawaiians or other ethnic group

This category includes religious sites - <u>heiau</u> - and sites containing human burials. The sites identified as <u>heiau</u> have cultural significance. Site 14 platform may be a smaller type of heiau. Sites most likely to contain burials are 42, 44, 45, 53, 57, and 58. Other sites whose burial or religious function is uncertain are marked E* in Table 1. If burials are found within lava tubes, then these sites would also be placed in this category. Site 11, a historic house foundation with a bread oven may be significant to the Portuguese ethnic group.

The sites which are disturbed to the point of bare recognition or those with no significance value are included in this category, such as isolated small rock mounds, minimally modified natural features and modern shelter structures (hippie camps).

F. Not Significant (NS) - These are sites which do not fit any of the above criteria, but are still listed for recording purposes. Included are minimally modified natural features and modern shelters (hippie camps).

G. No longer Significant - These sites were significant only under Criterion D for their informational content, but all information necessary has been recorded. Included are isolated rock mounds, ahu and sites which are disturbed to the point of bare recognition.

VIII. RECOMMENDATIONS

In spite of extensive historical modification of land for cane cultivation and pasture improvement, a large number of significant archaeological sites still remain in the uncultivated portion of the project area. These sites are variably significant in accordance with the 7 broad criteria described above. Mitigation of the significant sites can be undertaken by two possible actions.

1. preservation of sites in place for future generations, either by simple physical preservation or preservation with interpretation.
2. further study including subsurface testing and excavation preceding development impact and removal of sites.

Considering the variable significance and the different criteria applied to this significance, as well as a number of practical issues, it is only possible to preserve some sites - the most culturally significant and some of the best preserved examples of sites. The scientific and historical significance can be addressed through further study.

Therefore, the following steps are proposed:

1. Physical Preservation of Heiau

   Physical preservation of the 2 heiau (Sites 3 and 51) in the project area because of their religious and cultural significance to the Hawaiian ethnic group.

2. Physical Preservation of Other Sites.

   The physical preservation of the best preserved and unique example of an _auwai_ - the raised _auwai_ at Site 38A. This type of feature, to the author's knowledge, has not been found anywhere else in Hawai'i except at Kōloa. Physical preservation of other sites is not specifically recommended. Although there are well-preserved isolated examples of different types of features, many are in disturbed contexts. Similar but much more well preserved and better integrated agricultural/habitation complexes have been designated for preservation in the Kīahuna Development, east of Poipu Road. There, 5 separate areas containing clusters of house sites, shelters, _auwai_ and _lo'i_ have been designated as archaeological preserves.

3. Data Recovery

All significant archaeological sites not designated for preservation should be subjected to a program of subsurface testing followed by intensive excavation of selected sites and features to address scientific/informational significance. The majority of the habitation sites and features should at least be tested. All of the suspected burial sites should be tested.

4. The Lava Tube Sites

The lava tube sites present a somewhat ambiguous problem. All seven examples contain plentiful stratified cultural material. Thorough excavation of any one of them would be extremely productive from a scientific

perspective, but would also be expensive. The entrances could easily be sealed to preserve the deposits. However, construction activity is likely to collapse the tubes and endanger workers. For this reason, it is recommended that testing and excavation take place in all caves whose chamber areas cannot be set aside as open land.

5. Human burials are frequently a sensitive issue when discovered in proposed development areas. The present survey has identified at least 2 almost certain burial areas. However, as previously mentioned, burials can occur under habitation sites and even in small mound features. Reinterment of excavated burials will be a possible alternative and it is recommended that an area either on site or off site be designated for reinterment. Reinterment should take place after osteological study of the skeletal remains by a physical anthropologist. This process should be done according to Act 265 Chapter 6E Hawaii Revised Statutes and the State Dept. of Health Regulations.

Preservation of other good examples of habitation and agricultural features may be possible by incorporating them into landscaping plans and designating open areas where possible. This would of course depend on the intensity of proposed use of each of the separate developed parcels. If additional sites are not to be preserved, then they should be subjected to data recovery under item 3 above.

All phases of archaeological work should be coordinated with the Kaua'i County Historic Sites Commission and the State Historic Preservation Office. The testing and excavation (mentioned under Item 3) should be undertaken according to a data recovery plan prepared by an archaeologist and reviewed by these agencies.

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X. APPENDIX - TABLE 1

SUMMARY LIST OF ARCHAEOLOGICAL SITES

With Recommendations and with Significance Assessments

SUMMARY LIST OF ARCHAEOLOGICAL SITES
Kukuiula, Kaua'i
(58 sites and 150 features)
See last page for code explanations

Site/Feat. Number	Description/Comments	Recommendations	Significance
1	Auwai section/probable prehist. auwai, used in historic times for rice cultivation.	Check historical records	D
2	Auwai section/probably historic	None	NLS
3	Heiau/unrecorded, prehistoric	Preservation	C,D,E
4	Site Remnant/Disturb. by Bulldozing, is an "island" in a cane field.	None	NLS
5	Two adjacent habitation platforms/ Few pieces of shell midden observed.	Test	D
6	Habitation and agricultural complex/ includes auwai, fields & enclosures.	Test	D
7	Habitation and agricultural complex/ includes hab. platform, C-shape, & ag. walls and enclosures.	Test	D
8	Habitation, historic/ Cement slabs, probably associated w/ #11	Check Historic records(and Test?)	D
9	Habitation pavement/ Associated w/ Site 7, includes short auwai section.	Test	D
10	Agricultural wall/ Associated with historic occupation.	None	NLS
11	Historic House Remnant/ includes foundations, oven, cement slabs	Check historic records/ Test	C,D,E*
12	Habitation(?) and agricultural complex/ few historics observed & possible entrance to Cave #15.	Test	D
13	Habitation(?) platform/ site not far from Cave #15.	Test	D
14	Habitation Cave/ Lava Tube with modified interior.	Test	D

Site/Feat. Number	Description/Comments	Recommendations	Significance
15	Habitation Cave/ Lava Tube with prehistoric & historic materials (used by Civil Defense 1960's).	Test	D
16	Habitation(?) platform/ adjacent to short auwai section.	Test	D
17	Rock mound, agricultural/ close to surface scatter of historics.	None	NS
18	Habitation? platform/ disturbed by Test cane activity, but close to Cave #19.	Test	D
19	Habitation Cave/ Midden observed	Test	D
20	Habitation(?) platform/ Slab pavement.	Test	D
21	Habitation(?) platform/ Modified Outcrop.	Test	D
22	Habitational(?) platform/ probable rock clearance mound.	Test	D
23	Habitation Cave/ Lava Tube Midden, artifacts observed.	Test	D
24	Habitation Cave/ Lava Tube midden, artifacts observed.	Test	D
25	Habitation & agricultural Complex Midden observed.	Test	D
26	Auwai and associated features/ habitation & agricultural features.	Test	D
27	Modified Bedrock Outcrop/ Habitation?	Test	D
28	Agricultural features/ Disturbed by historical activities.	None	NLS
29	Habitation & Agricultural Complex/ C-shape platforms, fields, walls.	Test	D
29A	Habitation(?) platform/	Test	(D)
29B	Habitation(?) platform/	Test	(D)
29C	Habitation(?) platform/	Test	(D)

Site/Feat. Signi-

Site/Feat. Number	Description/Comments	Recommendations	Significance
29D	C-shape, probable habitation feature	Test	(D)
29E	Probable rock clearance mound/ disturbed by bulldozing.	Test	(D)
29F	Modified Boulder Depression/ Rough Leveling & paved area.	Test	(D)
30	Wall Remnant/ Stacked Boulders	None	NLS
31	Habitation & agricultural complex/ two caves, terrace, small & large fields	Test	D,E*
31A	Cave shelter(s) one sink w/ two openings/ Midden observed.	Test	(D)
31B	Terrace & associated ag. features small planting areas in rocky areas.	Test	(D)
31C	Cave shelter/ Midden observed & Possible burial feature.	Test	(D,E*)
32	Habitation & agricultural complex/ C-shapes, platforms, enclosures, fields.	Test	C,D,E*
32A	C-Shape on Modified Bedrock Outcrop/ Outcrop/ Good condition	Test	(C,D)
32B	Probable Habitational Enclosure/ Includes adjoining small platform.	Test	(D,E*)
32C	Probable Habitation Enclosure & Platform, possible burial.	Test	(D,E*)
32D	Probable Habitation Platform/ Platform has possible altar & hearth.	Test	(D,E*)
32E	Probable Habitation platform/ Mounded appearance.	Test	(D)
32F	L-Shaped Enclosure	Test	(D)
32G	Platform/ possible burial	Test	(D,E*)
32-H	Habitation terrace/ Midden, artifacts observed, possible <u>kauhale</u> feature.	Test	(C,D)
33	Agricultural & Habitation Complex	Test	C,D

Site/Feat. Number	Description/Comments	Recommendations	Significance
33A	<u>Auwai</u> & Enclosure/ Large walled Enclosure, <u>auwai</u> in good condition.	Test	(C,D)
33B	Probable Habitation platform	Test	(D)
33C	Probable habitation platform/ possible posthole observed.	Test	(D)
33D	Probable Habitation enclosure	Test	(D)
34	Large Modified Bedrock Outcrop adjacent to large boulder filled sink probable religious function(s), includes possible godstone & altar	Test	C,D,E*
34A	Large Platform on outcrop/ possible religious oriented feature.	Test	(C,D,E*)
34B	Modified Top Surface of outcrop/soil area with midden and possible hearth.	Test	(D,E*)
34C	Oval enclosure/ possible <u>lua iwi</u>	Test	(D,E*)
35A	Probable habitation platform/ Cupboard in SE corner.	Test	D
35B	Probable Habitational Platform	Test	D
36	Platform, Mounded appearance/ probable rock clearance, but possible burial	Test	D,E*
37	Old Railroad beam/ some well preserved sections.	Selective Preservation	C,D
38	<u>Auwai</u> & Associated features/ Agricultural features <u>mauka</u> of Prince Kuhio.	Test	C,D,E*
38A	<u>Auwai</u>/ Includes raised sections, i.e. low aqueduct	Preserve	(C,D)
38B	Agricultural field/ good condition	Test	(C,D)
38C	Circular platform/ Probable agricultural feature (possible burial)	Test	D,E*
39	Probable Habitation Enclosure	None	NLS

Site/Feat. Number	Description/Comments	Recommendations	Significance
40	Continuation of agricultural fields & raised auwai of Site #38 (auwai: remains 38A)	Test	D
40A	U-shaped shelter/ probable modern hippie camp.	None	NS
40B	Site Remnant/ Heavily impacted by recent construction.	None	NLS
41A	Two adjoining enclosures/ have been impacted by bulldozing; poss. habitation	Test	D
41B	Large Boulder Sink/ Minimally modified; Has standing water at lowest point.	None	NLS
42	Burial Complex	Test	D,E
42A	Probable Burial platform/ possible crypt in northern portion of platform.	Test	(D,E)
42B	Probable Burial platform/ possible crypt in center of platform.	Test	(D,E)
42C	Mounded platform/ possible burial; 1 piece of sandstone observed	Test	(D,E)
43	Habitation, and agricultural complex/ some of the features and surrounding areas impacted by bulldozing; probable association with Site(s) 42.	Test	(D)
43A	L-Shaped Wall/ Probable habitation enclosure but partially bulldozed.	Test	(D)
43B	L-Shaped wall remnant/ Probable ag. Field wall.	Test	(D)
43C	Rectangular platform-mound/ two circular depressions in mound; possible habitation feature.	Test	(D)
43D	Probable habitation terrace/ situated on edge of bedrock knoll	Test	(D)
43E	L-Shaped habitation terrace/ possible hearth on terrace.	Test	(D)
43F	Modified Bluff, poss.habitation site	Test	(D)

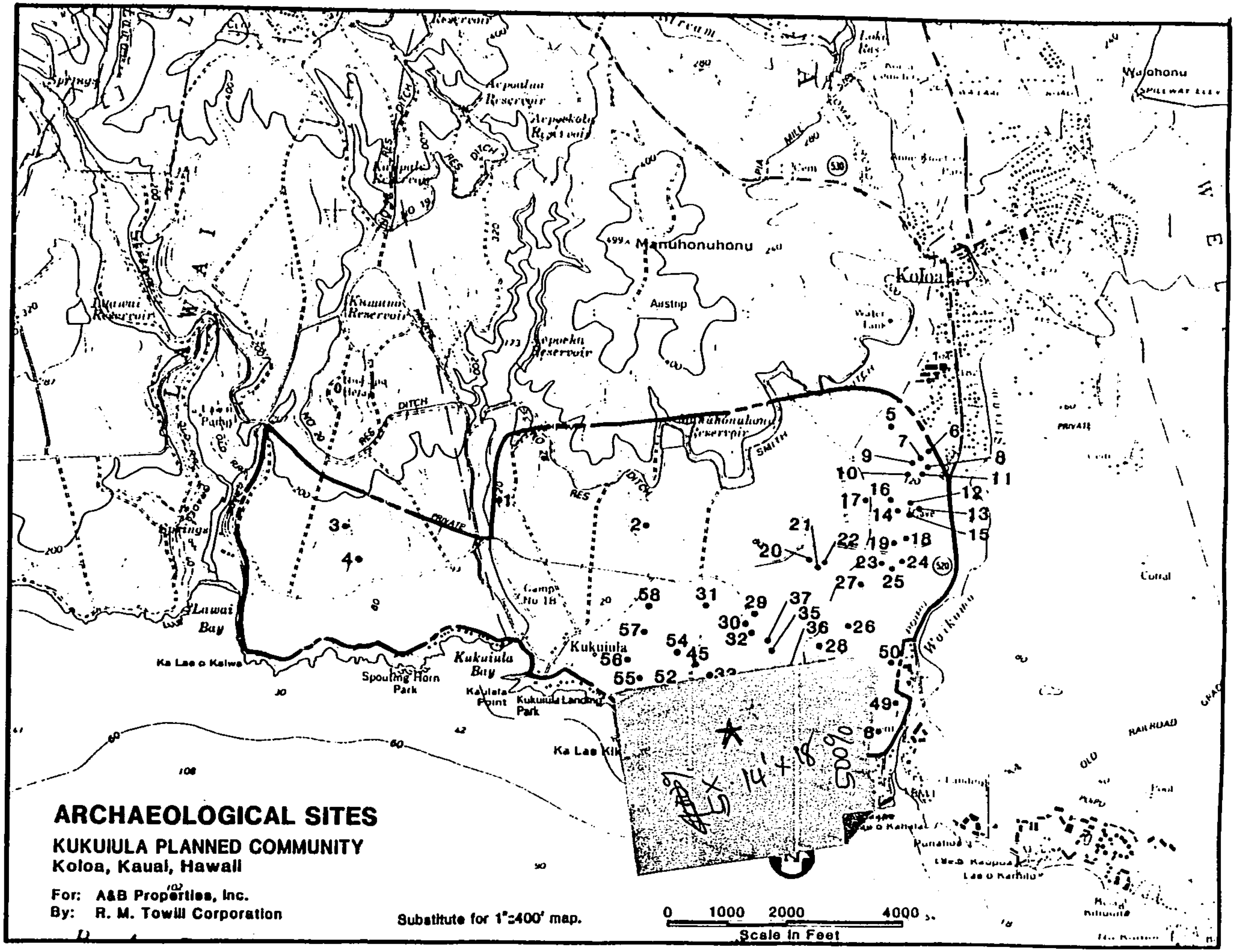
Site/Feat. Number	Description/Comments	Recommendations	Significance
44	Habitation and agricultural complex/ Auwai to west of sites; complex in rocky ground.	Test	D,E*
44A	Rectangular enclosure/ Uprights in wall and water rounded stones observed.	Test	(D)
44B	Rectangular platform/ Possible burial in center.	Test	(D)
44C	Mounded wall with two shelters, and two separate circular enclosures/ Probable habitation features, but possibly agricultural related.	Test	(D)
44D	Rectangular Enclosure/ Probable habitation feature, partially disturbed by bulldozing; some uprights in walls.	Test	(D)
44E	Probable Habitation Enclosure/ Long Cupboard on Northern edge.	Test	(D)
44F	Probable Habitation Enclosure/ Multi-component feature, possible kauhale.	Test	(D)
44G	Probable Habitation Enclosure/ Adjoining platform on west side.	Test	(D)
44H	Probable Habitation Enclosure/ Large upright abuts east wall, possible hearth or altar.	Test	(D)
44I	C-Shaped structure/ Probable habitation.	Test	(D)
44J	Two adjoining Enclosures/ Probable habitation.	Test	(D)
44K	Oval Enclosure/ Probable habitation	Test	(D)
44L	Circular Enclosure/ Probable habitation.	Test	(D)
44M	C-Shaped structure/ Disturbed by bulldozing.	Test	(D)
45	Platform Remnant/ With possible burial crypt, next to historic? auwai(?)	Test	D,E*

Site/Feat. Number	Description/Comments	Recommendations	Significance
46	Agricultural feature behind (mauka) Prince Kuhio Park, Continuation of Site 38 features.	Test	D
46A	Rectangular wall/ in agricultural area but possibly habitation related.	Test	(D)
46B	Oval Enclosure/ Similar to 46A	Test	(D)
46C	Oval Enclosure/ Similar to 46A & 46B	Test	(D)
46D	C-Shaped structure/ Probable habitation feature.	Test	(D)
46E	Large rectangular Enclosure/ Probable ag. field, makai side disturbed by bulldozing.	Test	(D)
47	Habitation and agricultural features, mauka of R.R. berm (continuation of # 38, 46).	Test	(D)
47A	Large modified Outcrop/ Adjoining habitation features, C-shapes, enclosures.	Test	(D)
47B	Oval Pit, Rect. Enclosure, C-Shape, Platform/ Probable Habitation features.	Test	(D)
47C	Rectangular Enclosure/ Probable habitation.	Test	(D)
48	2 Site Remnants	Test	D
48A	Site Remnant, Linear Mound/ Surface Scatter of midden and few historics (glass/ceramics).	Surface Collection	D
48B	Site remnant, Oval rock pile, and adjacent rectangular field/ Rock Pile w/ Possible paving, field probable loi remnant.	Test	D
49A	Site Remnant, T-Shaped/ Impacted by bulldozing, probable habitation platform, midden - artifacts (including historics) observed.	Test	(D)

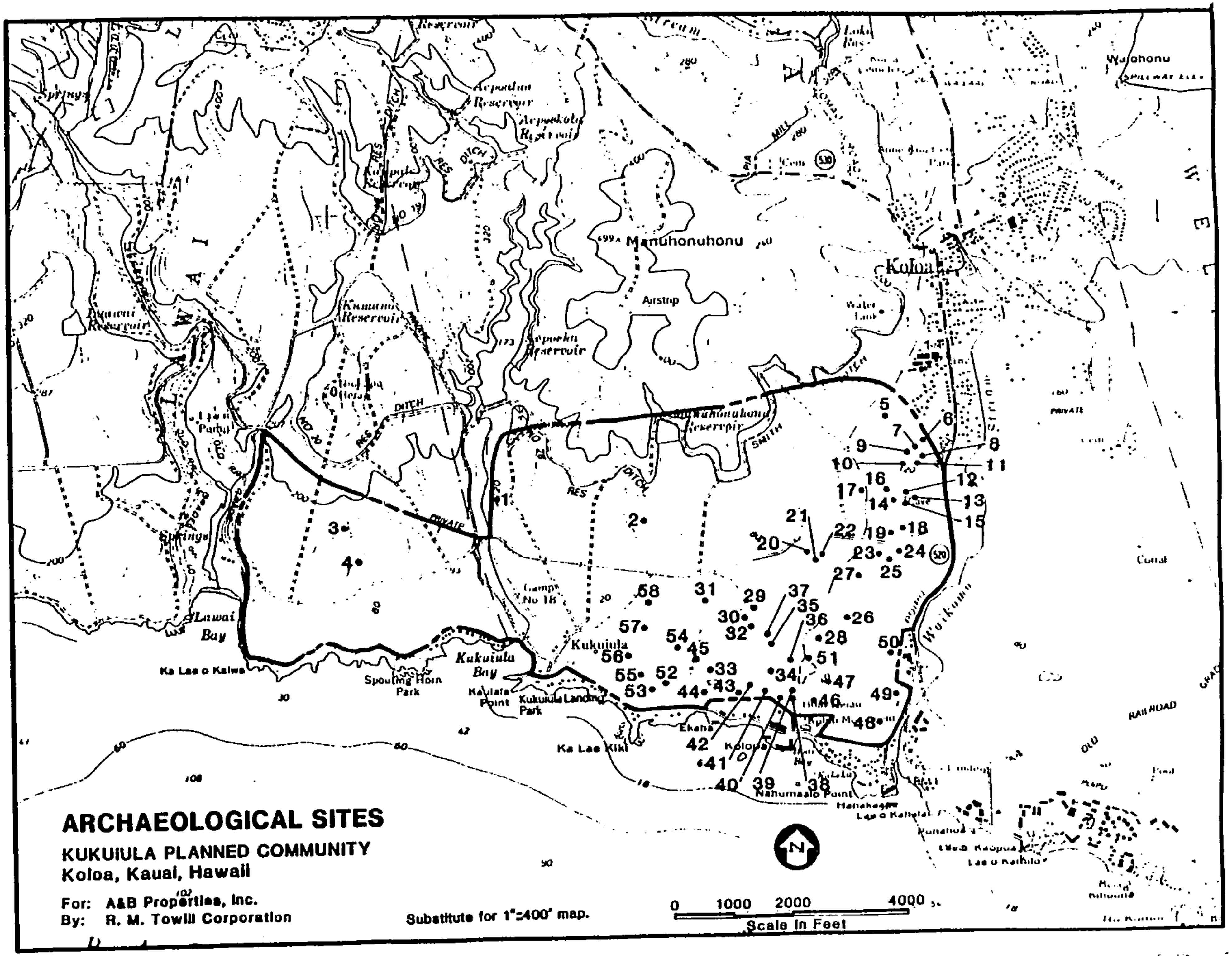
Site/Feat. Number	Description/Comments	Recommendations	Significance
49B	Rectangular Platform/ Disturbed by bulldozing, slab pavement, possible hearth.	Test	(C,D)
50	Large Rectangular Enclosures/ Associated with Auwai, (1) large intact enclosure, (2) others cut by existing buildings.	Test (Auwai section & intact enclosure)	C,D
	Note: Main Auwai possibly mauka portion of raised auwai 38A; historic reference to it - possibly used by ABM - for area mauka of Prince Kuhio Park.		
51	Large terraced platform, probable heiau/ (Kamaloula Heiau?) just mauka of pond/marsh settling pond for cane.	Preserve	C,D,E
52	Habitation and agricultural complex/ C-Shapes, enclosures, platform, mounds.	Test	C,D
52A	C-Shaped structure/ Field remnants to west.	Test	(D)
52B	Adjoining rectangular enclosures/ Probable habitation feature, midden observed "lanai"-like addition.	Test	(C,D)
52C	Rectangular Platform/ Internal enclosure, "lanai"-like addition with possible hearth.	Test	(D)
52D	Square stone-lined pit/ Probable cupboard, upright slabs for sides.	Test	(D)
52E	C-Shaped structure/ Probable habitation feature.	Test	(D)
52F	Square Enclosure/ Probable habitation feature, uprights, possible post holes.	Test	(D)
52G	Square Enclosure/ Walls mostly collapsed, but few pieces coral observed.	Test	(D)
53	Habitation and agricultural complex/ Enclosures, platforms, C-Shapes, mounds, walls.	Test	D,E*
53A	Two adjacent circular enclosures/ Probable habitation features.	Test	(D)

Site/Feat. Number	Description/Comments	Recommendations	Significance
53B	Rectangular platform and adjoining low enclosures/ Enclosures are possible burials, branch coral, midden and possible godstone.	Test	D,E
53C	Surface scatter/ Midden and artifacts observed.	Test Surface Collect.	(D)
53D	Rectangular Enclosure/ Probable habitation, coral in core filled walls.	Test	(D)
53E	Boulder paved adjoining terraces (2)/ Possible burials.	Test	(D,E)
53F	Boulder paved terrace/ Possible burial crypt in center, coral observed in terrace structure.	Test	(D,E)
53G	U-Shaped structure/ Probable habitation feature, agricultural features nearby.	Test	(D)
53H	Boulder paved terrace/ Possible burial but more likely just faced bluff edge.	Test	(D,E)
54A	C-Shape and adjoining platform/ Collapsed, very poor condition.	Test	(D)
54B	Oval enclosure/ Probable habitation interior faced with uprights.	Test	(D)
54C	Paved area/ Boulder paving, with possible cupboard.	Test	(D)
54D	C-Shaped structure/ Probable habitation, with possible cupboard.	Test	(D)
54E	Rectangular mound/ Probable rock clearance mound.	None	NLS
55	Habitation and agricultural complex/ In rocky pahoehoe terrain.	Test	C,D,E*
55A	U-Shaped structure/ Probable habitation, interior alignment of uprights.	Test	(C,D)
55B	U-Shaped structure/ Probably agricultural feature, low mounded walls.	Test	(D)

Site/Feat. Number	Description/Comments	Recommendations	Significance
55C	Mounded wall/ Associated with Ag.features, mounds, linear mounds, U-Shapes like 55B.	Test	(D)
55D	Mounds (2)/ Probable rock clearance mounds, small possibility of burials.	Test	(D,E*)
56	Agricultural and habitation complex/ In very rocky pahoehoe area, includes long stacked boulder wall, "main site wall".	Test	C,D,E*
56A	C-Shape and adjacent L-Shaped terrace/ C-Shape, Probable habitation; L-Shape probable agricultural feature.	Test	(D)
56B	Modified Outcrop/ Leveled-filled in areas, possible burials.	Test	(D,E*)
56C	Adjoining C- and L-Shaped Structures/ Habitation features, water rounded rocks (2), possible hearth and cupboard observed.	Test	(D)
56D	C-Shaped structure/ Habitation feature cantilevered walls.	Test	(C,D)
56E	L-Shaped terrace/ Probable agricultural feature.	Test	(D)
56F	U-Shaped structure/ Probable habitation feature with possible cupboard.	Test	(D)
56G	Stacked Boulder terrace/ Possible habitation feature, rough boulder paving.	Test	(D)
56H	Parallel walls/ Probable habitation shelter utilizing main site walls.	Test	(D)
56I	Oval terrace against bluff face/ Possible shelter, but more probably agriculturally related.	Test	(D)
56J	U- or C-Shaped structure/ Mostly collapsed walls, probable habitation, raised floor area.	Test	(D)
56K	Boulder faced terrace/ built against bluff, probable agricultural feature.	Test	(D)



ARCHAEOLOGICAL SITES
KUKUIULA PLANNED COMMUNITY
Koloa, Kauai, Hawaii
For: A&B Properties, Inc.
By: R. M. Towill Corporation
Substitute for 1"=400' map.
0 1000 2000 4000
Scale in Feet
Manuhonuhonu
Koloa
Austin
Lawai Bay
Ka Lae o Kalwa
Spouting Horn Park
Kukuiula Bay
Kaulala Point
Kukuiula Landing Park
Ka Lae Kiki
Kukuiula
Waikomo
Wailohonu
Springs
Lawai Reservoir
Kuauau Reservoir
Aepoeku Reservoir
Aepoalua Reservoir
Aepoekolo Reservoir
Camp No 18
RES DITCH
SMITH
PRIVATE
RAILROAD
OLD
Corral
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 35 36 37 45 49 50 52 54 55 56 57 58
Ex 14' + 18
500%


ARCHAEOLOGICAL SITES
KUKUIULA PLANNED COMMUNITY
Koloa, Kauai, Hawaii
For: A&B Properties, Inc.
By: R. M. Towill Corporation
Substitute for 1"=400' map.
0 1000 2000 4000
Scale In Feet
N
Manuhonuhonu
Airstrip
Koloa
Lawai Bay
Ka Lae o Kalwa
Spouting Horn Park
Kukuiula Bay
Kukuiula
Kukuiula Landing Park
Kalalaa Point
Ka Lae Kiki
Nahumaalo Point
Camp No 18
Waiohonu
RAILROAD
Ekaha

Site/Feat. Number	Description/Comments	Recommendations	Significance
56L	Ramp-like feature/ Possible short elevated auwai section.	None	(NLS)
57	Habitation and agricultural complex within walled enclosure.	Test	C,D,E*
57A	C-Shaped terrace/ Probable habitation platforms, possible burials.	Test	(C,D,E*)
57B	L-Shaped terrace/ Probable habitation, midden, artifacts, probable hearth observed.	Test	C,D
57C	C-Shaped structure/ Probable habitation, midden observed.	Test	(C,D)
57D	Rectangular Platform/ Probable habitation.	Test	(C,D)
57E &F	Outside of (mauka) the enclosure of the main site 57 area (57 A-D and enclosing wall).	Test	(D)
57E	Faced bluff edge/ Possible habitation more probably agriculturally related.	Test	(D)
57F	Rectangular enclosure and adjoining C-Shape/ habitation feature.	Test	(D)
58A	Wall remnant/ Probable historic stacked boulder wall.	None	NLS
58B	Platform remnant/ located next to cane debris filled in sink - tube has possible burial crypt in center.	Test	D,E*

CODES FOR CRITERIA FOR SITE SIGNIFICANCE

NS	Not Significant
NLS	No Longer Significant
A	Site reflects major trends or events in the history of the state or nation
B	Site is associated with the lives of persons significant in our past
C	Site is an excellent example of a site type.
D	Site may be likely to yield information important in prehistory or history.
E	Site has cultural significance; probable religious structures (shrines, heiau) and/or burials present

E* Signifies site is only a possible burial or religious feature.

(D) Parenthesis used for feature criterion

D No parenthesis used for site criterion

APPENDIX J

AGRICULTURAL ASSESSMENT

AGRICULTURAL ASSESSMENT

I. LAND EVALUATION

Land Studies Bureau Detailed Land Classification (1967)

The Land Studies Bureau issued its Detailed Land Classification for the Island of Kauai in 1967. The Kukuiula region is located primarily in Area 4b, which spans from Kukuiula and Koloa west to Waimea. This area is characterized by a warm and dry climate, high sunlight levels, and red, deep, Low Humic Latosol soils. Without irrigation, the area is too dry for cropping; however, with irrigation this area, together with the Kekaha coastal flats, is considered among the more productive areas on Kauai. Most of the arable areas are presently in irrigated sugar cane.

The LSB study identifies Overall Productivity Ratings for each land type, ranging from A (the highest) to E (the lowest). Approximately two-thirds of the project land are classified in the A or B categories and the other one-third classified as D or E land (Table 1). There are no C-rated soils in the project. Selected crop productivity ratings are given in Table 2 for the more common land types. Ratings range from a (the highest yield potential) to e (the lowest yield potential).

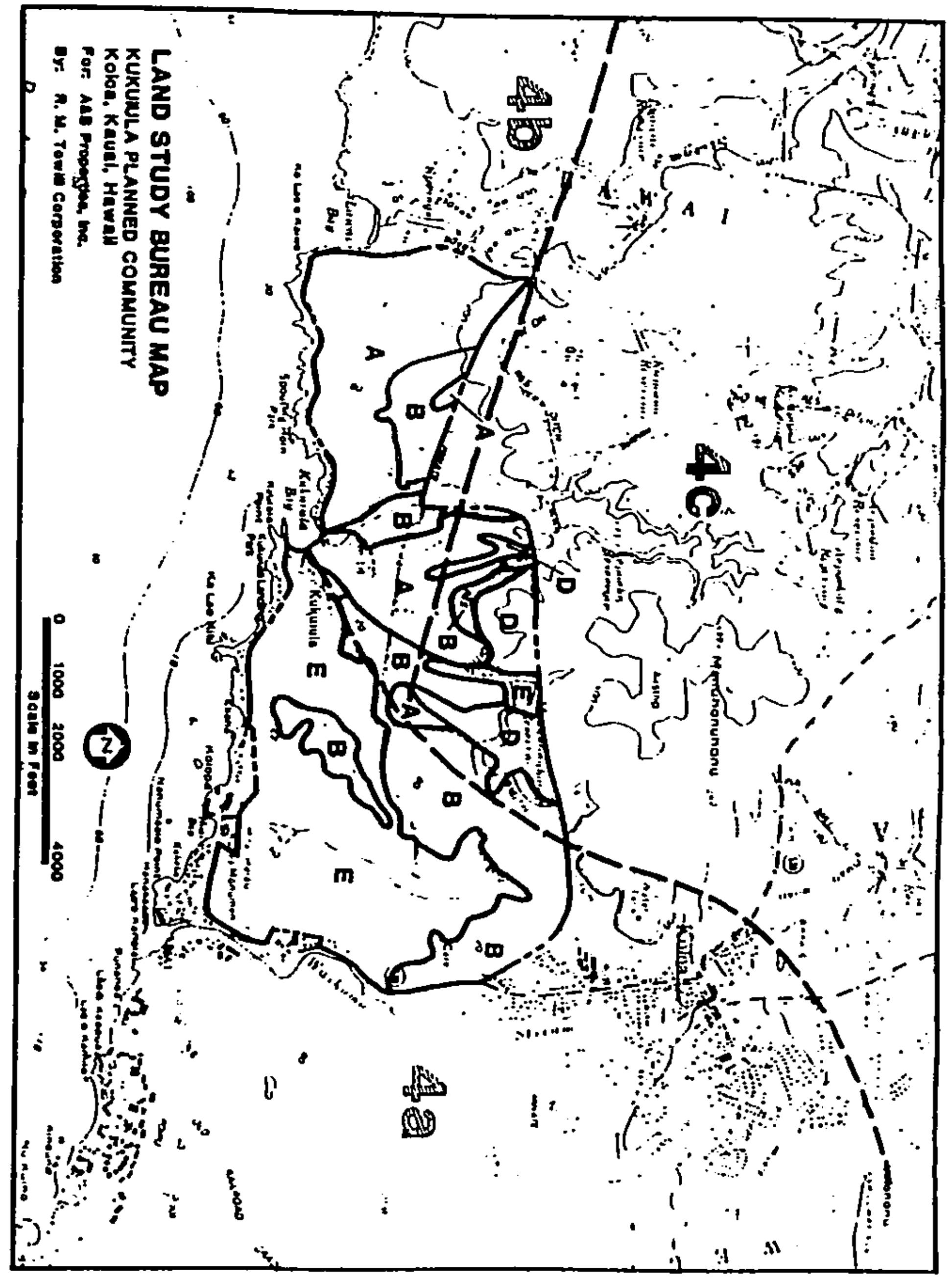
The project lands rated in the A and B categories have deep topsoil and are moderately to well -suited to machine tillage. They are currently used for irrigated sugarcane production. The selected productivity ratings (see below) indicate that they can support a wide range of diversified agricultural alternatives.

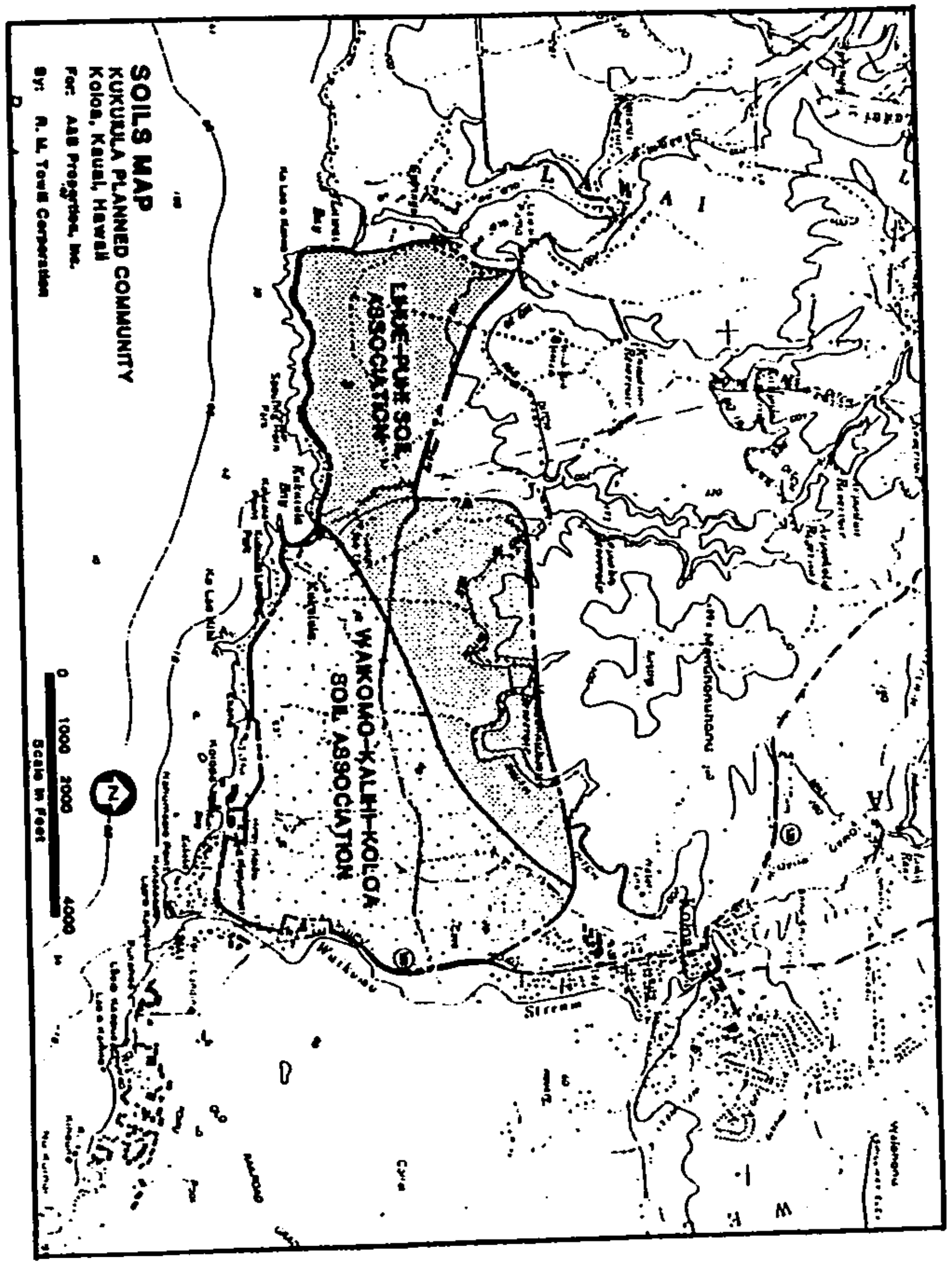
Project land in the D and E categories are either too rocky or too steep for machine tillage and their agricultural potential is limited to grazing and forage crops. These soils can be found in the eastern section and along the coastal fringe of the project.

U.S. Soil Conservation Service Soil Survey (1972)

Soil conditions in the project area are dominated by the Waikomo and Lihue series, which account for about 80 percent of the area. The Waikomo soils are found in the eastern part of the project area and the Lihue soils are located in the western part.

Waikomo soils are part of the Waikomo-Kalihi-Koloa Association, which consists of well-drained, fine-textured soils that developed in material weathered from basic igneous rock and poorly drained, very fine-textured soils that developed in alluvium. These soils are gently sloping to nearly level and are on the uplands and bottom lands of southeast Kauai. Waikomo soils have a surface layer of dark-brown to very dark grayish-brown, very firm stony silty clay. The subsoil is reddish-brown to dark yellowish-brown, firm heavy silty clay loam. The substratum is hard basic igneous rock. These soils have properties that severely affect crop production. They are





generally unsuited to cultivation.

The 148 acres of Waikomo very rocky silty clay (Wt) soils, which accounts for about 16 percent of the project area, contain rock outcrops covering 3 to 25 percent of the surface. They are almost entirely uncultivated. The 109 acres of Waikomo stony silty clay (Ws) soils, accounting for about 12 percent of the project, are presently in sugar cane production.

The Lihue soils are part of the Lihue-Puhi Association, consisting of well-drained, medium-textured and fine-textured soils on the uplands of South and East Kauai. Lihue soils have a surface layer of dusky-red to dark reddish-brown, firm silty clay. The substratum is soft, weathered basic igneous rock.

The Lihue soils are silty clay of varying slopes. The soils are subject to moderate erosion if they are cultivated and not protected. Soils are from 30 inches to more than 60 inches deep. The LhB soils have less that 8 percent slope and the LhC soils have 8 to 15 percent slope. These two soil types account for 245 acres in the project and are presently devoted to sugar cane production.

__Hawaii Department of Agriculture ALISH Ratings__ (1977)

The ALISH, or Agricultural Lands of Importance to the State of Hawaii, study classifies nearly all of the land in the western half of the project as "prime." This designation means that the land has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed according to modern farming methods. The eastern half of the project area contains a small amount of prime land, with the bulk approximately evenly split between "other important agricultural land" and "land of no agricultural importance."

__Summary of Land Evaluation Ratings__

The three rating systems discussed above give the following general evaluation. Rocky lands along the coastal fringe and in the eastern third of the project area have poor agricultural potential. Steeply-sloped land in the north central area also has a limited agricultural potential. These soils cover approximately one-third of the project. The remaining two-thirds of the area are agricultural lands of significance, being roughly equally divided between land well-suited and land moderately-suited for crop cultivation. The Department of Agriculture rates about half of the project lands as "prime."

Although land evaluation systems are useful for identifying specific types of land in terms of their physical productivity potential, they cannot predict the full economic potential of land. This broader issue requires information difficult to measure and continuously changing. A soil type may have good productivity potential but market conditions and other economic factors will bear heavily on whether the soil type has a favorable economic potential.

II. IMPACT OF CANE LAND WITHDRAWAL ON AGRICULTURAL LAND AVAILABILITY AND STATE AGRICULTURAL POLICIES

A. IMPACT ON STATE AND KAUAI AG LAND AVAILABILITY

The withdrawal of 600 acres of agricultural land presently in sugarcane production represents 1.4 percent of sugarcane land on Kauai and less than 1 percent of Kauai's agricultural production acreage. There are over 20,000 acres of class A, B and C agricultural lands on Kauai not under crop cultivation.

Statewide, the withdrawal represents 1/3 of 1 percent of state sugarlands and 0.06 percent of state agricultural production acreage.

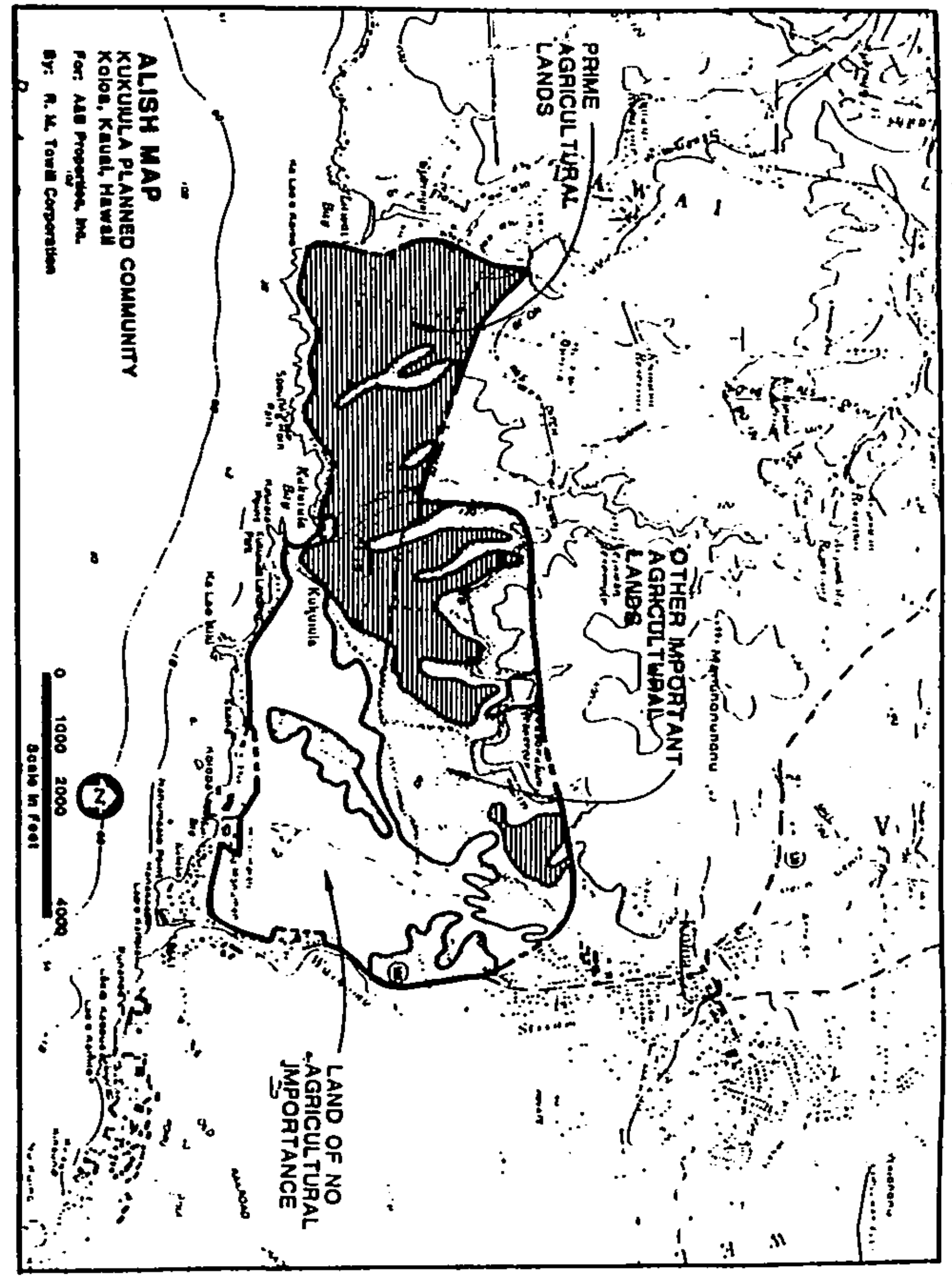
PROPOSED AG LAND CONVERSION RELATIVE TO PRESENT SUGARLANDS AND IMPORTANT AGRICULTURAL LANDS INVENTORY

	SUGARLANDS 1986 acres	SUGARLANDS row 1 as % of	LAND STUDY BUREAU CLASS A & B & C 1968 acres	LAND STUDY BUREAU CLASS A & B & C row 1 as % of
Row 1: Cane land in project	600		600	
McBryde Plantation	12,379	4.85%		
KAUAI	43,156	1.39%	66,805	0.90%
OAHU	25,855			
MAUI	43,501			
HAWAII	66,149			
STATE OF HAWAII	178,661	0.34%	366,979	0.16%

SOURCE: HSPA, Hawaiian Sugar Manual, 1987
Land Study Bureau, Detailed Land Classification, 1968

B. DEMAND AND ABILITY OF FARMERS TO LEASE AGRICULTURAL LANDS IN KAUAI

Persons knowledgeable about diversified agriculture on Kauai were queried about the demand for land for agricultural diversification. Other than ranching, little diversified agriculture has taken place on Kauai historically. Papaya is grown primarily in the Moloaa area. C. Brewer has developed a substantial guava plantation in the Kilauea area. Both of these diversified agricultural areas are on Kauai's eastern side. McBryde Sugar Co. has planted 450 acres of macadamia nuts on the



Kauai's southern side.

With the exception of what may be in the plans of the large landowners, all other ideas expressed for diversified agricultural involve small acreages. There is very little apparent demand for agricultural land at present.

C. LONG RUN OUTLOOK FOR SUGAR FOR KAUAI AND THE STATE OF HAWAII

Profits of sugarcane producers in Hawaii has been low or negative in the past decade. The long-run outlook is likely to be a continuation of this situation. Kauai is less subject to urbanization that are the other major islands. However, the two sugar plantations with the lowest recorded yields per acre are located in Kauai: the McBryde and Lihue plantations. Yield data is an imperfect indicator of profitability. Irrigated and nonirrigated lands are not separated. However, in McBryde's case, the percentage of sugarland irrigated (52 percent) is only slightly less than the state average of 60 percent. Furthermore, the McBryde plantation has made a profit in only one of the past seven years.

SUGAR PLANTATION ACREAGE AND SUGAR YIELDS IN HAWAII, 1986

Name of Plantation	Island	Acres	Tons Sugar per Harvested Acre
Gay and Robinson	Kauai	2,678	16.53
Olokele	Kauai	4,812	14.26
Oahu Sugar	Oahu	14,023	14.20
Wailuku	Maui	2,597	14.11
H C & S	Maui	35,890	13.88
Waialua	Oahu	11,832	13.78
Kekaha	Kauai	8,351	13.49
Pioneer Mill	Maui	7,611	13.43
Mauna Kea	Hawaii	15,743	12.18
Ka'u Agribusiness	Hawaii	16,018	11.51
Hamakua Sugar	Hawaii	34,688	11.25
Lihue	Kauai	14,936	10.32
McBryde	Kauai	12,379	9.56
Total All Companies		181,558	12.47

SOURCE: HSPA, Hawaiian Sugar Manual

Under the current price support program for sugar, which expires in 1990, import quotas are regulated to maintain the target support price. There is no cost to the US Treasury. Imports quotas have been drastically slashed in recent years to maintain the required target price. It is possible that in a few years there will be no more imports to cut back. If imports are completely eliminated, domestic competition will continue to exert downward pressure on sugar prices. New domestic competition has mostly come from high fructose corn syrup (HFCS), which has made tremendous inroads in the industrial use sugar market. It has captured virtually the entire soft drinks market.

The State Department's efforts to aid the depressed economies of the Caribbean and the Philippines has been undermined by the need to drastically reduce imports, as required under the Farm Bill. US sugar policy will be influenced by negotiations with the European Community, who are even more protective of its sugar industry. The Common Market countries are a net exporter of sugar, despite being one of the highest cost producing area in the world.

There is pressure in the Congress and from the Reagan administration to lower current support prices for sugar. An optimistic scenario would be retention of sugar support prices at current levels. Continued progress by McBryde and other plantations in increasing yields and lowering costs may allow the company to keep the profitability situation from worsening. But it is likely that the Hawaii sugar plantations will continue to earn low profits or losses.

The uncertainties in the formulation of future US sugar policy and poor outlook for improved prices are major factors in Alexander and Baldwin's attempt to diversify the McBryde plantation away from sugarcane.

D. CONFORMITY WITH STATE OF HAWAII PLANS AND POLICIES

The Agriculture Functional plan, Implementing Action B(5)(c) sates that:

> "In implementing the State Land Use Law and county zoning ordinances, important agricultural lands shall be classified in the State Agricultural District and shall be zoned for agricultural use, except where substantial injustice or inequity will result, or where overriding public interest exists."

The proposal to reclassify and rezone the project lands, which include about 600 acres of "important agricultural lands" from agriculture to urban clearly rests on the argument of overriding public interest. These lands are ideally suited for residential or resort development, as they represent an expansion of the popular Poipu urban area. The ocean, beach, climate and other environmental amenities in this area make the lands close to the ocean ideal areas for housing or resort development.

The Hawaii State Plan contains the following relevant objectives, policies and priority guidelines:

226-7(b) "Assure the availability of agriculturally suitable lands with adequate water to accommodate present and future needs."

226-103(c)(1) "Provide adequate agricultural lands to support the economic viability of the sugar and pineapple industries."

226-103(d)(1) "Identify, conserve and protect agricultural and aquacultural lands of importance and initiate affirmative and comprehensive programs to promote economically productive agricultural and aquacultural uses of such lands."

226-104(b)(2) "Make available marginal or non-essential agricultural lands for appropriate urban uses while maintaining agricultural lands of importance in the agricultural district."

Evidence presented above shows that there are significant acreages of prime agricultural land available in Hawaii which are not being intensively utilized at present. The amount of important land proposed for urbanization are not large enough to affect the viability of sugar. Other factors, like the U.S. sugar support price, technological innovation and managerial expertise will be the overriding determinants of whether sugar survives in Hawaii and on individual plantations. Sugar production is simply not profitable for many Hawaii plantations today and the future outlook does not lend support for optimism.

Agricultural diversification is also very risky. McBryde Sugar Co. is aggressively pursuing agricultural diversification on the rest of its land, as discussed later on, but there are no guarantees that it will be profitable. The loss of a relatively small portion of its sugar lands which are well situated for urban use should be viewed in the larger perspective of overall diversification for economic survival. The more certain profits of developing the Kukuiula project may be an important hedge against the far riskier agricultural diversification plans.

The economic and public values of using the project land for urban use far exceed the values of retaining it in agriculture. And few alternative areas in Kauai can match the Kukuiula area in the amenities that create these urban and public values.

III. IMPACT OF CANE LAND WITHDRAWAL ON MCBRYDE SUGAR COMPANY

A. RECENT HISTORY OF MCBRYDE SUGAR CO.

McBryde Sugar Co., a subsidiary of Alexander and Baldwin, Inc., was founded in 1899. Today, the McBryde plantation farms 12,400 acres of sugar and 500 acres of macadamia nuts. Less than half of the plantation, 5,700 acres, is owned by A & B; the rest is leased from the Knudsen Estate (2,200 acres) and from Grove Farm Company (5,100 acres).

A major expansion occurred in 1975, when 5,100 acres of leased land was acquired from Grove Farms. This land had been part of the Grove Farm Plantation which ceased operations in 1974. The Knudsen Estate leases were acquired at the same time. As a result of this dramatic expansion, the center of the plantation shifted considerably eastward. The Numila mill in the western part of the plantation was closed in favor of the newly acquired Koloa mill in the eastern part.

As with sugar plantations statewide, drip irrigation has been adopted where it can be economically justified. Currently 6,800 acres are under drip, with the last acreage having been converted in 1983. 1,700 acres are furrow irrigated, using recycled mill water. The remaining 4,500 acres are rainfed; plantation management does not consider it profitable to convert this remaining acreage to drip irrigation.

McBryde has recorded increasing yield performances in recent years as a result of improved management and cultural practices. In the past decade, average yield has increased from 8.8 tons of sugar per acre to a record average yield of 9.8 tons per acre in 1987. Not considering Hurricane Iwa-impacted years in 1982-4, the increase in average yield has been consistent. Despite this improved performance, McBryde reports the lowest average yield in the state.

A program to increase the efficiency of the workforce and reduce costs was initiated in 1983. The labor force was reduced from 543 in January, 1983 to a current level of 433 employees. The reduction was accomplished without layoffs using normal attrition and incentive early retirement.

B. IMPACT OF PROJECT ON THE McBRYDE SUGAR CO. PROFITABILITY

Despite increasing yields and reduced costs, McBryde Sugar Co. has been profitable in only 2 years in the past 10. Sugar prices have remained low primarily because of the dramatic inroads made by high fructose corn syrup into the U.S. market for sweeteners. The short and long run outlooks for sugar profitability are not optimistic.

Yield data by fields are not publicly reported. The project lands under question are approximately in the middle of the sugar belt on Kauai and are adjacent to the southern coast. Based on location, yields on irrigated lands in the Kukuiula project area are likely to be somewhat higher than irrigated lands in the Lihue plantation to the east and lower that irrigated lands in the Olokele and Kekaha plantations to the west. This is due to the increased sunshine that occurs as you move westward along the southern coast.

McBryde Sugar Co. did make available the recorded yields of one field said to be typical of the sugar lands in the project area. The field yielded 100 tons of cane and 12.59 tons of sugar per acre in 1987, although this represents a 2-year crop cycle. With approximately 600 acres of cane to be withdrawn, there will be an annual reduction of 30,000 tons of cane supplied to the mill and a loss of 3777 tons of unrefined sugar. These losses would be gradually incurred as the project is developed in increments, possible lasting up to 20 years.

The impact on the profitability of McBryde Sugar Co. cannot be directly estimated, since cost data is not available in a readily usable form. However, a study for neighboring Lihue Plantation several years ago estimated that removal of 270 acres would increase the cost of producing sugar by 0.28 percent or 0.07 cents per pound. The labor force would be reduced by 10 full-time employees. Since the sugarcane acreage in the Kukuiula project is slightly more that double the acreage site above, it can be estimated by extrapolation that the cost of sugar would rise by $3.00 per ton, or $0.0015 per pound. This is about 0.7-0.8 percent rise in the cost of sugar.

The size of financial impact on McBryde Sugar Co. is not large enough to force the closure of the company. In terms of acreage, McBryde is midsized among Hawaii sugar plantations. It will still be several times larger that two other Kauai plantations: Gay and Robinson, and Olokele. The fact that the size of Hawaii sugar plantations vary tremendously, and are as low as 2600 acres, implies that economies of scale are not critical to the survival of individual plantations.

The labor force would decrease by an estimated 15 - 25 workers. Employment created in the proposed development would far surpass this loss in agricultural employment.

The financial impacts of the project are therefore insignificant. Given that Alexander and Baldwin is committed to agricultural diversification of the McBryde operation, the financial impacts discussed above may also be irrelevant. A discussion of long-run plans for McBryde, although speculative at this time, follows.

C. LONG RUN PLANS FOR LANDS FARMED BY MCBRYDE SUGAR CO.

Alexander and Baldwin is committed to agricultural operations at the McBryde plantation. The company is also committed to a program of evaluation and experimentation with alternative crops. The vast majority of lands cultivated by McBryde will not be needed for urban expansion in the foreseeable future. Thus agricultural diversification in the next 20 years, if successful, will far overshadow conversions to urban uses.

The fact that A & B is a highly profitable corporation enables the company to assist its sugar plantation subsidiaries to diversify and plan with more certainty than less profitable corporations. A & B has the financial strength to finance their own diversification plans. Joint venture agreements may be

pursued where advantageous, such as in marketing, but are not required to raise investment capital.

A & B is about two years away from finalizing its plans for diversification. To date, McBryde Sugar has almost 500 acres in macadamia nut production but the company does not plan much expansion beyond this level. Test trials with coffee and tea are ongoing and so far have shown promising results. A & B is anticipating that a combination of high quality and Hawaii's image of tropical paradise will produce an upscale product commanding a premium price.

While the decision to expand into coffee and/or tea is uncertain, the greater uncertainty is how many acres of agricultural diversification can be achieved. Additional study and planning is required before a more certain answer can be known.

McBryde's leases with Grove Farm Properties and Knudsen Estate expire in 1994. A & B believes that its diversification plans must be finalized far before 1994. The company hopes to finalize plans within the next two years. While the diversification picture is still fuzzy, it is clear that A & B is committed to keeping its agricultural lands in production.

D. IMPACT OF PROJECT ON SUGAR OPERATIONS AND DIVERSIFICATION VENTURES

In the event that all sugar lands cannot be converted to alternative crops, one possibility under consideration is to consolidate remaining McBryde plantation sugar lands with AMFAC's Lihue plantation sugar lands. With the investment of several million dollars, it is estimated that the Lihue Mill could be expanded beyond its current effective capacity of approximately 80,000 tons to a maximum 115,000 tons capacity. Combined production of the McBryde and Lihue plantations is now in the range of 130-140,000 tons. Sugar production in both plantations would need to decline by about 25,000 tons under this scenario.

Historically, sugar plantations and urban areas have been good neighbors on Kauai. Public complaints about blowing smoke or dirt are infrequent and likely to draw countervailing support from the public. Evidence that sugar cultivation and resorts can exist side by side is found in the Kauai Hilton, which is bordered by sugarcane fields. Problems that have occurred on more urbanized islands will likely increase as Kauai's population grows. Sugarcane fields are also a source of visual amenity with their lush green appearance.

Because most of the land lying upwind from the proposed housing area are not in sugar cultivation, urban complaints should be small. The biggest concern is likely to be the cane haul road planned to run through the golf course and near some housing. However, there are several reasons why this is not likely to create a problem. First, it is possible that the land serviced by the cane haul road will not be in sugar production by the time the golf course and affected housing areas are developed. Second, even if the lands remain in sugar, there are several options that can be taken to reduce the noise and dust from the road. Trees and shrubbery are planned to serve as a buffer. The road can be watered by sprinklers, as is currently done in sections of the cane haul road near houses. Visual observation confirmed that this is an effective measure. Paving the road and enforcement of speed limits are other ways to further reduce noise and dust.

If McBryde lands are diversified into orchard crops like coffee and tea, then fewer problems are envisioned. These crops are perennial and would have no problems of blowing smoke or dust. Their visual amenities of orchard crops would be greater than that of sugarcane since they are permanently green.

Removing 600 acres from the land available for cane or alternative crops would not affect the feasibility of either diversification or consolidation with Lihue. Analyses by A & B have been carried out assuming these lands would not be available.

INTERVIEWS

Dennis Ikehara, former County Administrator, Cooperative Extension Service, University of Hawaii (retired)

John Hoxie, Manager, Field Operations, McBryde Sugar Co.

Phil Scott, General Manager, McBryde Sugar Co.

APPENDIX TABLE 1. LAND STUDIES BUREAU DETAILED LAND CLASSIFICATION FOR KAUAI

Area Within Project:	WEST		CENTRAL		EAST	
FACTOR Soil Type:	A491	B191	A171	D19 and D20	B831	E84
Tillability	Well-suited	Mod. suited	Well-suited	Mod./poor-suited	Mod./poor-suited	Not suited
Stoniness	Non or slight	Non or slight	Non or slight	Non or slight	Stony	Rocky
Depth	Deep, over 30"	Deep, over 30"	Deep, over 30"	Deep, over 30"	Variable	Variable
Slope	0-10 %	11-20 %	0-10	11-35%	0-10%	0-35%
Texture	Mod. fine	Mod. fine	Mod. fine	Mod. fine	Fine	Medium to fine
Drainage	Well-drained	Well-drained	Well-drained	Well-drained	Well-drained	Well-drained
Annual Rainfall	20-40"	40-65"	40-65"	40-65"	35-60"	20-40"
Elevation	0-500 ft.	400-800 ft.	400-800 ft.	400-800 ft.	0-350	0-1000 ft.
Soil Series	Makaweli	Ioleau	Ioleau	Ioleau	Waikomo	Waikomo
Existing Uses	Sugar cane	Sugar cane	Sugar cane	Grazing	Sugar cane, grazi	Grazing
Vegetation Zone	A & B	B to C1	B to C1	B to C1	B to C1	A & B
Color	Dusky red to dark reddish brown	Brown to dark brown	Brown to dark brown	Brown to dark brown	Dark grayish brown	Dark reddish brown to black

APPENDIX TABLE 2. LSB SELECTED CROP PRODUCTIVITY RATINGS

	pineapple	vegetable	sugarcane	forage	grazing	orchard
A17i	a	a	b	a	a	a
A49i	a	a	a	a	a	a
B19i	b	c	c	d	a	b
B51i	b	b	b	d	a	b
B73i	b	b	b	a	a	a
B83i	e	c	c	b	a	b
D19	d	d	d	d	c	d
D20	d	e	e	e	c	d
E84	e	e	e	e	c	e

APPENDIX TABLE 3. KUKUIULA BAY PROJECT LANDS- USDA SOIL CONSERVATION SERVICE RATINGS AND ACREAGE

Project Acres	Rating	Description of Soil Type
24.60	HsB	HANAMAULU - Silty Clay, 3-8% Slopes
1.54	IoC	IOLEAU - Silty Clay Loam, 6-12% Slopes,
27.91	IoD2	IOLEAU - Silty Clay Loam, 12-20% Slopes, Eroded
50.31	IoE2	IOLEAU - Silty Clay Loam, 20-35% Slopes, Eroded
23.26	KvB	KOLOA - Stony Silty Clay, 3-8% Slopes
6.60	KvD	KOLOA - Stony Silty Clay, 15-25% Slopes
128.50	LhB	LIHUE - Silty Clay, 0-8% Slopes
116.86	LhC	LIHUE - Silty Clay, 8-15% Slopes
34.47	LhD	LIHUE - Silty Clay, 15-25% Slopes
22.62	LhE2	LIHUE - Silty Clay, 25-40% Slopes, Eroded
31.42	MgB	MAKAWELI - Silty Clay Loam, 0-6% Slopes
10.21	MgC	MAKAWELI - Silty Clay Loam, 6-12% Slopes
17.42	NnC	NONOPAHU - Clay Loam, 0-2% Slopes
4.50	PdA	PAKALA - Clay Loam, 0-2% Slopes
8.91	PkB	POHAKUPU - Silty Clay Loam, 0-8% Slopes
25.63	PnD	PUHI - Silty Clay Loam, 15-25% Slopes
59.25	PnE	PUHI - Silty Clay Loam, 25-40% Slopes
31.62	rRO	ROCK OUTCROP - Exposed Bedrock, 90% of Surface
10.68	rRR	ROUGH BROKEN LAND - Very Steep Land Broken by Drainage Channels
128.24	Ws	WAIKOMO - Stony Silty Clay
347.48	Wt	WAIKOMO - Very Rocky Silty Clay
0.00		Reservoir
9.38		Undetermined
1121.41		Total acres in project

APPENDIX K

MARKET ASSESSMENT - PHASE I, SUMMARY